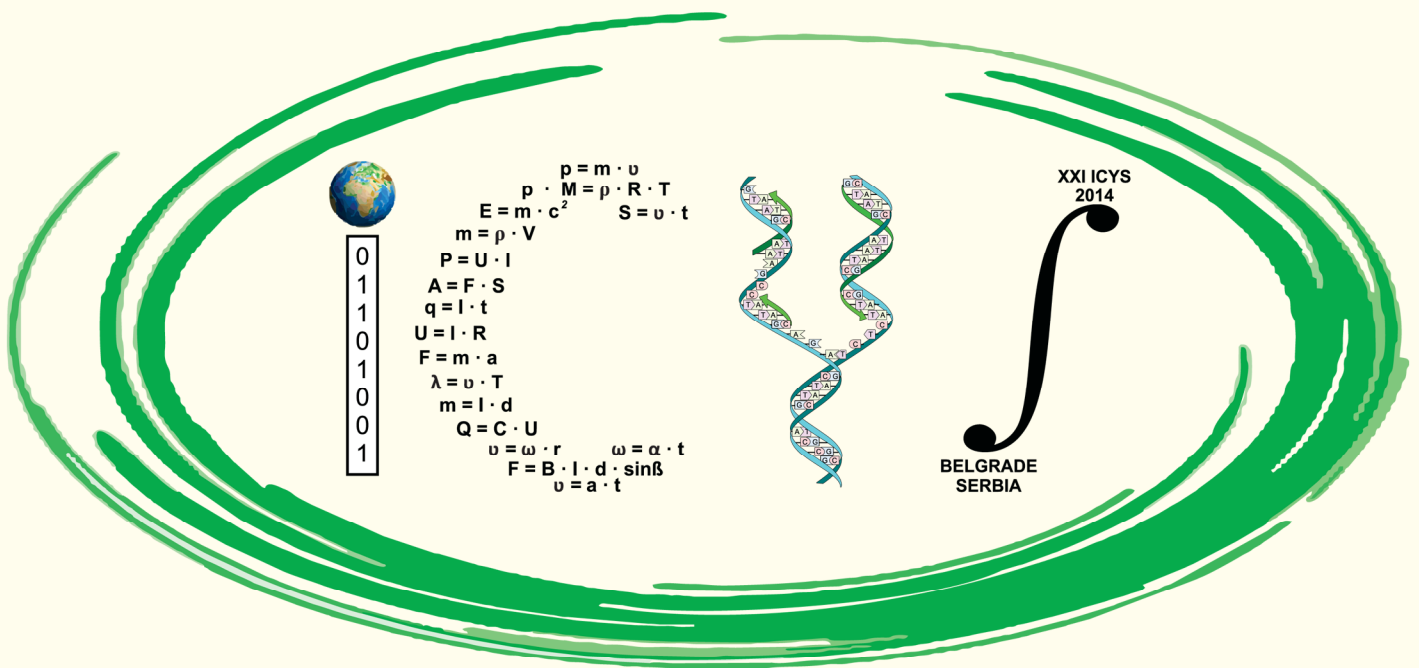


Book of Abstracts

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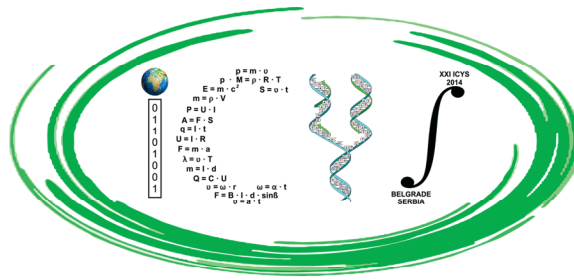
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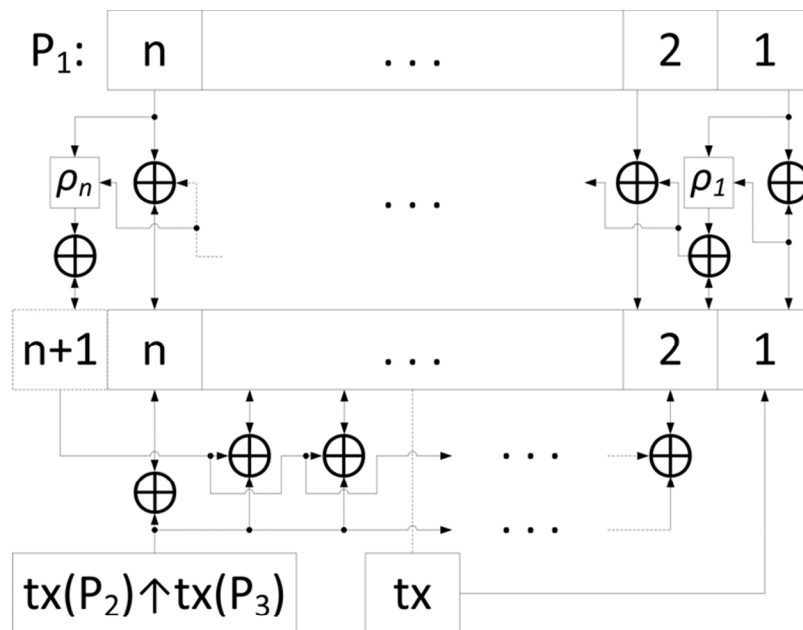
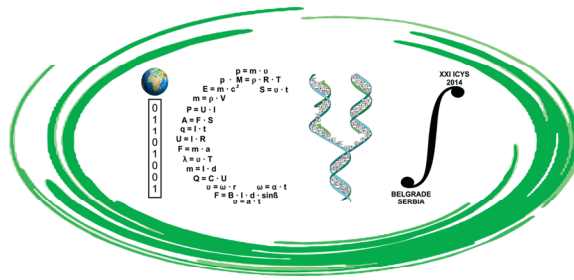
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Computer Science

Application of texture recognition using three-dimensional textons to iris biometric authentication

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1. Introduction

The iris is a muscular circular structure in the eye. It is responsible for controlling the diameter and size of the pupil – so as the amount of light reaching the retina. Color of iris determined by more than one gene, but iris pattern is developed in uterus in period from three to eight months after conception. It is distinctive by each iris and represents different positions, numbers and sizes of iris arteries. Iris pattern is same regardless of age and it is impossible to surgically modify it without risking loss of vision and as number of possible pattern combinations is several times greater than whole world population, all these things make iris good candidate for biometric authentication.

2. Method

Most popular method for iris recognition is one suggested by J.Daugman. In this research we study usability and performance of Iris recognition technique based on texture recognition algorithm by Thomas Leung and Jitendra Malik. Advantage of this method is that it uses entire filter bank, so it produces more features for comparison. This is the first attempt of this kind of application for that algorithm. Implementation is done in MatLab environment and combined with iris normalization by converting cartesian to polar coordinates, and produces fair results comparing to conventional method. Also multiple different parameters for number of clusters in K – Means are tested to select one that is most appropriate.

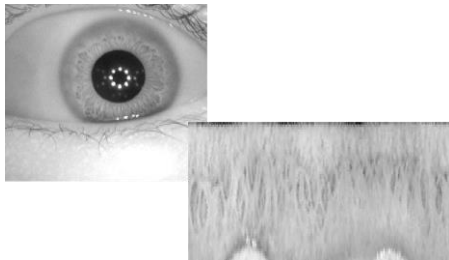


Image 1 – Segmented and normalised iris used in implementation

3. Results

Algorithm is trained on 20 classes (different irises) with 10-20 iris pictures for each subject and testing was done on 65 randomly selected irises. Also S, MR8 and LM filter banks were used. Collected results are shown on Figures 1 and 2.

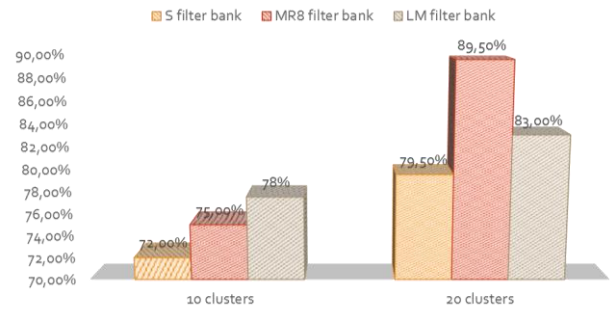


Figure 1 - Efficiency of different filter banks (training set - 15 irises).

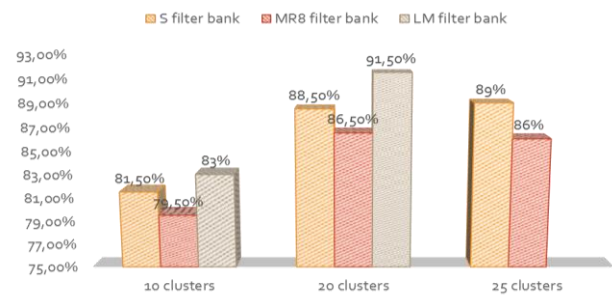


Figure 2 - Efficiency of different filter banks (training set - 15 irises).

4. Conclusion

Implemented method is shown to be usable for iris recognition with over 72% success rate. However, we also saw that this method is not as precise as Daugman's because of false positives on badly defocused examples. This rate could be increased by using higher resolution samples in controlled environment, different threshold for histogram comparison and automatic segmentation algorithm with eyelashes exclusion.

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- [2.] **How Iris Recognition Works**, John Daugman, PhD, OBE
- [3.] **Representing and Recognizing the Visual Appearance of Materials using Three-dimensional Textons**, Thomas Leung, Jitendra Malik

chaos – real random numbers via electronics

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1 Why does one need random numbers?

Cryptography recently gained a high significance due to the revelations about the NSA and thus random numbers, who are important in cryptography, are getting more important. Computers can only generate so called pseudo random numbers, which results in a big security gap. Therefore this project aims to generate real random numbers in an easy way by using deterministic chaotic circuits.

2 The Lorenz-Attractor

One of the best known chaotic Systems is the Lorenz-Attractor, who is described by the following coupled differential equations:

$$\dot{X} = a(Y - X) \quad (1)$$

$$\dot{Y} = X(b - Z) - Y \quad (2)$$

$$\dot{Z} = XY - cZ \quad (3)$$

If you plot the trajectories of the solutions for X,Y and Z in a three-dimensional phase space you get the butterfly-like pattern below.

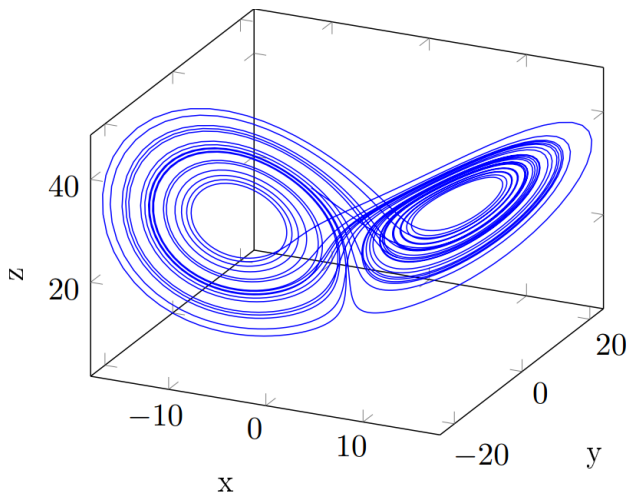


Fig.1 trajectories of the Lorenz-Attraktor

2.1 Solving the differential equations using electronics

Certain electronic components can convert these equations into an electronic signal, which can then be processed further to get the random numbers.

You can see the electronic circuit down below.

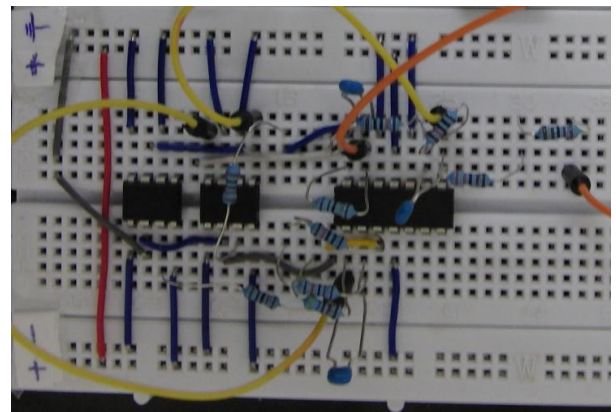
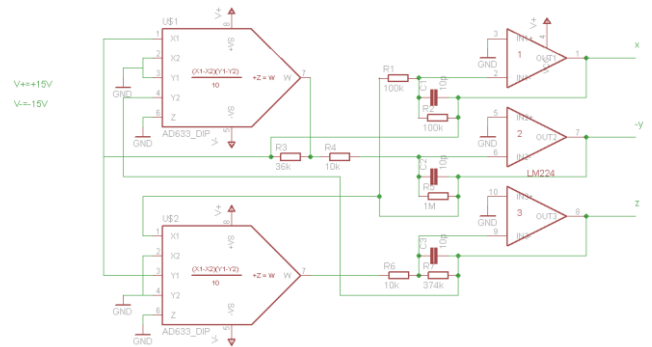


Fig.2 circuit diagram and the electronic circuit

3 Getting the random numbers

If the X-Signal is positive we write down a 1, if it is negative we write a 0, both events having the same probability. This process of getting the random numbers can also be see below.

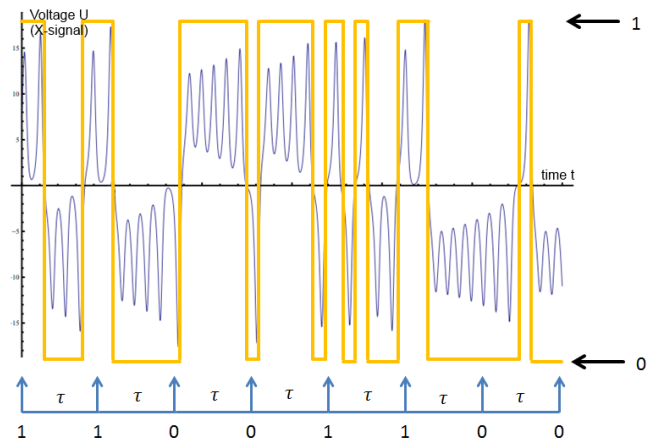


Fig.3 getting the random numbers

If the interval τ is big enough, there is no more correlation between two following Bits and it has been shown that these random numbers are real random numbers.

Learning *Saron* by Motion Gesture Technology

Gracesilia

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1 Introduction

Indonesia is a prosperous country which has various kinds of unique cultures and traditions, including its musical instrument. Unfortunately, in the urban areas, these instruments are hardly recognized by the students because nobody introduced them including the school. From the observation, students prefer to play with many kinds of modern technology rather than with traditional musical instruments, so I made a simulation of *Saron* with a modern technology called Motion Gesture.

2 Content

2.1 The purpose of the investigation

The purpose of this investigation is to growing traditional *Saron* in computation with Motion Gesture Technology (make the simulation of *Saron*), so it will be easier to introduce *Saron* .

2.2 Method of the investigation

Motion gesture is a technology in the computer field which allows gestures as the input sensor to control the objects inside the computer. The mechanism of this program starts from capturing motion using webcam which then changed into cursor so that it can follow the given movement. The program then will match and select the event determined, and this program will produce the selected tone.

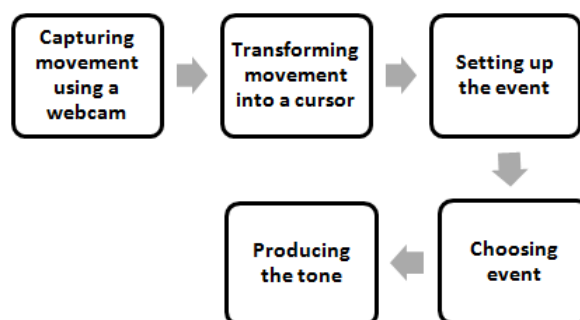


Fig.1 Motion Gesture Works Flow

3 Result

By using this program, we can easily learn *Saron*. The sound produced is approximately the same as the sound produced by the real *Saron*.

4 Conclusion

Motion gesture programs on traditional instruments is quite interesting based on testing against some students who initially less interested in traditional music, became interested in studying various traditional musical instruments using motion gesture technology. This program can be used in teaching and learning traditional musical instruments and also learning motion gesture technology.

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PRACTICAL APPLICATION AND CONSTRUCTION OF FOUNTAIN CODES FOR MILITARY SCENARIOS

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Abstract

In military scenarios, receive-only communications is essential for maintaining stealth. However, conventional communication protocols (e.g. TCP/IP) require explicit receiver acknowledgements for reliable data transmission. A possible solution is the application of fountain codes that allow reliable transmission of data packets over lossy packet erasure channels without requiring explicit receiver acknowledgements and a priori knowledge of the channel's probability of information loss. The trade-off is that a slightly greater number of data packets compared to the original data needs to be transmitted and this overhead is independent of the channel's loss probability. Previous

works focused mainly on the theoretical analysis of fountain codes and therefore provide insufficient or inexplicit analysis on the various factors and parameters relating to the practical application and construction of fountain codes. In contrast, our work focuses instead on the practical application and construction of fountain codes, starting with the Luby-Transform (LT) class of fountain codes. We apply the LT codes to different scenarios with different parameters so as to analyze trends between selected parameters and the performance of the LT codes. The result of our analysis will drive our final recommendations regarding the practical application and construction of LT codes for receive-only communications in military scenarios.

SocialGrid: Utilising power of social networks for distributed computing

Aleksandr Goncharov

Today discoveries in science are hardly possible without using massive computing power and processing large amounts of data. Unluckily, few researchers can afford to create and support their own cluster for computing with sufficient power.

At the same time more than 2.5 billion people surf the Internet every day. For simple displaying web pages no more than 10% of CPU is generally used. If the remaining 90% could be used to assist research projects, then mankind would receive the world's largest distributed computing system with the performance of more than 47 exaFLOPS.

The purpose of this research project is to develop a distributed computing system, which could utilize the unused computing power of Internet users to solve complex science problems.

The main idea of the system is to use a browser as a computing element. The system has to be able to easily

expand, shouldn't require special software, shouldn't interfere with the user and should be convenient for developers.

The result of the project is the distributed computing system. The system has some advantages in comparison with its desktop analogs (like BOINC), such as expandability by connecting web-sites audience. There is no need to install special software and tasks can be written in one or more languages (the system can recompile some languages for using in web). Thanks to the system API and a special library, developers can use it directly from science project source code.

The developed system provides opportunities for thousands of science projects which had no access to required computing power. It's being used in actual research projects and could become the largest distributed computing system in the world. This will utilize the unused potential of the Internet to help humanity.

THE PROGRAM OF MODELING THE RELIEF FORMATION AND ENVIRONMENTAL DISASTERS

Vlad Dziuba

Scientific advisors: Moturnak Eugene and Nikolaev Taras
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Introduction

Knowledge of erosion is an accumulative work of water flow necessary for the proper resolution of problems associated with water-power stations and construction of bridges, improvement of inland waterways, agricultural reclamation, and many other practical issues. In addition, the urgent environmental problem is the proliferation of harmful substances in the water or soil, so it is important to know where and how harmful substances are moved as a result of natural disasters, industrial accidents and to predict their effect on the environment. Creating a computer model will facilitate research on these issues.

Method of the investigation

For my research I use Ukrainian relief (Fig.1).

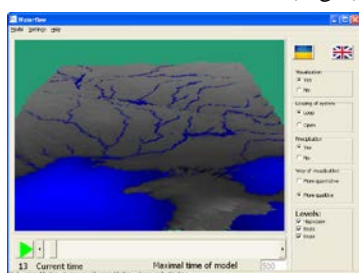


Fig.1 Ukrainian map

At the beginning the program requires the initial data concerning map, precipitation, materials and amount of control points. Then the program splits the map to control points. Every control point has its own set of layers of different material. The program calculates interaction between different layers at one control point and then between different control points by iteration progress.

Every material in my program has its own properties. Different liquids have different fluidity, power of ability to transfer solid substances. Different solids have different portability, friability. Also the program allows choosing colors for each material.

There are some additional programs. There are Material Editor and Maps Editor. These programs were created for easy opportunity to create new materials and maps.

Results of the experiment

My experiment is aimed to increase amount of precipitation at the surface of Ukraine and then observe the aftermath. This situation is the same with dam bursting in Kiev region.

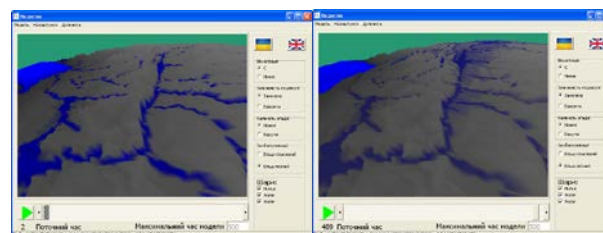


Fig.2 Experimental model of progress

As we can see at Fig.2, water rises up and lands along the flow of a riverbed. Also the left side of a river is has more active flow because there are mountains at the right side. It is obvious that the program predicts a trustful picture of dam bursting.

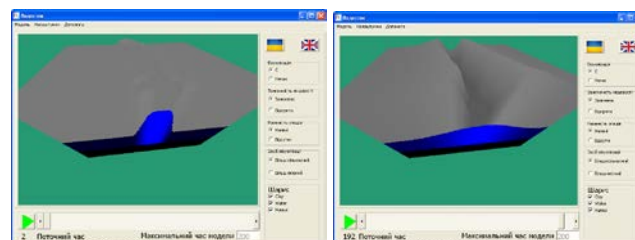


Fig.3 Landfall

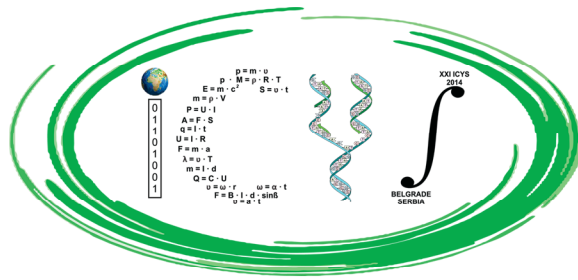
Also I conducted an experiment with a ground water of the landfall (Fig.3). Ability of water to transfer ground is the main power that provides changing of the relief.

Conclusions

The research problem was solved by writing a program. The initial data of the program is information about the terrain and precipitation, properties of the substances that are on the map, such as fluidity and density, the temperature of the environment. Using initial data the program models processes which takes place in real life, while the user can look at processes in different speed mode in two-dimensional or three-dimensional form by different angles and different scales. The program allows to generate computer reliefs as well as to download information about the real location. It allows you to this tool in practice to predict processes of terrain changing and proliferation of harmful substances in the event of accidents, catastrophes or natural disasters. As an example, I used hydroelectric cascade of the Dnieper River and the program predicts which areas will be overblown.

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Environmental Science

Biogenic silicon content of maize hybrids (*Zea mays* L.) and its effect on the quantity of the yield

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1 The purpose of the investigation

One of the most important plant physiological effects of silicon aggregation is that the increased uptake of silicon can reduce the water loss caused by respiration, according to the literature (Sangster and Parry, 1971; Raven, 1983). The high stress tolerance, as follows the increased tolerance to drought is a high of priority plant breeding direction throughout the world. This can be applied to cover the growing demand in plant cultivation, so with more cost-effective fertilizing and irrigation we can decrease the load on our environment. The examination of silicon as plant micronutrient is significant, because the loss of organic matter from soils under agricultural cultivation can cause shortage not just from essential matters, but from silicon, too (Desplanques et al., 2006).

Our research aims were to examine how to exploit the possibilities of the aggregation of SiO₂ in sublimation and plant cultivation. The ultimate practical aim of the research: selection criteria and determining directions through genetically drought-adapted entities which are efficiently accumulating the hydrated SiO₂.

In the investigations presented the following aims were addressed:

- (i) Examine changes of the hydrated silica content during development of maize plants.
- (ii) Examine the hydrated silicon accumulation of the differently watered maize substances.
- (iii) Examine the correspondence between maize hybrids hydrated silicon content and the quantity of the yield.

2 Method of the investigation

The maize leaf samples came from the Experimental Station of Plant Production in Látókép. We examined the temporal change of biogenic silica on 10 hybrids at 3-5 and 11-13 leaf stadiums on control and fertilized stands. The effect of watering was tested on the *Rezeda* maize hybrid. We worked with three settings: no watering, half-dose and full-dose watering.

After collecting the samples were dried. Then a method called dry-ashing (Albert and Weiner, 2001, modified by Mercader 2009,2010) followed after. The next steps were purifying and cremation, then measurement.

3 Results of the experiment

The biogenic silica content of 3-5 leaf maize plants increased up to 11-13 leaf age in control stands. In case of the fertilized stands we discovered significant difference in the biogenic silica content, except from three hybrids. In case of the watering, the full-dose stands showed significant increase in biogenic silica content compared to the no watering and half-dose watering stands. In terms of these hybrids stands it can be concluded that the hybrids with higher biogenic silica content showed favourable yield results. We can add the following answers to the questions taken in the purpose:

- (i) The amount of hydrated silicon increases by 2-4% during the growing.
- (ii) The hydrated silica content of differently watered maize stands differs, higher in the watered stands. The yield of the sample with higher silica is favourable, resulted by the adsorbed water on the silica.
- (iii) We discovered connection between the yield and hydrated silica content of different maize hybrids, this connection is stronger in fertilized stands. Hybrids with higher biogenic silica content has favourable yield.

4 Conclusion

The biogenic silica can accumulate the water, which is an important source in critical periods. We can conclude that fertilizing can increase biogenic silica content of some hybrids. The accumulated water is useable in surviving the dry period. The most productive hybrids were: SY AFINITY, P9175, P37N01, PR37M8.

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Converting Waste to Energy via Anaerobic Digestion: The Singapore Context

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Abstract

Anaerobic digestion (AD) is classified by critical operating parameters and reactor design. Currently, the correlation between some parameters and methane gas production has not been well-established for some of the wastes used. Moreover, how different operating conditions affect the methanogenesis step of the AD process has not been investigated in many literature reviews. This paper determines the potential of Singapore food and yard wastes for biogas production and investigates how key factors affect methane gas production and the methanogenesis step for these wastes, with the final intention to craft a generalised model that can describe the anaerobic digestion process under certain operating conditions. This model documents key physiochemical and biochemical processes, so that digester response can be predicted under a range of

conditions and we can investigate the optimum condition for methane gas production for the specific wastes. For our experiment, we used wastes that are commonly found in Singapore— food and yard wastes. Besides varying the type of wastes, three other factors that greatly affect AD were varied, namely the mass of initial total solid content used, the temperature of the reaction and the type of inoculum used. This research paper also cross compares the methane gas production for both wastes. There is a correlation between the initial mass of solid content in the waste and the amount of volatile fatty acids it produces during the experiment. This key finding explains how the mass of solid content affects the efficiency of the anaerobic digesters. Our experimental results also show that using PUB inoculum enhances methane gas production, and using food wastes, for a certain range of initial total solid content, can produce more methane gas than yard wastes.

Effect of litter manipulation researches on the biomass of fungi and on soil enzyme activities

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1 The purpose of the investigation

One of the biggest problems in our world is global climate change. There are many of greenhouse fumes in the air which are resulted by environmental pollution and natural way, too. There is more than twofold carbon-dioxide in the atmosphere than in the soil and in plants. Mobilization of this could increase the amount of greenhouse fumes. The Síkfőkút DIRT (Detritus Input and Removal Treatment) Project was established to examine the effects of litter, this project belongs to the USA-International Long Term Ecological Researches.

Fungi are important in the temperate zones because they have a main role in the litter decomposition and many other processes as well. The main objects of our study were:

- to assess the biomass of fungi with an improved method on the basis of ergosterol content in the cell wall;
- compare the results to other ecological factors;
- examine the activity of arylsulphatase soil enzyme and comparison with other ecological parameters.

2 Method of the investigation

There were established 18 pieces of 7×7 metres plots in the DIRT Project in 2000. There are 6 treatments in three repeat. Our soil samples were collected from the 6 treatments.

Control (C) plot has normal litter inputs. From No Litter (NL) plot the aboveground litter was removed by raking. To Double Litter (DL) plot aboveground leaf inputs are doubled by adding litter removed from NL plot. Double Wood (DW) aboveground wood debris inputs are doubled by adding 17 kg of wood. In case of No Roots (NR) plot roots are excluded by a resistant plastic foil in the depth of 1 m. Trees and shrubs were eradicated. From No Inputs (NI) all of the organic matters were removed.

In our study we tested Gessner (2005) methods improved by the College of Nyíregyháza to determine the fungi biomass. It is faster, cheaper, and more punctual than the original way. From soil solution the absorbance of extracted ergosterol was measured by HPLC. The examination of the activity of arylsulphatase was done by Schinner (1996) method. The results were analysed by SigmaStat (ANOVA, post-hoc Tukey test).

3 Results of the experiment

Significant differences were found in the amount of ergosterol in case of DL, DW, and Control treatments

compared to the NL, NR and NI treatments. We compared our results with the results of 2010, too. We experienced that the biomass of fungi decreased in the last 3 years. Furthermore we compared our data to soil moisture as well. There is a correlation between the biomass of fungi and soil moisture, biomass of fungi was higher near wet conditions. We proved that fungi like the acid pH, in case of NI, NL, NR treatments the pH was about 4 resulted by lack of oxygen. Moreover correlation was between fungi biomass and carbon, and organic nitrogen, too.

The effect of increased litter input is lower on the arylsulphatase enzyme activity than the removing of litter compared to the control plots. The activity of enzymes decreases with the deepness significantly. Microbiological activity is higher on the DW plots than in the DL plots. The thicker litter layer can reduce the microbiological activity on the DL plots; we can explain the higher activity on DW plots with this. The concentration of mineralised nutrients increased in the soil resulted by doubled litter amount. These nutrients can cause catabolite-repression in case of many enzymes.

4 Conclusion

As a result of our study we can conclude that fungi have an important role in decomposition of litter. The biomass of fungi was higher in the soil of DL and DW plots. The effect of increased litter input is lower on the ergosterol content than the removing of litter compared to the Control plots. There is a close correlation between the organic nitrogen, carbon content and the soil moisture of fungi biomass. The activity of microorganisms is lower in dry periods. Based on our results we can state that the measurement of ergosterol content is suitable to examine the stress answers in the soil. Furthermore a lot of facts determine the later climate of our world and it is difficult to make predictions about the global climate changing because of the feedback processes.

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FROM WASTE TO WEALTH: “INORGANIC NEUTRALIZER AND HEAVY METAL ADSORBENT”

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1.0 INTRODUCTION

Cockles or *anadara granosa* is a type of bivalve shellfish that grows well in muddy coastal area. It is quite commonly served as local dishes. Malaysia is expected to produce 13000 metric tonnes of cockles during Ninth Malaysia Plan. Till 2007, Malaysia is having 1055 number of farmers working on cockle cultivation agriculture which involving 6000 hectares of cultivation area. The shells that have been dumped and left untreated may cause unpleasant smell and disturbing view to the surrounding. In our research we found that cockle shells can be used as inorganic neutralizer, heavy metal adsorbent and colour removal agent in wastewater treatment (electroplating waste water).

2.0 Materials And Methods

Waste cockle shells are grinded into 250µm sized powder using Fritsch grinder. The purity of the sample was estimated using X-Ray Diffraction, XRD (Model:Mettler Toledo TGA/SDTA 851). Jar Test procedure using Jar Test equipment was conducted by using 0.3g cockle shells powder in 500 cm³ wastewater had achieved approximately neutral pH (6.0). Wastewater before and after treatment was analyzed using two specific Inductively Coupled Plasma (ICP-OES) units, the Perkin Elmer Optima 3300DV and a comparison is made. In our investigation, we concentrate on the main heavy metal, copper. Cockle shell before treatment and the residue of the cockle shell after treatment at 90 RPM are sent into Scanning Electron Microscope Machine (SEM) to compare the percentage of heavy metal copper in the residue. Both of the cockle shell powder (before and after treatment) was put into SEM machine to get an image structure. The images were sent into Energy Dispersive X-Ray machines (EDX) which were needed to obtain the percentage of heavy metal removed by cockle shells powder.

3.0 RESULTS

Diagram 3.1 shows the analysis of crystal structure using X-Ray Diffraction (XRD) illustrating that raw cockle shells are made up of aragonite, CaCO₃. The results shows that the purity of calcium carbonate in the cockle shells powder are 99% pure.

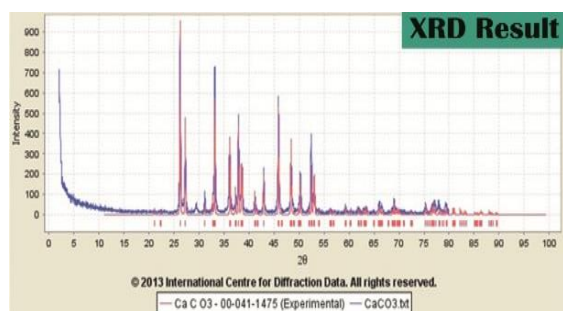


Diagram 3.1: X-Ray Diffraction (XRD) Spectra of Cockle Shell

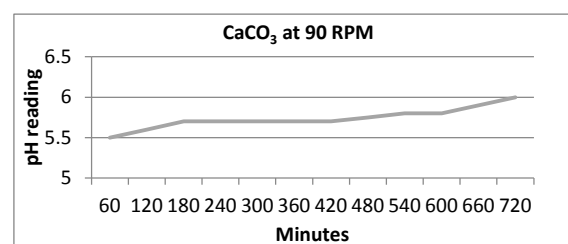


Diagram 3.2: Graph of pH measurements against time

Table 3.1: Result Tabulation Of Cockle Shells powder at 90 RPM With Mass 0.3 g in 500 cm³ of wastewater after 12 hours

NO	DESCRIPTION	READING	
1	pH	Before treatment	3.0
		After treatment before filtration	5.8
		After treatment after filtration	6.0
2	ICP-OES Analysis : Amount heavy metal (copper)(mg/L)	Before treatment	188.75
		After treatment	68.04
3	ICP-OES Analysis : Percentage Removal (%)	63.95	
4	SEM Analysis : Percentage Copper Adsorbed By Inorganic Neutralizer	54.97	

The Scanning Electron Microscope (SEM) obtains the surface morphologies of the aragonite crystals in the cockle shells powder



3.3: Scanning Electron Microscope Image CaCO₃ At 90 RPM

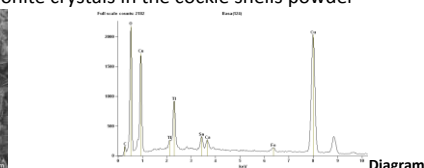


Diagram 3.4: Graph Of Each Atom Microscope Image CaCO₃ At 90 RPM

Table 3.2: The Percentage Of Weight analyzed by The Energy Dispersive X-Ray of cockle shells powder residue after treatment at 90 RPM

Element Line	Weight %	Weight % Error	Atom %	Atom % Error	Compnd %	Norm. Compnd%
Cu K	58.05	+/- 0.58	26.45	+/- 0.27	58.05	58.05
Cu L	---	---	---	---	---	---
Total	100.00	---	100.00	---	100.00	100.00

4.0 CONCLUSION

The findings confirmed that by using the cockle shell, the possibility of cockle shell to neutralize water is proven. The waste cockle shells can be a neutralizer, a heavy metal adsorbent and colour removal agent.

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INFLUENCE OF DIATOMITE MICROSTRUCTURE ON ADSORPTION CAPACITY FOR HEAVY METALS

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1. The purpose of the investigation

Pollution of surface and ground waters with heavy metals, such as lead, copper and iron, represents a global problem. The accumulation and excessive levels of heavy metals in living organisms can cause serious illness. Diatomaceous earth (diatomite) is a naturally occurring sedimentary rock that may be applied for waste water filtration. The aim of this study was to investigate how microstructure of diatomite from the Kolubara river basin influences its adsorption capacity for lead, copper and iron.

2. Methods of the investigation

Diatomite used in the study was sampled from the deeper layers of Kolubara river basin. Microstructure and morphology of the sample were analyzed by X-ray diffraction (XRD) analysis, scanning electron microscopy (SEM) and atomic force microscopy (AFM). A particle distribution graph was obtained by laser diffraction, while atomic absorption spectroscopy (AAS) was used for the measurement of the concentration of heavy metals in the sample.

3. Result of the experiment

Based on the XRD analysis it was concluded that the diatomite sample is a multiphase material that mainly consists of quartz, muscovite, kaolinite and enstatite. It was established that pore size is a few hundred nanometers and that the skeletal shells are about 11 μm , based on micrographs of diatomite sample and particle size distribution graph. AFM analysis has confirmed that diatomite is a multiphase material and it was observed that the structure of the diatomite sample resembles a sponge with small pores.

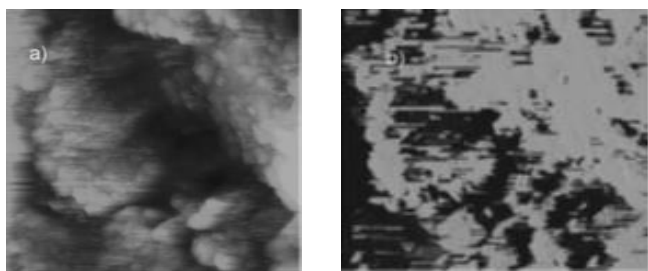


Fig.1 AFM images: a) topography, b) phase structure

The adsorption efficiency of the diatomite sample was satisfactory, with especially high efficiency obtained for copper ions. Adsorption efficiency was higher at lower concentration for all metals, which can be explained by a larger free contact surface area of diatomite.

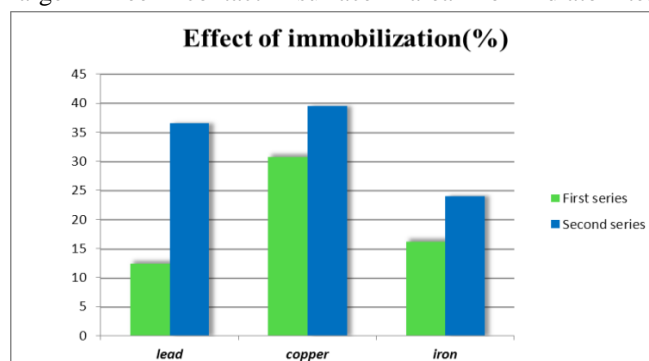


Chart 1. The effect of immobilization of lead, copper and iron ions

4. Conclusion

The diatomite sampled from the deeper layers of Kolubara river basin was used to investigate the adsorption capacity for heavy metals. The results of the study have shown that the copper ions are best adsorbed by the diatomite sample. In addition to the influence of the metal concentration, the influence of the other parameters, such as temperature and pH, should also be investigated. Investigations of physicochemical properties of adsorption of heavy metals by diatomite are necessary for potential future applications of diatomaceous earth for soil remediation and waste water filtration.

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Investigation of indoor radon in the dwellings and environment

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School of a name of F. Skoriny of the City of Vilnius

1. Introduction

Ionizing radiation is one of the most hazardous elements for humans. People are affected by natural radiation in the air, soil and atmosphere and from other man-made sources of ionizing radiation. Total annual exposure for adult is 2.83 mSv.

2. Content

2.1. The purpose of the investigation

To estimate the levels of indoor radon in the learning and living premises

Research tasks:

1. To perform radon activity concentration measurements in the living and learning environment, in the tap water, which is used in high school
2. to make assessment of radioactive contamination of soil in the high school area
3. to measure radon concentrations in water around the high school (rivers, lakes)

Hypothesis: Radiation situation of learning and living premises unsuited. The main threat of radiation - high radon content at learning and living premises.

2.2 Method of the investigation

- ▶ Time when the research was performed: October 2013 and January-February 2014.
- ▶ Duration of one indoor radon measurement is 21 days. Measurements were carried out during the heating season, when the external and internal air temperature difference between soil gets for the radon easier to fall into the building.
- ▶ The measurements were carried out in two lower-most used rooms constantly using E-PERMTM elektrets (*Electret Passive Environmental Radon Monitor*).

2.3. Equations

Indoor radon concentration is estimated using formula:

$$A = \frac{I - F}{kT} - B$$

where I – start voltage, F – end voltage, k – coefficient of calibration, B – correction value.

T is duration of measurement in days. coefficient of calibration for the "S" type camera is :

$$k = 1,6978 + 0,0005742(I + F)/2$$

2.4. Results of the experiment

The measured radon concentration in living and learning premises are not exceeding levels required by the Lithuanian Hygiene Standard HN 85:2011 "Natural Exposure. Radiation Protection Standards (approved by Order No. V-890 of the Minister of Health of Lithuania in 7 October, 2011. (Official Gazette, 2011, no. 124-5917), ie radon concentration is less than 200 Bq/m³ .

3. Conclusion

General conclusion is that the radiation situation in the learning and living areas is appropriate. Our hypothesis was not confirmed.

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Optical properties of nuclear chromatin of *Chrysanthemum × hortorum* Bailey pollen grains as a perspective indicator of air pollution with nanoparticles

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1. Introduction

The atmosphere pollution causes annually the pre-term death of over 2 million people throughout the world. It is influenced by aerosol components with diameter less than 2,5 μm . It has already been ascertained that different substances assume new properties in the form of nanoparticles [1]. For instance, they can penetrate through the cells membranes and damage DNA. The assessment of air pollution with nanoparticles requires expensive and unattainable equipment so the search for new methods of bioindication is urgent.

2. The purpose of the investigation

The objective of the research was to work out the express-method which would adequately assess the level of air pollution with micro- and ultramicroscopic particles using structural parameters of nuclear chromatin of *Ch. × hortorum* pollen grains.

3. Method of the investigation

Portable laser meter Met One GT-321 was used to measure the concentration of micron and submicron particles and SMPS-iFT device was used for nanoparticles in the process of air monitoring in different areas of Chernivtsi. *Ch. × hortorum* pollen grains were dehydrated with ethanol and after that were embedded in paraffin wax. The microscopic sections were painted with azure-2-eosin. The digital copies of optical depiction were taken with the help of the microscope 40x. The arithmetic mean of the colouring optical density, as well as the magnitude of its standard deviation, were calculated within the nucleus by means of computer program GIMP (Fig. 1) with the further calculation of the coefficient of the nuclear chromatin colouring optical density variation.

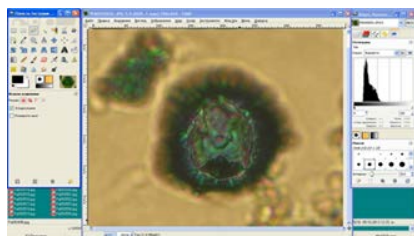


Fig. 1 Analysis of *Chrysanthemum × hortorum* Bailey pollen grains using graphic editor GIMP

4. Results of the experiment

Nanomicroscopic (10-100 nm) and submicron (0,1-0,5 μm) particles with the share of 71% and 26% prevail in the range of aerosol pollution in Chernivtsi. The level of

aerosol pollution is higher in the areas near highways and industrial enterprises and it is the highest within intensive traffic areas of Chernivtsi.

The reliable growth of the coefficient of the chromatin colouring optical density variation has been determined in the nucleus of *Ch. × hortorum* pollen grains: over 42% for the areas with moderate traffic, over 75% – for the areas with intensive traffic, and over 57% – for the areas, located not far from the industrial enterprises (Fig. 2).

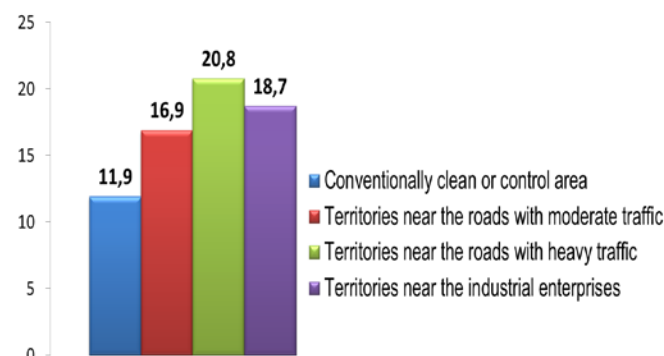


Fig. 2 Coefficient of the optical density variation of nuclear chromatin of *Chrysanthemum × hortorum* Bailey pollen grains for different territories in Chernivtsi, %

Besides, we have ascertained the reliable direct correlation between the coefficient of the colouring optical density variation of nuclear chromatin of *Ch. × hortorum* pollen grains and the number of microscopic particles in the air. The correlation dependence is increasing proportionally to the reduction of their size and has a linear character for microparticles and exponential character for ultramicroscopic ones.

We have determined equations of dependences which allow us to calculate the probable number of particles in the air using the coefficient of variation of the optical density of the nuclear chromatin colouring.

5. Conclusions

Suggested express-method of assessing the level of air pollution with micro- and ultramicroscopic particles allows estimating of the negative influence on nuclear structures by means of quantity assessment of *Ch. × hortorum* chromatin organization. This method is informative, it doesn't require big expenses and additional equipment as well as highly-skilled staff.

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Optimizing the allocation of urban land uses

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Accepted by Ariaian Young Innovative Minds Institute, AYIMI

Abstract:

Today, one of the most important parameters of urban management, land use planning, can help to find a way of applying, explaining and protecting of the urban estates efficiently. By providing a mathematical model in the urban system it can be prioritized based on selection of the type of use.

In this regard, initially, each of municipal collected uses is given a score between zero and one. Its desirable, according to this number, is determined; so that how to select the use whatever is more desirable,

the number is closer to 1. In the next step, with the help generalized Sterling of quadratic numbers and space - time relationship, the number of calculated scenarios and user selection from the current uses list is done. According to the scores each of the scenarios defined, the best state is determined. As a result; with the help of that, inappropriate land use in urban management is reduced and the correct arrangement of uses will be adjusted in line with the strategy of urban management.

PREPARATION OF PS/PMMA POLYMER NANOCOMPOSITES CONTAINING Ag NANOPARTICLES AND THEIR PHYSICAL PROPERTIES

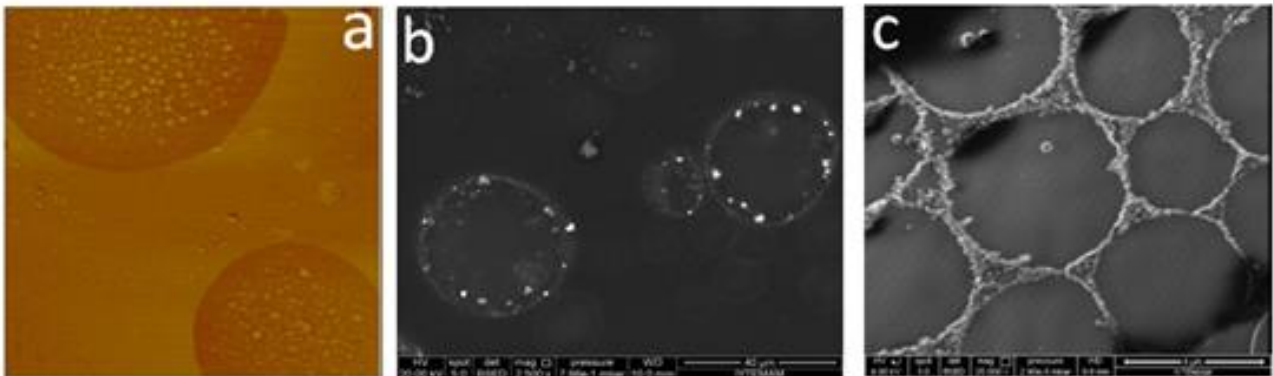
Batuhan Sakal



In this project, Ag nanoparticle-including transparent polymer composites are produced, their optical and antibacterial properties are investigated. Ag particles are synthesized via colloidal method by reducing AgNO_3 with NaBH_4 . Ag particles are blended with PS and PMMA solution. Then, this mixture was poured as a film on glass surface and annealed up to 160°C . PS and PMMA show phase separation because of thermo dynamical incompatibility of the material components and Ag particles prefer to be located selectively in a phase depending on the annealing temperature and this affects the final properties of composite materials.

The nanocomposite films absorb light at 400 nm and bacterial formation on film is significantly decreased by comparison with other films that are lack of Ag nanoparticles. If they are used in touch screen devices, they will show superiority to other used materials. New age product in information and communication technology has been developed.

Key words: Ag nanoparticle, PS, PMMA, polymeric composite, nanocomposite.



Roar & Run: An Alternative Way to Get Rid of Monkeys

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1. Introduction

Monkeys are creating lot of problems for the school community. They are wild animals and become pests when they ravage gardens and ransack the dormitories. When monkeys move in a group, they can become threatening and dangerous: they have been known to attack students to get food, make a mess around the school compound and destroy school properties. Dominant males are always threatening and dangerous. We need to get rid of monkeys from the school territory but we don't want to hurt or kill them although they have been troublesome for many years. We just to scare them away and not hurt them. We have tried many techniques such as trapping and spraying red paint to scare them.

2. Purpose of the Investigation

Monkeys are very fearful of tigers or lions. So the purpose of this investigation is to see whether using a toy tiger to frighten monkeys away will work and decrease the number of monkeys without harming them.

3. Method of the Investigation

We started our research by tossing food such as fruits (bananas, watermelon and apple) and bread at a chosen spot where monkeys usually frequent. The time for data collection was fixed at around 5 – 6 pm. The number of monkeys that come to take the food will be counted for 1 hour.

There were three phases of investigation. Each phase is 30 days.

1st phase: without a toy tiger

2nd phase: with a toy tiger

3rd phase: with a mechanical tiger.

We modified a toy tiger with mechanical parts. The toy tiger could move its tail, move its head up and down as it roared with taped tiger sound. We use car windshield motor to initiate the movement. A movement sensor was put into the system so that when the monkeys passed by at a certain distance, the toy tiger's system would activate automatically. It produced a roaring sound, swing its tail and move its head up and down. We used an amplifier to make the roaring sound louder. A timer was added into the circuit in order to make the movement sequential and continuous.

4. Result of the Investigation

In the first phase, we found that the monkeys which came to take the food identified the location as a place where they could get food easily. The monkeys came every day to get the food.

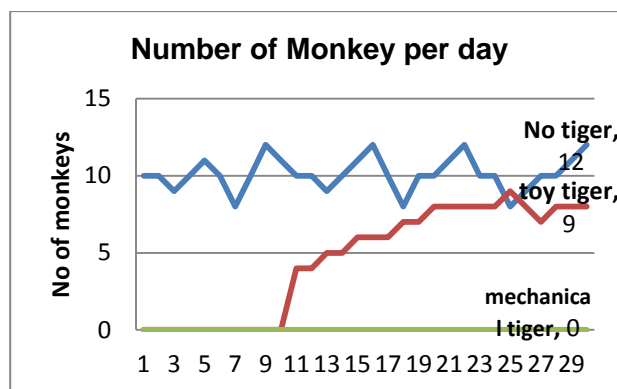
In the second phase, we put a toy tiger and scattered the food around it for 30 days. The first time the monkeys saw the toy tiger, they ran as fast as they could to avoid the toy tiger. They made noise sound to warn their troop. The number of monkeys decreased drastically. Realising that monkeys are the cleverest among mammals, we cannot hold them off for long. They knew that the tiger was not real one. After the third week, the number of monkeys coming to get the food kept increasing. We also realised that the monkeys came to the spot to get the food but they never got close to the toy tiger.

In the third phase we repeated phase 2 but by putting a mechanical toy tiger at the same spot for another 30 days. The monkeys were shocked to see the toy tiger move and produce sound like a real tiger. We noticed that the number of monkeys coming to the place fell to zero.



The mechanical parts of the toy tiger

The graph on number of monkeys against number of days is shown below.



5. Conclusion

The result of our investigation proved that monkeys are afraid of tigers even though we only used a toy tiger in order to get rid of them. As a result, we have put toy tigers at most strategic places. The toy tiger has helped us to solve our monkey problem.

Rubber isolation from Euphorbia Trigona

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1 Introduction

The growing demand of rubber is a problem of today. To increase the production of natural rubber, more rubber trees are needed [*Hevea Brasiliensis*]. A problem many countries are facing is the disease susceptibility of the rubber tree.

Synthetic rubber is derived from petroleum.

2 The Investigation

2.1 The purpose

Crude oil is a limited substance. Due to this I want to decrease the production of synthetic rubber, by researching an alternative for natural rubber. I put special emphasis on plants that are suitable for temperate to subtropical climate zones to prevent deforestation of the rain forest.

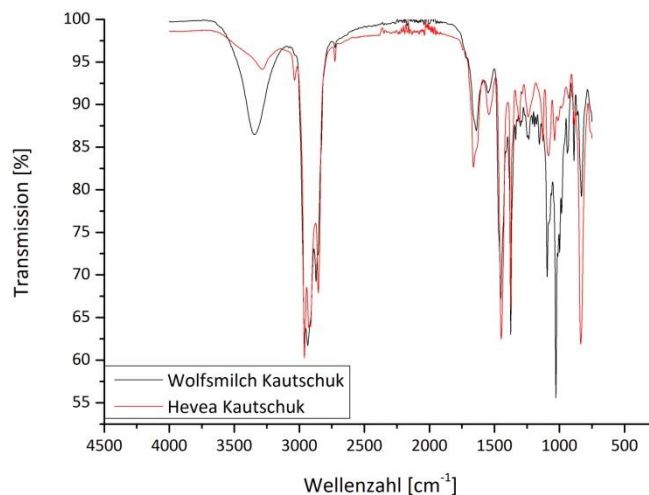
2.2 Rubber Isolation

My plant of choice is the African Milk Tree [*Euphorbia Trigona*]. I opted for this plant because it grows very fast and is easily propagated.

I am isolating rubber from the latex sap of the plant.

2.3 Analysis

To see which atomic bonds are present in the substance, I made an IR spectrum.



I compared our result (Wolfsmilch) to the rubber from the rubber tree (Hevea). Because of its resemblance to natural very likely to be rubber too.

3 Conclusion

In summary, it can be stated that the *Euphorbia Trigona* could be used as an alternative to the rubber tree.

Scylla serrata as Bioplastic

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1 Introduction

Plastic plays very important roles in our daily life. There are great needs of producing strong plastic and strong biodegradable plastic at present. Chitin, contained as much as 18-32% in abundantly available crab shell wastes, is a potential source to increase the strength and the elasticity of bioplastic due to its ability to form fibers similar to cellulose. In this research, chitin was extracted from crab shell wastes, the extracts were then mixed with Low-Density Poly Ethylene (LDPE) representing synthetic commercial plastic, and with cassava starch-based plastic representing biodegradable plastic, to form stronger and more elastic bioplastic and biodegradable plastic.

2 Content

2.1 The purpose of the investigation

To explore the usage of crab shell wastes as a source of chitin that can potentially be used to make plastic stronger.

2.2 Method of the investigation (in comparison with known methods)

In the past decades, many studies have been done on the utilization of cellulose fibers as reinforcement agent for plastic, as well as the extraction of chitin from shrimps, mushrooms, etc. This experiment used crab shell wastes as a source of chitin. The first modified method (from that of shrimp), consisted of demineralization using HCl 0.5% followed by 5%, deproteination with NaOH 5%, and decolorization using NaClO. The second self-designed method was comprised of dissolution of crab shells in CaCl₂ 0.2N and methanol. Detection of chitin in the extracts was conducted by firstly dissolving the extracts in acetic acid and nitric acid, followed by characterization with FT-IR spectroscopy. The influences of chitin on the strength and elasticity of plastic were observed by mixing the solution of chitin in acetic acid with LDPE, and with cassava starch-based plastic, and tested the strength and elasticity of the products using autograph.

3 Results of the experiment

Ratio	Tensile strength/N	Elongation/mm
Control(pure LDPE)	80	2.23

1:1(w/v)	60	-
1:2(w/v)	184.5	4.9
1:4(w/v)	98	2.8
1:8(w/v)	35.5	-

Table 1 Autograph test of bioplastic products (mixtures of LDPE and chitin)

Ratio	Tensile strength/N	Elongation/mm
Control (pure cassava starch-based plastic)	9.5	50.8
1:1(w/v)	10.25	45.39
1:2(w/v)	12.25	50.54
1:4(w/v)	6.75	18.16
1:8(w/v)	4.75	15.12

Table 2 Autograph test of biodegradable plastic products (mixtures of cassava starch-based plastic and chitin)

Ratio	Tensile strength/N	Elongation/mm
Control (pure cassava starch-based plastic)	3.5	86.2
1:1(w/v)	2.5	45.29
1:2(w/v)	7	86.13
1:4(w/v)	5	78.89
1:8(w/v)	2	100.08

Table 3 Autograph result of biodegradable plastic products (mixtures of cassava starch-based plastic and chitin, after being dipped in water for 5 minutes and wiped using dry cloth afterwards)

4 Conclusion

The characterization using FT-IR spectroscopy showed that chitin can be extracted from crab shell wastes. The autograph test confirmed that chitin can be used to reinforce bioplastic and biodegradable plastic, with the ratio of 1:2 being the strongest and the most elastic plastic products.

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The future of wave power

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1 Introduction

The world is running out of its fossil fuels, and therefore it is necessary to invest in the development of renewable energy. The world is already using wind and sun as sources, but mankind has not been taking advantage of wave power, one of the most promising energy sources. All the waves of all the oceans together contain five times the world's total energy demand. Furthermore, 71 percent of earth's surface consists of water. Therefore, it is very important to investigate the possibilities of wave power.

2 The purpose of the investigation

The goal of this investigation was to answer the question whether wave power has the potential to become a useful energy source. This subject has been researched by investigating the literature and building a personally designed construction, which is able to convert the kinetic energy of waves into electrical energy. In this way we hope to contribute to the investigation and development of wave power.

3 Method of the investigation

3.1 Comparison of different techniques

First of all, different techniques to convert the kinetic energy of the waves into electrical energy were compared by judging them on various aspects. The technique with the best results, *the oscillating water column*, was chosen to be the basic concept for our design. This technique is still in its early development stage, and this concept is still poorly documented.

3.2 The prototype

Subsequently, our design was made based on this chosen concept, by improving and elaborating it. The functionality of this design was examined by building and testing a prototype, made out of simple materials, which did not yet generate electricity. After several tests, the results showed that our design was functioning properly, with the possibility of a few possible improvements.

3.3 The final construction

After the results of the prototype's tests, a new design was made for the final construction, including the possible improvements. Specifications were written for this final construction, to ensure that the various important aspects were considered. After the development stage, the final design was build. During this construction stage, the aspects of the specifications were always taken into account. Once the construction was finished, its functionality was evaluated during several experiments, by measuring the production of electricity.

4 Results of the experiment

The results of the experiments of the final construction were positive. During these tests, there was a constant production of electricity of around 0,6 Watt. This level of electricity production was the result of a test on a small scale, without optimal circumstances. Calculations were made with an increased scale and improved efficiency, showing that it is possible to make an estimation of the electricity production of a bigger construction under perfect circumstances. According to these calculations, this ideal construction should be able to produce enough electricity for a couple of households.

5 Conclusion

The results of our tests and experiments prove that it is possible to make a functional construction capable of converting the kinetic energy of waves into electrical energy. Our literature survey shows that there is an increasing need for renewable energy and that wave power offers huge possibilities. Moreover, all the waves of all the oceans together contain five times the world's total energy demand. As mentioned in the introduction, 71 percent of the earth's surface consists of water, which means that there is enough space for wave power plants. Therefore, to conclude; wave power has the potential to become one of the most valuable energy sources of our future.

Tinospora crispa As A Future Cure For Obesity

Ahmad Salman B. Omar Zaki
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Abstract

Nowadays, people suffering from obesity are often heard. This disease is due to the excess of mainly carbohydrate and lipid in an individual's diet and the lack of expenditure of energy such as exercise. Therefore, the patawali plant, or its scientific name, *Tinospora crispa* is believed to be a traditional cure for the problem.

A sample of patawali plant (*Tinospora crispa*) juice, lime juice, ginger juice and grapefruit juice was prepared for the experiment. Next, fresh chicken fats are chosen and prepared as they contain a high value of cholesterol. The chicken fat was rinsed with water, dried using a filter paper and then immersed in the juice samples for a duration of 1 hour. The initial and final mass of chicken fat was recorded. At the end of the experiment, it is found that ginger and *Tinospora crispa* shows significant in reducing the mass of chicken fat. Thus, it can be concluded that *Tinospora crispa* and ginger has the potential to be the future cure for obesity.

Introduction

Obesity is a condition in which the cholesterol level in an individual's body is too high. Thus, causing the afflicted individual to be overweight, have a unusual large body and being constantly exhausted. Other disease such as high blood pressure may lead as a result of obesity. Therefore, an experiment was conducted to confirm the belief of the ability of *Tinospora crispa* in reducing cholesterol level. *Tinospora crispa* which is know by the common name Guduchi is an herbaceous vine of the Menispermaceae family. The alkaloid content found in the stem of this herbaceous vine is beneficial in treating wounds and cuts. Research also indicated that it helps to increase one's appetite and lowers insulin levels in the blood.

Objectives

- Identifying a cure that is suitable in treating obese patients.
- Knowing how suitable *Tinospora crispa* is in treating obese patients.
- Finding an alternative cure for obesity without depending on chemical drugs solely.

Investigation Methods

1. The grapefruit and lime was cutted using a small knife and then squeezed to obtain their juices.
2. The *Tinospora crispa* was cutted using a small knife and crushed into smaller pieces with a mortar. Then, one portion of the sliced and crushed *Tinospora crispa* was boiled in water while another portion was put into a blender.
3. The *Tinospora crispa* was boiled for 30-45 minutes while the other portion was broken down into even smaller pieces by the blender. This is because the juice cannot be directly obtained by squeezing the *Tinospora crispa* itself as it is very hard and stiff.
4. After boiling and blending the pieces of *Tinospora crispa*, their juice was able to be obtained.
5. The ginger was cutted into smaller pieces by using the small knife and then crushed or mashed with a mortar. After that, the ginger juice was obtained by simply squeezing the mashed pieces.
6. The juices were filled in beakers, 15ml for each juice.
7. The initial mass of a chicken fat was weighed and recorded. Then, the chicken fat was immersed in a beaker containing lime juice.
8. After about 1 hour, the chicken fat was taken out, dried with a filter paper and its mass was weighed and recorded.
9. The percentage reduction of mass of chicken fat is calculated.
10. Steps 7- 9 was repeated by immersing the chicken fat in beakers containing grapefruit juice, *Tinospora crispa* juice, ginger juice and distilled water.

Tinospora crispa As A Future Cure For Obesity

Ahmad Salman B. Omar Zaki
Alam Shah Science School, Kuala Lumpur

Results

Type of juice immersed in.	Average of initial mass of chicken fat. (g)	Average of final mass of chicken fat. (g)	Percentage of reduction of mass of chicken fat (%)
Lime Juice	2.050	2.290	-11.7%
Ginger Juice	2.200	2.165	+1.6%
Grapefruit juice	2.125	2.190	-3.1%
Distilled Water	2.090	2.125	-1.7%
Boiled <i>Tinospora crispa</i>	2.205	2.075	+5.9%
Fresh mashed <i>Tinospora crispa</i>	1.625	1.455	+10.5%

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Conclusion

After conducting all the experiments, it is proven that *Tinospora crispa* and ginger has the potential to be an effective agent in reducing the cholesterol level as the mass of the chicken fat was managed to be reduced.. Thus, it is possible for *Tinospora crispa* to be added in the future as one of the ingredients in the slimming products due to its ability to reduce cholesterol level. It also has been proven that this plant is safe to use compared to other chemical drugs or medicines out there. Besides that, this plant also has the potential of being the future primary cure for high blood pressure as it has its own commercial value in terms of curing this disease.

Project Cost

Materials	Cost (RM)
<i>Tinospora crispa</i>	4.00
Chicken fat	8.00
Lime	6.00
Grapefruit	10.00
Ginger	5.00
Total	33.00

The Use of Neem (*Azadiractha indica*) Incense as a Mosquito Repellent

Ni Luh Putu Lilis Sinta Setiawati

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1. Introduction

Kubutambahan people have a local wisdom to burn rubbish names dry neem leaves to repel mosquito. In other hand, they also aim to tackle the environmental problem that caused by these leaves but it's not an effective way indeed. The utilization of these leaves as raw material to make incense is a new idea to solve the problem and add value for the rubbish. In line with the idea, incense also highly need by Balinese people to use in worshipping.

2. The Purpose of Investigation

The hypothesis of this research is that dry neem leaves can be used as a mosquito repellent. Based on the hypothesis, this research aims to find out some scientific reasons by analyzing that event. It will become supporting data to show the effectiveness use of neem incense as mosquito repellent and prove that it's not only people belief. Furthermore, this research would also identify the potential risk of these repellent.

3. Method of the investigation

Regarding to prove the local wisdom firstly was collecting the data from literatures about the active compounds in dry neem leaves and their effect through the insect. Moreover, experiment was conducted by an olfactometer that was filled by CO₂ (dry ice and burning incense) to achieve the purpose of this research.

4. Result

Time / minutes	Average frequency	
	Neem Incense	Synthetic repellent
1	3.3	3.3
2	3.0	2.0
3	2.7	2.3
4	2.0	1.7
5	2.0	0.7
6	2.0	1.0
7	1.0	1.0
8	0.3	0.7
9	0.0	0.0
10	0.0	0.0

Table 1 Average frequency of mosquito that comes into the repellent

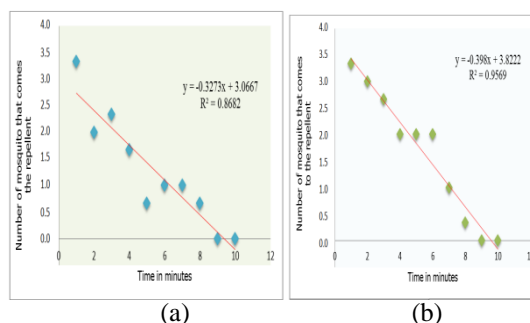


Fig. 1 Graph of the experiment by neem incense (a) and synthetic repellent (b)

5. Discussion

Based on the result, the hypothesis is accepted. Neem incense could be used as a mosquito repellent appropriate with the result in Fig. 1 and Fig. 2. Those two graphs do not show extreme differences in the number of mosquito that comes to them. Moreover, Fig. 1 show better correlation between the data which means it is well ordered repellent in repelling mosquito. This ability of neem incense is caused by some active compound in dry neem leaves. Those compounds were azadirachtin, salannin, meliantriol, nimbin and nimbidin that affect metabolism system of mosquito.

Furthermore, neem incense is a safe mosquito repellent to because this incense is not contain toxic substance that usually kills the mosquito directly. However, it acts through a slow rate. The active compounds were only working at the insect's body in line with the same structure of the active compounds and mosquito's body.

6. Conclusion

Neem incense could be used as a mosquito repellent as the active compounds in dry neem leaves that effect the mosquito's body. It is also not harmful for human because this incense is not contains toxic substances that usually kill the mosquito directly.

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Using glowing monads for water quality tests

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1. Introduction:

We live in times of high environmental pollution. Especially the oceans suffer from it.

We researched on a bio indicator which doesn't have complicated numbers as the result, but a visual effect and is therefore easy to understand.

For our project we worked with the monad *Pyrocystis lunula* which can glow. We researched on the connection between their illuminating power and the substances we added to them.

2. Experimental setup:

We measured the light they produced quantitatively with a Photomultiplier and an oscilloscope.

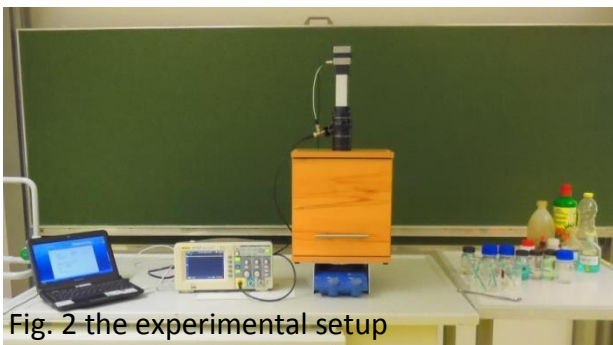
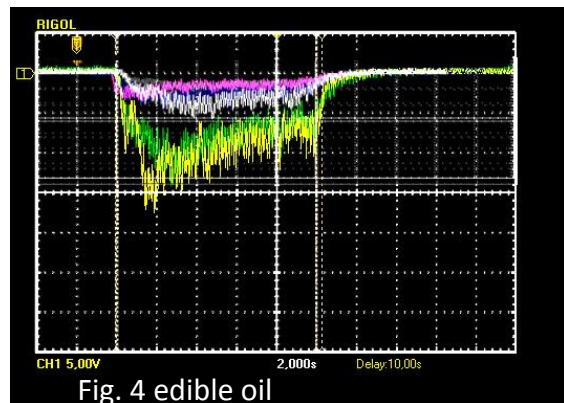
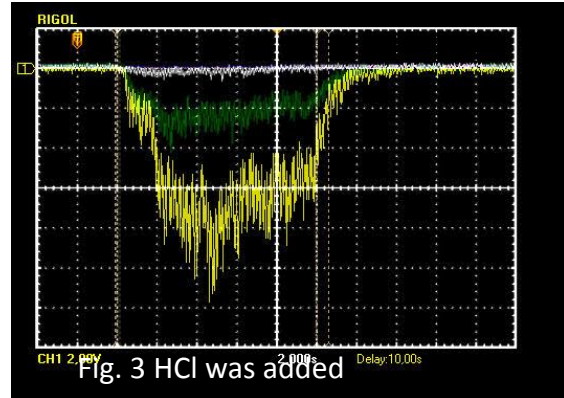


Fig. 2 the experimental setup

3. Our results

We found out the monads react to different substances: They don't glow anymore when hydrochloric acid was added, nor when heavy metal ions or fuel oils were. They lose some of their illuminating power through the add-on of NaOH, dung and edible oil.



4. Conclusion

We found out that *Pyrocystis lunula* can be used to test the water quality. They react to the substances which end up in the ocean and harm the organisms.

Water purification by hair-melanin can bind toxins

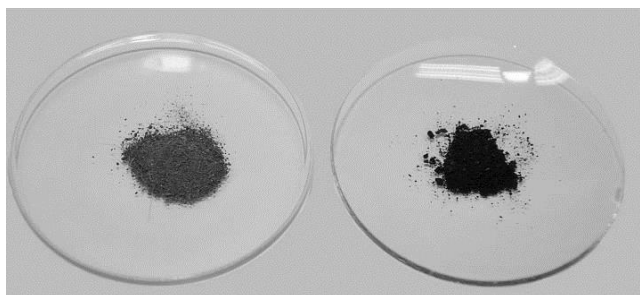
Linus Wiora

Supervised by Dr. Rudolf Binder

Schüler-Forschungs-Zentrum Bad Saulgau

In my project I examined the binding abilities of different heavy metals to the hair and skin pigment melanin in order to find a cheap and easy method to clear water from these toxins. This method of water purification could help to improve the water quality, especially in poor countries.

I was able to show that the heavy metals bind well to most of the melanins examined. The melanin was extracted from different sources, for example human hair (Picture 1) and was also synthesized from L-Dopa.



Pic. 1 melanin extracted from red and black human hair

I've used a highly sensitive spectro-photometric method in order to examine the binding abilities of heavy metals to melanin. As can be seen in figure 1 the binding of lead to melanin extracted from human hair worked very well. The results of experiments with other heavy metals were similar.

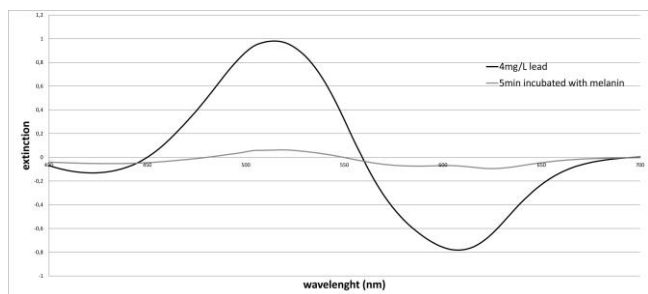


Fig. 1 decrease of lead saturation caused by melanin extracted from brown human hair

In further experiments I found out that the purification also works without the extraction of melanin from the hair. Thus water can be purified, just by putting naturally colored hair into it.

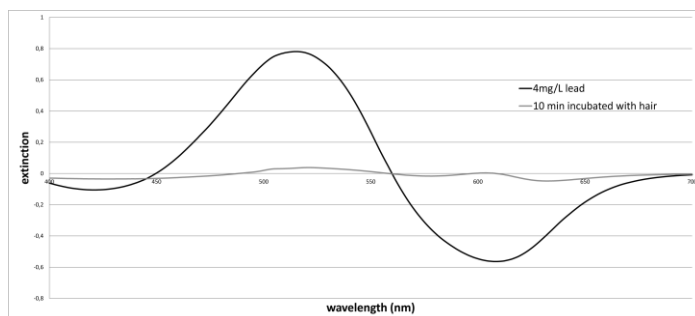
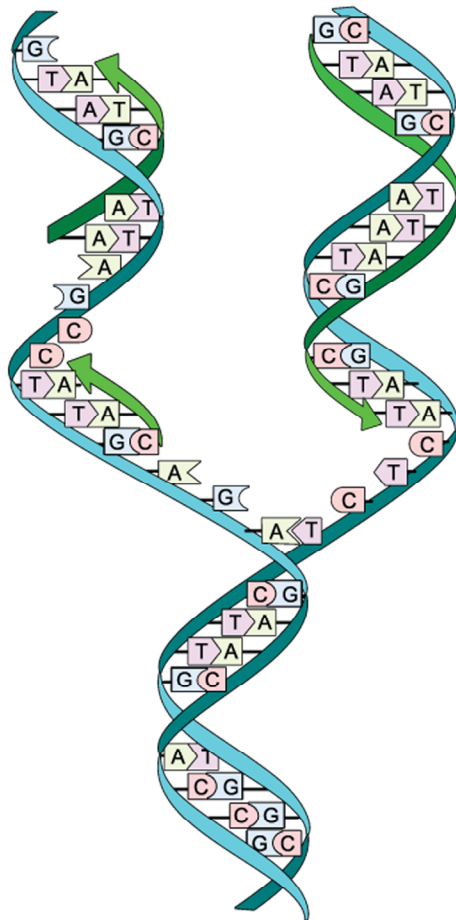
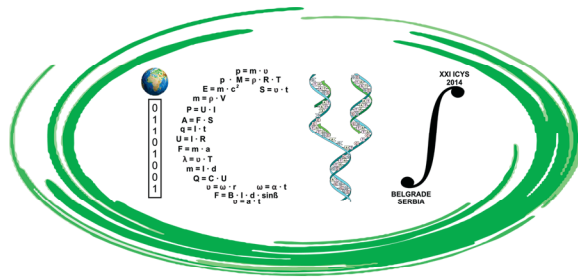


Fig. 2 decrease of lead saturation caused by black human hair



Life Science

A Novel Antibacterial Agent from *Eichhornia crassipes* (Water Hyacinth)

Josiah Christopher

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1. Introduction

Bacterial infection in humans is an indiscriminating concern to countries worldwide. Some of the contributors are *Staphylococcus aureus*, *Escherichia coli*. Large number of it occurs in developing countries with poor economic condition such as countries in Africa and Asia.

Eichhornia crassipes, also known as water hyacinth in English, is a floating hydrophytic plant that is notorious for its invasive ability. Due to its prolificness, the plant constantly and quickly causes eutrophication and retardation of the flow of the water it lives in. This results in the need of constant removal of this plant by the people [1].

This research has led to the discovery of using the abundantly found *Eichhornia crassipes*, as a cheap yet effective source of antibacterial agent.

2. Method and Experiment Design

The ethanol extract of *Eichhornia crassipes* is first purified through centrifugation and pasteurization, and then diluted into 3 different concentrations; 75%, 50% and 25%. In three trials, each of the three *Eichhornia crassipes* extract concentrations is tested against the two bacteria: *Staphylococcus aureus* and *Escherichia coli*, in vitro, by the cylinder plate assay method. Water is used as negative control and ampicillin is used as positive control and comparison, being a representative of conventional antibacterial agents. The size of zone of inhibition produced after incubation will be the measure of the antibacterial effect of the extract.

A second experiment is conducted to test whether the extract is bacteriostatic or bactericidal. The second experiment involves the transfer of the inhibition zone liquid into a new nutrient media. Presence of bacteria on the new media after 24 hours incubation will determine the type of the antibacterial activity.

3. Result and Analysis

The negative control shows no inhibition effect, indicated by the absence of inhibition zone. The highest inhibition effect is produced by the 75% concentration, with inhibition zone of diameter 15.45 mm. The smallest inhibition effect is produced by the 25% concentration, with diameter of

10.32 mm. The ampicillin produces higher inhibition effect than the extracts, with diameter of 20.94 mm.

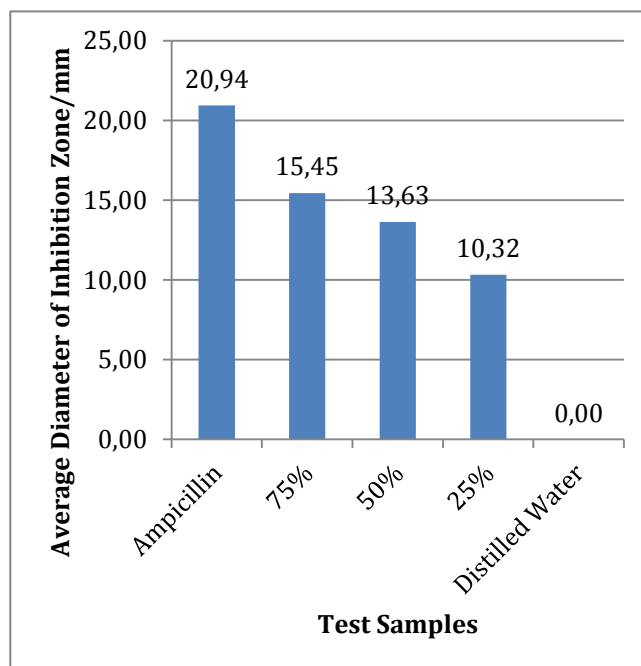


Fig. 1 Average results of the first experiment: average diameter of inhibition zones.

Presence of bacteria in the new nutrient media of the second experiment indicates that the extract is bacteriostatic.

The antibacterial property of *Eichhornia crassipes* is due to the presence of two biosactive chemicals; flavonoid and alkaloid [2, 3].

4. Conclusion

Eichhornia crassipes extract possesses antibacterial properties, and is bacteriostatic. Therefore, *Eichhornia crassipes* is a good and cheaper substitute of antibacterial due to its easy accessibility and abundance.

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Acrylamide – Dangerously delicious

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1 Introduction

In 2002 the Swedish National Food Authority discovered that acrylamide occurred in daily foodstuff. At that time, acrylamide was only known as a neurotoxic chemical on industrial scale. Because of this remarkable discovery, international research on the effects of acrylamide were set up. Presumably the intake of acrylamide could lead to an increased risk of cancer.

Because the assumptions on acrylamide had not been confirmed and the results of the inquiries differed, acrylamide could not be excluded to be dangerous. This caused international authorities and the food industry to think up a solution to reduce the amount of acrylamide in nutrition. Many possibilities have been considered so far and consequently formed the foundation of our research and main question today: “How can the amount of acrylamide in foodstuff be reduced?”

2 Method of research

In order to shed more light on the dangers of acrylamide, literature search was carried out. Various research on the association between dietary acrylamide intake and human cancer risk were examined and compared. To form an objective conclusion, research from different countries were consulted, such as the research of Hogervorst, Wilson, Mucci, and Pelucchi. The results of this comparison led to the determination of the danger of acrylamide in this research.

To answer the main question, different solutions to reduce the amount of acrylamide in foodstuff were examined and evaluated. On the basis of the ‘Acrylamide Toolbox’, created by FoodDrinkEurope, the solutions were examined with multiple approaches: both theoretically and practically. For the theoretical part, chemical structures and reactions were analysed. For the practical part, previous research was consulted to determine how effective and suitable the already existing solutions were.

The experiment of this research was set out to examine the application ability of two of the solutions described in the Toolbox. In a bakery, three kinds of crackers were baked. The first recipe included standard ingredients. The second recipe had a different raising agent. Ammonium bicarbonate – which is known to stimulate the formation of acrylamide – was replaced with sodium bicarbonate. The third recipe had an extra ingredient. The enzyme asparaginase – which prevents the formation of acrylamide – was added. All the other ingredients of the recipes and the baking processes were kept constant. From this experiment, the application ability of the solutions could be determined.

3 Results

The literature research indicated that acrylamide increased the risk of postmenopausal endometrial and ovarian cancer. Renal cell cancer is still a dubious case. These findings have not been confirmed by authorities yet and therefore more research needs to be carried out.

From the Toolbox five main solutions were deducted. The first possibility to reduce acrylamide in foodstuff is to apply a change in the process: either lowering the processing temperature or shortening the processing time. Also, replacing a stimulating ingredient in the recipe could be a good solution. Additionally, adding another ingredient, such as another amino acid, decreases the acrylamide formation. In the future, agricultural adjustments could minimize acrylamide formation as well. Lastly, adding the enzyme asparaginase is considered an effective method in reducing the acrylamide content.

All these possibilities have been proven to lower the acrylamide content, but they are only modestly applicable. If the changes are too great, the product will eventually deviate too much from the original product, making the substitute product no longer suitable.

The experiment also indicated which difficulties may arise when trying to put the solutions into practice in the international food market. In this case, adding asparaginase turned out to be a better substitute for the original cracker than changing the raising agent.

Nevertheless, these findings should be put into perspective. Since every foodstuff has different qualities, these findings might not be true for other foodstuff. Therefore, it can be concluded that it is extremely difficult to find a universal solution for every foodstuff. Instead of one single solution, every foodstuff needs its own practical application. To minimize the problems that come along with the different solutions, the best idea is to combine multiple approaches suggested by the Toolbox.

4 Final conclusion

As it is still difficult to determine the exact effects that acrylamide may have on the human body it cannot be excluded from being dangerous. Hence it is important to reduce the amount of acrylamide where possible. For this purpose different solutions are invented. As is shown in our experiment, it is hard to apply this on each and every product. Therefore each product requires its own application or a combination of the different solutions.

Finally, it is important to note that the focus of acrylamide reduction should be on the food industry for now. People should not worry too much about acrylamide, as long as the industry tries to reduce the amount of acrylamide in their products as much as possible. That way, the consequences of acrylamide intake can be minimized.

Application of SSR markers for maize hybrids development

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1. Introduction

The foundation of producing a high quality hybrid is the selection of matching maize lines with good combining abilities. However, the identification of parental lines whose crossing provides superior hybrids is the longest and most expensive phase in maize breeding process which requires the search for new methods that would enable achieving the desired objective in shorter time [1].

2. The purpose of the investigation

Information about diversity and genetic similarity among maize inbred lines is indispensable for revealing potentially the best line combinations with the highest hybrid performance which could be used in breeding programs.

The aim of this research was to estimate genetic similarity by SSR molecular markers among six maize inbred lines, which are parental components of commercial hybrids and to compare the results with their hybrid performance.

3. Method of the investigation

Genomic DNA of six maize inbred lines was isolated and amplified by PCR reaction using 24 polymorphic SSR primer pairs. Amplified fragments were separated by electrophoresis and results were statistically processed. The bands were binary coded by 1 or 0 for their presence or absence in each genotype and these data were used for genetic similarity calculation (*Simple matching* coefficient of correlation) and cluster analysis using NTSYS pc ver. 2.1. program.

4. Result of the experiment

Genetic similarity coefficient was in the range from 0.451 to 0.890. Cluster analysis grouped genotypes in two clusters according to their pedigree.

Hybrid created by crossing lines with the greatest genetic similarity L2 and L3 (coefficient of similarity was 0.89) had the lowest yield (5.194 t/ha). Combination of lines with the lowest genetic similarity of 0.451 (L1xL6 and L5xL6) provided hybrids with much higher yield (11.048 t/ha and 11.638t/ha). L1 and L4 lines, whose genetic similarity

coefficient was relatively low (0.537), created a hybrid with the highest yield (11.910 t/ha).

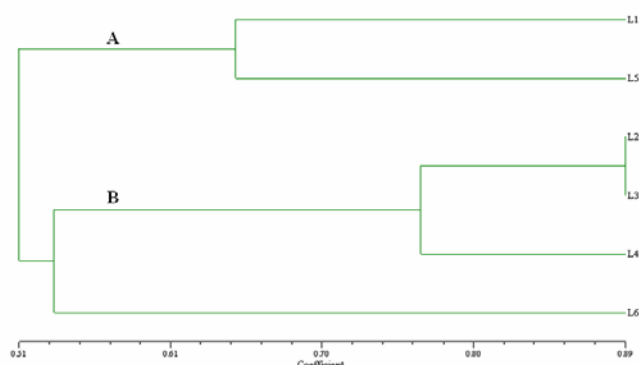


Figure 1 – Dendrogram of six analysed maize inbred lines based on genetic similarity calculated using SSR marker data

5. Conclusion

The results of SSR analysis confirmed the starting assumption that hybrids with the higher yield are created by crossing inbred lines with lower genetic similarity. This method can be used in maize breeding programs in order to increase the efficiency of conventional breeding.

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Bactericide effect of some TiO₂ compounds

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Supervisors: Maria Ceclan, dr. Dumitru Georgescu

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1. Introduction

TiO₂ is a semiconductor with a band gap that permits UV light absorption and possesses a high oxidation power. TiO₂ nanostructured materials are nanoscopic architectures with high surface area. Their high surface area, non-toxic nature, stability and high homogeneity make them extremely attractive for applications [1]. TiO₂ use for neutralizing polluting agents in water by photocatalytical processes is well known [2,3]. Also it is a known fact that nanostructured materials like TiO₂ are growing the photocatalytical activity because this depends on some factors like: specific surface area, the type of dopant and his concentration, crystalline structure, particle size, etc. On the other hand the bactericide effect of this compounds is well known but this mechanism is not very well understood on common bacteria like *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, etc. *E. coli* remains a more common uropathogen. Urinary tract infections (UTIs) refer to the presence of microbial pathogens within the urinary tract over 50% of woman and 13% of men are confronted at least once in a lifetime by a urinary infection [4]. The introduction of some dopants like silver has become one of the preferred methods that confer antimicrobial properties to biomedical materials and devices [5].

2. Objectives

The aims of the present work were to synthesize porous TiO₂ structural and morphological points of view and to analyze their bactericidal effects on strain bacteria (*E. coli*) considered to be drinking water pollution indicator. XRD was used for the morphological characterization of TiO₂-Ag system. The structural and morphological properties were correlated with the antimicrobial effects in order to explain the observed behavior.

3. Methods

TiO₂ gels were prepared by the acid-catalyzed sol-gel method using titanium isopropoxide (TIP), HNO₃, EtOH and H₂O in 1/0.08/21/3.675 molar ratios. The gels were allowed to age for three weeks, then impregnated with various concentrations of AgNO₃ ethanol solution and subjected to supercritical drying with liquid CO₂ by using a Tousimis 815 device. The specimens' morphology was examined by XRD.

4. Results of the experiment

XRD measurements were firstly performed and the obtained diffraction patterns are presented in Figure 1.

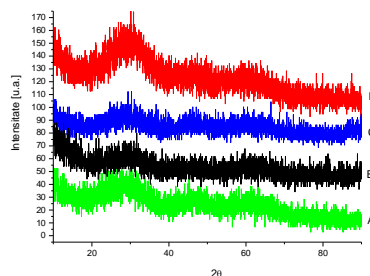


Fig. 1 Diffraction patterns

The diffraction patterns of all investigated aerogels show weak and broad diffraction peaks. Identification of the titania crystal phase and confirmation of the silver presence cannot be done from these peaks due to the low signal/noise ratio. The quantitative assessment of the bactericide effect of the synthesized porous samples shows very promising results for the silver doped TiO₂ (see Figure 2).

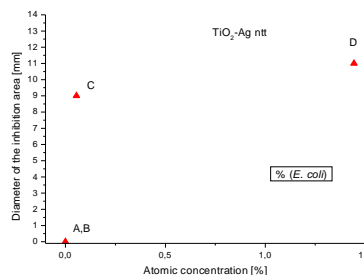


Fig. 2 Quantitative results for non thermal treated samples

If the samples was thermal treated at 500 °C the bactericide effect was not present (see Figure 3).

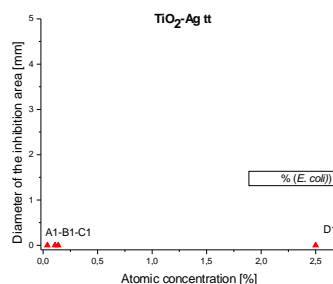


Fig. 3 Quantitative results for thermal treated samples

5. Conclusion

The best bactericide effect was observed for D sample, most probably due to silver presence and to the existence of an amorphous character for this sample, so that a higher surface area of the pores is expected to be formed in comparison with the others silver doped samples. Surprisingly, the result obtained in the case of sample A (without silver) points to the fact the inhibitory mechanism is not photocatalytic. The values of the inhibition area points to the fact that the efficiency of this nanostructured compounds is comparable to some powerful antibiotics.

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BIOTECHNOLOGICAL METHOD DEVELOPMENT BASED ON AFFINITY MEMBRANE SYSTEM FOR ANTIBODY RECOGNITION

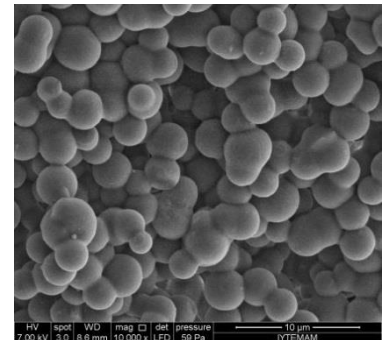
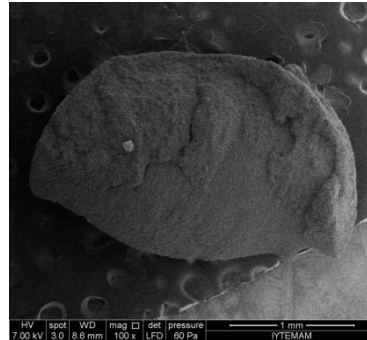
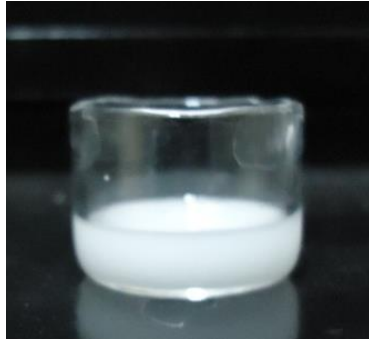
Özgür Ülker



My purpose was to recognize Ig G antibody for diagnosis and treatment of diseases, efficiently, high amount, with less toxicity, economically and purifying Ig G in high ratios from its natural sources. p(HEMA-EDMA) were synthesized with photopolymerization method and characterized according to SEM and swelling behaviors. In the SEM results it is examined that membranes are in spherical structures. Highest swelling value is determined as 224.8%. In order to adsorb Ig G to p(HEMA-EDMA); they were activated with IMEO and derivatized with Con A. Optimum conditions for Ig G adsorption to membranes are; 1.5 mg/ml Ig G concentration, 30 min, pH 4 citrate buffer, 37 °C and without any different ionic

strength. Maximum adsorption capacity is determined as 352.8 $\mu\text{g}/\text{cm}^2$ and is 4 times higher than nonspecific Ig G adsorption to p(HEMA-EDMA). Ig G adsorption-desorption cycles proved that product is reusable without losing its adsorption capacity.

Key words: Polymeric membrane systems, lectin affinity chromatography, Ig G recognition.



p(HEMA-EDMA) polymeric membrane and its SEM images

Cellular ageing

Chiri Loeters and Annabel Broer

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1 Ageing in general

All living organisms in this world, from the mayfly, which only lives for about 24 hours, to the Ocean Quahog clam, which has a lifespan of over 500 years, share one thing in common. All organisms age. Their tissues deteriorate, eventually leading to their death. Ageing is not necessarily the wear and tear of an organism. It can be described as the inability of an organism to sufficiently restore its damaged tissue. The phenomenon of ageing has been researched for centuries. In the past decades scientists have been investigating ageing on a cellular level to gather information about the fundamental basis of ageing. Our project is based on the following guiding question: “What is the relation between the visible features of a cell and cellular ageing?” Three of the most renowned theories about ageing have been investigated. After that an observational experiment with yeast cells has been carried out and analysed. The link between the observations during the experiment and the investigated theories can be found in the conclusion.

2 The theories of cellular ageing

2.1 Oxidative stress

The theory of oxidative stress is based on the harmful effects of the Reactive Oxygen Species (ROS). These ROS are formed during aerobic processes inside the cell, mainly during the oxidative phosphorylation. Due to electron leakage free radicals or the ROS are formed which damage several tissues inside the cell such as the cytoskeleton, lipids and proteins. Oxidative stress has a positive influence on ageing.

2.2 Telomere shortening

The end of each chromosome consists of a repeating set of noncoding base pairs called the telomere. During each replication of a cell these telomeres are shortened until they reach a critical length. When this length is surpassed the chromosome will be unstable and this will cause the cell to die. Therefore the telomere length is a limiting factor for the Replicative Lifespan (RLS) of a cell. The shortening of telomeres has a positive effect on ageing.

2.3 Sirtuins

Sirtuins are proteins that regulate essential biological pathways in all cells. The name sirtuin originates from the first found sirtuin gene, namely the “silent mating-type information regulation 2” (Sir2) gene. This gene is responsible for the cellular regulation in yeast. It carries out the tasks that protect the cell and regulate the ageing process of the cell. The presence of sirtuins has a negative effect on ageing.

3 The experiment

This report includes an experiment with *Saccharomyces cerevisiae*. During a period of three days a microscopic picture was taken every ten minutes. The data has been analysed and several observations, such as the increase in size of the cells, the Chronological Lifespan (CLS), the Replicative Lifespan (RLS), and the replication rate, have been analysed. This data has been linked to the three investigated theories.

4 Conclusion

Oxidative stress stimulates the ageing process. The amount of oxidative stress is elevated by processes, such as growth and reproduction. The presence and the relative amount of these processes and thus the amount of oxidative stress is indicated by the cell size and by the RLS and the replication rate. The amount of reactive oxygen species formed as a repercussion of these processes has a negative effect on the total lifetime and the CLS. Telomere shortening stimulates ageing as well. The length of the telomeres mainly determines the RLS. It also has an influence on the CLS and the lifetime. Shorter telomeres result into a shorter RLS, CLS and lifetime. The Sir2 gene promotes longevity by regulating homeostasis in yeast cells. Amongst other types of homeostases is cell size homeostasis. An increase in cell size usually indicates a decline in the health and fitness of a cell. Cells that possess the Sir2 gene are smaller than cells that do not. Our investigation has showed that the cell size and the RLS are inversely proportionate. Therefore, the presence of the Sir2 gene is linked to a higher RLS, CLS and lifetime.

The influence of chronotype and time of day on school performance

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1 Background

Humans have an internal biological clock that regulates various biological functions, such as the sleep-wake cycle. There are large individual differences in the preferred sleep timing. Chronotype, defined as the mid-point of sleep on free days, can be used to describe the distribution of early (larks) and evening (owls) types in the population. Chronotype varies with age and sex and reaches its maximum in lateness during adolescence.

Studies found that chronotype affects school performance, with earlier types achieving better grades than later types [1,2,3]. Yet, no study has so far tested whether the chronotype-dependent performance varies with the time of day at which tests were taken. We therefore investigated the influence of both chronotype and time of day on school performance.

2 Methods

We collected 5,572 grades achieved by 887 high school students as a measure for school performance. 742 of the 887 students also completed the Munich ChronoType Questionnaire (MCTQ). Test times ranged from 8:15 h to 15:00 h.

3 Results

We found that later chronotypes achieved, on average, lower grades than earlier chronotypes ($F_{4,520.6} = 3.8635$; $p = 0.0042$), which supports previous research. Grades of tests taken during the 1st school hour (8:15 to 9:00) were significantly lower ($F_{7,3579} = 4.181$, $p < 0.0001$). There was a significant interaction effect between chronotype and time of day at which tests were taken ($F_{2,3551} = 4.171$, $p = 0.0155$). When tested in the morning, late chronotypes achieved lower grades compared to early chronotypes. This effect disappeared in the early afternoon.

4 Conclusion

These findings confirm that chronotype impacts school performance. Furthermore, we showed for the first time that testing students in the early afternoon could reduce the chronotype-dependent differences in school performance.

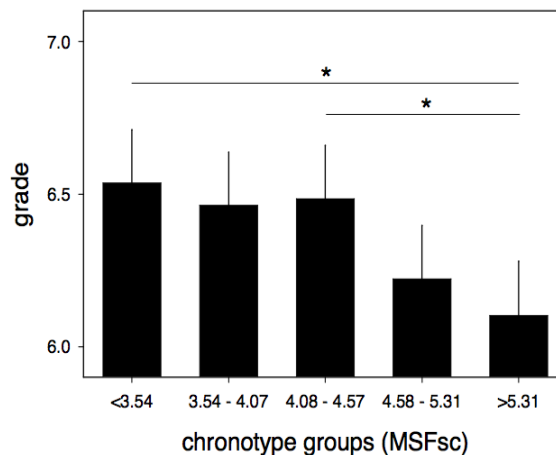


Fig.1 Chronotype effect on grades.

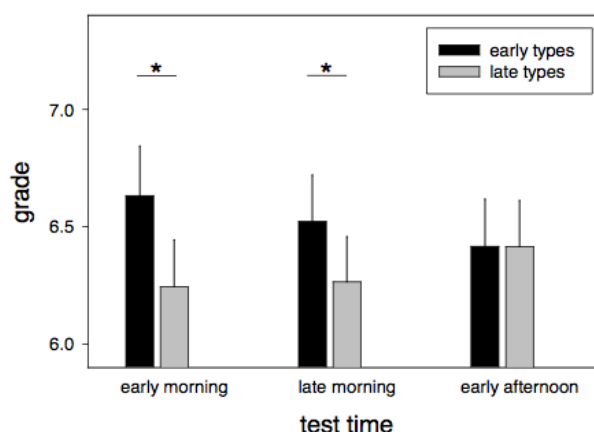


Fig.2 Interaction effect between chronotype and time of day.

References

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Concentration effect of Papaya (*Carica papaya*) Stem Extract To Inhibit The Growth of *Phytophthora infestans* on Potato (*Solanum tuberosum*)

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1. Background

Potatoes can be consumed as a main food in this worldwide. Unfortunately, quality of harvested potatoes in Indonesia are decreasing because its attacked by fungi (*Phytophthora infestans*) which is called potato blight disease. Farmers are usually utilizes fungicide to inhibit the growth of fungi.

But it would be very dangerous because it can harm our health such as cancer and our environment such as air pollution, water pollution, and soil contamination. On the other hand, Indonesia is an agricultural country with limitless and endless potential of natural resources among its archipelago. This tropical country produces a lot of natural resources that benefits it in economy section such as papaya tree. We, Indonesian cut down the papaya tree after it couldn't produce good fruit. From this potential, papaya stem can be utilized as a bio-antifungal instead of fungicide.

Moreover, the cost of this bio-antifungal is more affordable than fungicide because materials can be found in nature and it is also eco-friendly.

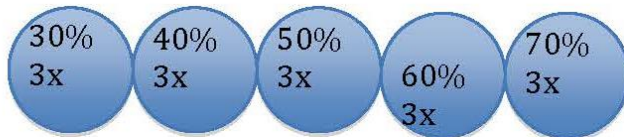
2. Goal

1. To prove that papaya stem extract can be used as an antifungal
2. To determine the most effective concentration to inhibit the growth of *Phytophthora infestans*

3. Methodology

1. In Vitro (Clear Zone)

Making media → Inoculate fungi → Testing various concentration of papaya stem extract



2. In Vitro (Extract Testing on Potato)

Weighing initial mass (data) → Testing various concentrations of papaya stem extract on potato (to get optimum concentration doesn't cause cell membrane of potato to lyse) → Weighing final mass

3. In Vivo (applying optimum concentration to potatoes)

Inoculate *Phytophthora infestans* on potato → Testing extract on potatoes

4. Result and Analysis

Table of Clear Zone of the Growth of *Phytophthora infestans* (In Vitro)

Papaya Stem Extract	Media 1	Media 2	Media 3	Average
30%	0.2 cm	0.1cm	0.15cm	0.125cm
40%	0.4cm	0.5cm	0.45cm	0.45cm
50%	0.7cm	0.9cm	0.8cm	0.8cm
60%	0.9cm	1cm	1.3cm	1.07cm
70%	1.4cm	1.2cm	1cm	1.2cm

Based on table of data, higher concentrations of papaya stem extract produce larger clear zone which is 70%.

Table of Extract Testing on Potato

Papaya Stem Extract	Initial Mass of Potato	Final Mass of Potato
10%	0.4gr	0.5gr
20%	0.4gr	0.43gr
30%	0.4gr	0.43gr
40%	0.4gr	0.39gr
50%	0.4gr	0.38gr
60%	0.4gr	0.37gr
70%	0.4gr	0.32gr
80%	0.4gr	0.29gr

Based on table of data, 80% concentration can cause the cell membrane of potato to lyse so, concentration below 80% are used. Based on graph, there is an intersection line which is 36% concentration. It means that doesn't cause the cell membrane of potato to lyse.

5. Conclusion

1. Papaya stem extract can be used as antifungal
2. 36% concentrations has a potential as an antifungal

6. References

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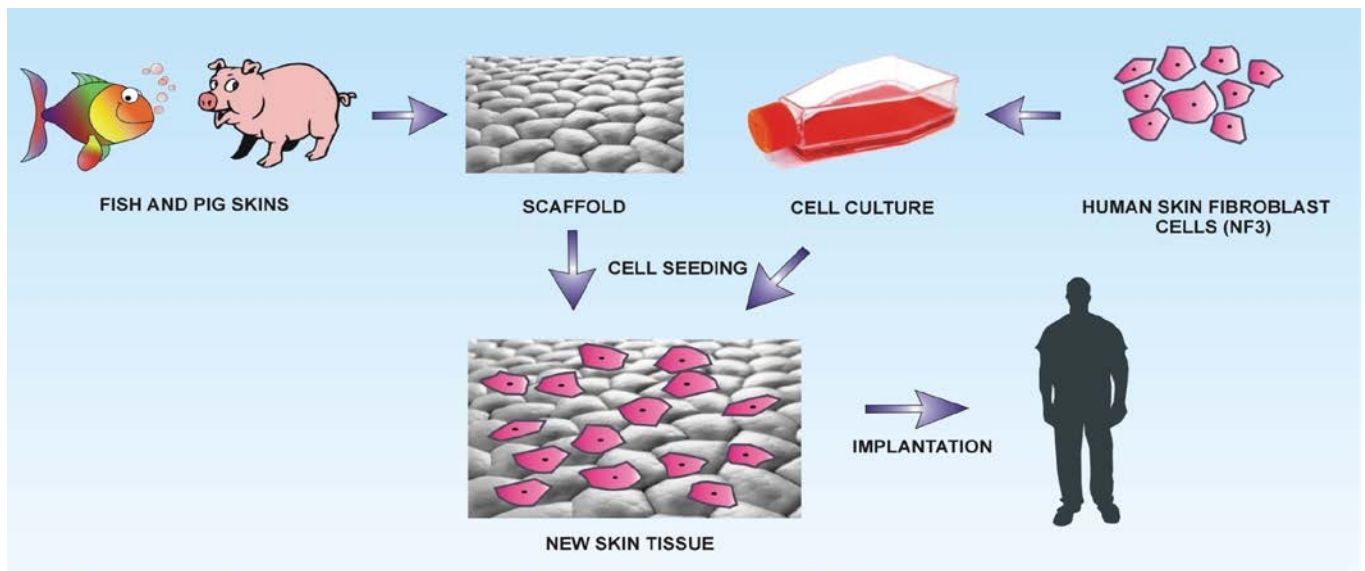
DEVELOPMENT OF BIOMIMETIC SKINS

P KISHORE

Abstract

The objective of the project is to develop a novel biomimetic membrane and/or a scaffold for the said membrane. The approach of the project is to use animal skin from the domesticated pig or fish as a scaffold material for the adherence and growth of human skin fibroblasts to create a biomimetic membrane that can be used in medical applications as an alternative to today's gold standards of Xenograft, Allograft and Autograft procedures. The biomimetic skin membrane can be used to treat victims of burns or scarring with a natural material that would be eliminated via natural bodily functions while eliminating the side effects and drawbacks such as scarring, secondary

infections and tissue damage resulting from the current gold standard graft procedures on donor sites. Pig and fish skins were treated with ethanol and dehydrated or were coated with a biodegradable, biocompatible coating like polyvinyl alcohol, polyethylene glycol, gelatine or Polycaprolactone followed by perfusion with Phosphate buffer solution and cell culture media. Human skin fibroblasts were seeded on the animal skin scaffold. The human skin fibroblasts were then observed to determine their morphology and membrane formation properties. It was observed that the human skin fibroblasts were able to adhere to the non-human skin scaffolding and proliferate forming a membrane. More research is needed to determine their viability as a biomimetic membrane.



Overall process for creation of the biomimetic membrane

Genomic stress influence on wing size and shape in *Drosophila subobscura*

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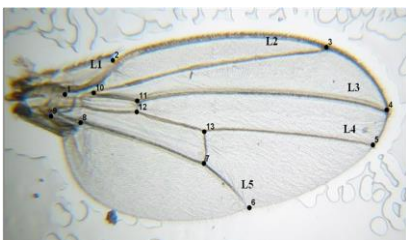
1. Introduction

Inbreeding, mating between close relatives, is a genomic stress that may disrupt the stability of the genome [1]. This phenomenon occurs in nature, especially in situations of habitat fragmentation caused by anthropogenic influence, global climate changes and rapidly growing pollution. In those cases, population could be isolated for a certain period, which would lead to mating closely genetically related individuals [1]. Inbreeding results in homozygosity, and has both positive and negative effects on whole range of traits, including morphological traits and fitness components [2].

The aim of this study was to evaluate influence of experimentally increased homozygosity, as genomic stress, after 14 generations of full-sib inbreeding treatment in laboratory conditions on *Drosophila* wings morphological traits.

2. Materials and methods

In this experiment, highly inbred lines of *D. subobscura*, originating from two ecologically and topologically distinct habitats were used, knowing that they possess a certain degree of genetic differences due to their different evolutionary histories. Beside homozygotes from inbred lines, heterozygotes from direct and reciprocal crosses between these populations were used. For analysis of phenotypic variability of the wings males and females were separated. The right wing of each fly was fixed and the digital photograph was taken. Images were landmarked with 13 landmarks (Picture 1). Wing size was examined using centroid size (CS) and shape was examined using weight matrix (*wm*). Differences in CS were tested with ANOVA, and the ones in *wm* with MANOVA.



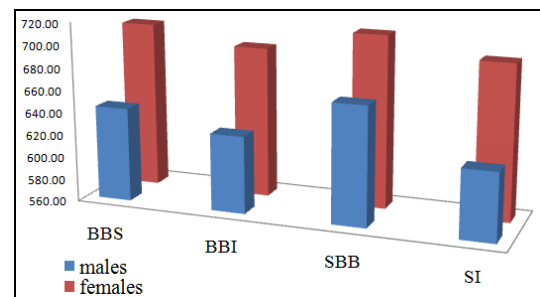
Picture 1. Right wing of *D. subobscura* with 13 landmarks

3. Results and discussion

The results for wing size showed significant difference between homozygote and heterozygote groups (Table 1). Heterozygous individuals have larger wings than homozygous (Picture 2). Also, between sexes is significant difference: males have smaller wings than females, due to clear sexual dimorphism in this species (Picture 2). There is significant interaction between sex and groups (Table 1).

Effect	df	MS	F
group	3	23606	37.7 ***
sex	1	492693	787.2 ***
group x sex	3	4089	6.5 ***
Error	481	626	

Table 1. Two-way ANOVA on wing size (CS) of individuals from four groups and both sex



Picture 2. Mean values of centroid size for all experimental groups and both sexes

MANOVA showed no difference in wing shape between experimental groups, as a result of different genes and genetic pathways involved in development of these wing morphological characteristic [3], and which is consistent with results of previous studies.

4. Conclusion

Understanding nature of phenotypic variation is important aspect of evolutionary biology. One of the reasons why homozygous individuals have smaller wings may lie in fact that more recessive genes are expressed in phenotype than expected, which can lead to lower performances in individuals as well as in populations.

Another explanation is heterozygote superiority, theory which states that higher level of heterozygosity increases fitness of an individual, and since the wing size is closely related to a fitness of an individual, obtained results are in concordance with this theory.

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Improved multiplexed automated genome engineering through directed evolution

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Abstract

Multiplex automated genome engineering (MAGE) is a versatile tool for efficient genome-wide genetic modification. However, a high cell death rate, and a low percentage of genetically modified cells are serious limitations of MAGE's applicability. Using directed evolution as a tool for improving MAGE, we show one *Escherichia coli* (*E. coli*) strain which evolved over 14 MAGE cycles to acquire a lower cell death rate and a higher percentage of genetically modified cells. However,

pleiotropic antagonism was observed, at the cost of an acquired reduced growth rate for ECN2. Furthermore, we observe that the increase in percentage of genetically modified cells was greater after the initial eight MAGE cycles than after six subsequent MAGE cycles, suggesting the presence of slower average fitness gains over successive generations of bacteria. A second *E. coli* strain did not significantly change over the course of directed evolution, possibly due to maximum MAGE efficiency already being attained. Directed evolution significantly improves MAGE efficiency, and has potential applications in molecular biology and biotechnology.

Influence of plasma on conformation of plasmid DNA

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1. Introduction

Plasmids are extrachromosomal double-stranded DNA molecules that are typically found in prokaryotes, but are also present in some eukaryotic cells [1]. In the bacterial cell, plasmids are often in a twisted (supercoiled) form, but under certain conditions they can be found in linear, circular or multiple twisted forms. Their simplicity and small size make them suitable for use as DNA models in studying DNA damage [2]. Plasma sterilization is fast evolving into a promising alternative to standard sterilizing techniques [3-5]. It has several advantages: usually is conducted at room temperature, does not involve any chemicals and hence is non-toxic, time of treatment is fast and can sterilize almost any material and any shape. The main objective of this study was to determine the influence of plasma treatment on conformation of plasmid DNA, used as a DNA damage sensor.

2. Method of the investigation

Plasmid pGEM was isolated from 5mL of transfected *E.coli* liquid culture. Same amount of plasmid water solution (3 μ L containing approximately 1 μ g of plasmid) was placed at the bottom of each of 96 wells in a microtiter plate. To create helium gas plasma, the signal generator, amplifier and voltage signals and sequencer networks were used. Wells were treated with the voltages of 80mV, 90mV and 100 mV, in time intervals of 5, 15, 30 and 60 seconds. Twelve control wells were not treated. The flow of helium was 1slm. After the treatment, plasmids were resuspended in the same water volumes and electrophoretically analyzed on 2% agarose gels. Plasmid DNA was visualized with ethidium bromide and on UV transilluminator (266 nm).

3. Results of the experiment

Analysis of treated plasmids on agarose gels has shown that helium plasma mildly affects conformation of plasmid DNA. Analysis of gel bands profile in treated and control plasmid samples has shown that single-strand and double-strand breaks in plasmid DNA are slightly more frequent in treated samples than in control samples.



Figure 1. Plasmid DNA electrophoresis on 2% agarose gels (1-3: treatment with 90mV, 4-7: treatment with 100mV, 8-9: controls, 10: 1kb DNA ladder)

4. Conclusion

The helium gas plasma at low voltages influences the configuration of the plasmid DNA. Treatment of plasmid DNA with low-level voltage of helium plasma induces single-stranded and double-stranded breaks. Further investigations should encompass treatments with wider range of voltage and duration, as well as use of other gasses, in order to thoroughly investigate how plasma influences DNA molecule. Such investigations are necessary to conduct before plasma sterilization can be used routinely in clinical practice.

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Oral biofilm analysis

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1. Introduction

Dental plaque (biofilm) represents a complex community of microorganisms of oral microflora in the matrix of bacterial and salivary origin [1]. The bacteria of dental plaque play a part in the making of caries. With their enzyme activity they decompose carbohydrates to acid products, which leads to the decline in pH value on the very surface of teeth, which stimulates the occurrence of initial caries lesion. The aim of this study was to analyze the specificity of oral microflora of high school students, as well as to evaluate their oral health and level of oral hygiene.

2. Method of the investigation

Forty students from first to fourth grade of Dental technician school in Belgrade were chosen by random selection. Each respondent was subjected to dental examinations and filled out in the survey that concerns their life habits and degree of oral hygiene maintenance. The oral health of subjects was estimated by commonly used indexes: average number of decay, missing and filled teeth (DMFT) and Community Periodontal Index of Treatment Needs (CPTIN) [2]. In the dental office the respondents brushed their teeth with their toothbrush, without toothpaste and rinsing for three minutes. Single fiber beam from the central part of the brush was cut off with sterile scissors, immersed in thioglycollate broth and incubated for 24 hours at 37°C and afterwards disseminated on three types of media to cultivate the following types of microorganisms: aerobic bacteria, anaerobic bacteria and fungi. Microorganisms were identified based on a set of standard microbiological tests.

3. Results of the experiment

The survey showed that majority of subjects used toothbrush as the main medium for hygiene maintenance for two months or longer, while 97.5% do not use or seldom use mouthwash. Also, 82.5% of subjects did not attend professional sediment removal in the past year. The average value of DMFT was 3.2, which is considerably higher than in other European countries where results amount from 1.8 in Slovenia to 0.9 in Denmark and Switzerland [2]. For the CPTIN index the following results

were obtained: 0 (healthy parodontium) – 62.5%, 1 (mild bleeding gums on probe provocation) – 22.5%, 2 (hard-sediments scale) – 15.0%. The obtained results were in compliance with the recommendations of World Health Organization [3]. The microbiological analysis has shown presence of 15 bacterial species, while *Candida albicans* was present in four subjects.

Bacterial species	G	No	%
<i>Staphylococcus aureus</i>	+	10	25.0
<i>Streptococcus mutans</i>	+	7	17.5
<i>Mycrococcus spp.</i>	+	7	17.5
<i>Streptococcus salivarius</i>	+	6	15.0
<i>Klebsiella pneumoniae</i>	-	6	15.0
<i>Enterococcus faecalis</i>	+	3	7.5
<i>Enterobacter cloacae</i>	-	3	7.5
<i>Mycobacterium spp.</i>	+	3	7.5
<i>Streptococcus pneumoniae</i>	+	2	5.0
<i>Streptococcus pyogenes</i>	+	2	5.0
<i>Listeria spp.</i>	+	2	5.0
<i>Lactobacillus spp.</i>	+	1	2.5
<i>Pseudomonas spp.</i>	-	1	2.5

G – Gram staining, No – number of subjects

4. Conclusion

Among the bacteria isolated from toothbrush samples of the high school students there were species that are not common inhabitants of the oral cavity, but represent pathogen bacteria, which indicates poor general hygiene, primarily of hands. Although the values of DMFT and CPTIN indexes were in accordance with WHO and results of previous studies, the need for training and re-motivating high school students to improve oral hygiene should not be neglected.

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Snow – bio-indicator of the atmospheric pollution

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1. Introduction

The study was conducted in Vilnius on the site of P.Skorina gymnasium and the nearby forest. The gymnasium is located in the western part of the district Karolinishkes. On the west side of the school with there is a road with an average traffic, which increases in peak hours. Behind the road there is a small forest, on the edge of which the roundabout is being built (it is planned to build a wider road for a heavy traffic). Blocks of flats are located in the North, East and South-East from the gymnasium.

2. Content

2.1. The purpose of the investigation

To determine the degree of the atmospheric pollution in the area around the gymnasium premises

2.2 Method of the investigation

Part I (The exploration of snow and its admixtures)

All samples of snow were melted (The volume of water is the same in each sample – 200 ml)

- All of the samples contained not a lot of sediment (1-2 g)
- Sediment was explored under the microscope
- In all of the samples, sediment contained sand

Method:

Part II (General exploration of toxicity using bio-indication method)

For the purpose of the study, two types of seeds were used:

- a) Processed seeds from the store (experiment Nr 1)
- b) Unprocessed seeds of the pumpkin that was grown in the garden (experiment Nr 2)

Two experiments were carried out simultaneously

10 pumpkin grains were numbered and placed onto Petri dishes

- Nr.1 – gymnasium premises
- Nr.2 – gymnasium premises
- Nr.3 – road
- Nr.4 – forest
- Nr.5 – car park

The grains were watered by the melt water for 10 days.

- The level of the snow toxicity was determined by the germination and the development speed of seeds' roots and the stem. During the experiment, the changes of the pumpkin growth were observed: the emergence of sprouts; the average length of the root; the appearance of the first leaves
- Experiment lasted 10 days

3. Conclusion

The study of snow using the bio-testing method was successfully completed. This method helped to determine the pollution level of the gymnasium territory and the area in which it is located. After conducting all of the experiments the following conclusions were made: the most polluted area is the road, where there is an active transport movement. Because of the fact that the Gymnasium is surrounded by residential houses, its pollution level is not very high.

4. References

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The effect of working in shifts on the life span of the *Drosophila melanogaster*

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Supervisor: Mike van den Hurk

Het Hooghuis, locatie Titus Brandsmalyceum, Oss, The Netherlands

1 The purpose of the investigation

The aim of this study was to investigate the effect of the disturbance of the circadian rhythm caused by working in shifts on humans. The *Drosophila melanogaster* (fruit fly) was used as a model for the human being.

2 Methods

For this investigation 120 male *Drosophila melanogaster*s were used. The fruit fly is a suitable subject to study since there are strong similarities between the mechanism of clock cell function of the fruit fly and humans [1]. Working was simulated by raising the temperature to 25°C, as 25°C is the temperature where the maximum level of enzymatic activity in the fruit fly is reached [2]. To achieve a temperature of 25°C, infra-red light was used.

The fruit flies were divided into three groups of 40 flies each. The working schedules of these three groups were as follows (table 1):

Group 1: Every day the same shift.

Group 2: Every three days a new shift.

Group 3: Every 7 days a new shift.

Each day shift lasted for 8 hours (07:00h-15:00h, 15:00h-23:00h or 23:00h-07:00h).

Day	Group 1	Group 2	Group 3
1	07:00h-15:00h	07:00h-15:00h	07:00h-15:00h
2	07:00h-15:00h	07:00h-15:00h	07:00h-15:00h
3	07:00h-15:00h	07:00h-15:00h	07:00h-15:00h
4	07:00h-15:00h	15:00h-23:00h	07:00h-15:00h
5	07:00h-15:00h	15:00h-23:00h	07:00h-15:00h
6	07:00h-15:00h	15:00h-23:00h	07:00h-15:00h
7	07:00h-15:00h	23:00h-	07:00h-15:00h
8	07:00h-15:00h	07:00h 23:00h-	15:00h-23:00h
9	07:00h-15:00h	07:00h 23:00h-	15:00h-23:00h
10	07:00h-15:00h	07:00h	15:00h-23:00h

Table 1 Example of the working schedule per group

Each group was exposed to the same amount of light (12 hours of artificial light) a day. Fruit flies are not able to perceive infra-red light. Therefore, the only change perceived by the fruit flies was the raise in temperature resulting in a change of the activity level. The food was given ad libitum and refreshed every third day. The room temperature was kept between 18°C and 22°C, except for the duration of the working schedule (25°C). A room temperature below 18°C was prevented as this would result in additional stress obscuring the final results. Every three days, at the moment the food was refreshed, the number of dead *Drosophila melanogaster*s was counted. The total experiment lasted for 70 days.

3 Results

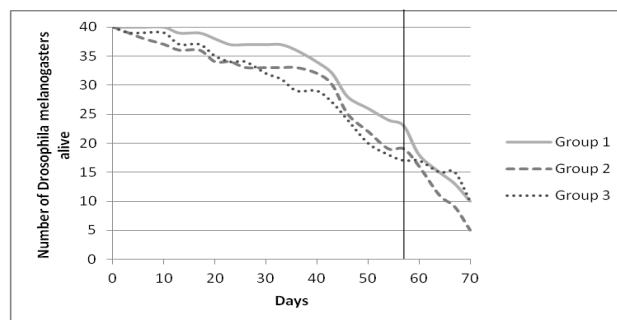


Figure 1 The number of living *Drosophila melanogaster*s per group over time

As can be derived from figure 1, a trend towards higher mortality in the groups with irregular shifts (groups 2 and 3) was observed. For statistical evaluation, only the data obtained before day 57 was used, as the food in group 1 had become mouldy on day 57. The mouldy food was replaced with fresh food. However, as the effect of the mouldy food on the outcome of the experiment was unclear, it was decided to exclude the results obtained in the period from days 57 to 70 from the evaluation. This is indicated by the vertical line in figure 1.

Although the total number of dead fruit flies at day 57 was higher in group 2 (#21) and group 3 (#23) compared to group 1 (#17) no statistical significant difference between the groups was seen. Both the relatively small group size, and the biological variation between the fruit flies, had a negative contribution to the outcome of statistical evaluation.

4 Conclusion

This study indicates that working in shifts may have a negative effect on the life span of the *Drosophila melanogaster*. Due to the strong similarities between the mechanism of clock cell function of the fruit fly and humans, it is reasonable to believe that working in shifts is also unhealthy for man.

5 Reference

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The frequency of Human papilloma virus genotypes in cervical cancer tissues

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Introduction

Cervical cancer is third most common cancer among women worldwide [1]. Serbia is among the countries with the highest incidence of cervical cancer in Europe [2]. Human papillomavirus (HPV) is demonstrated in more than 95% of cervical cancer cases. According to their oncogenic potential, HPV genotypes are classified in two groups: high-risk and low-risk. HPV genotypes 16 and 18 belong in high-risk group and they appear in 71% cases of cervical cancer [1, 3].

Objective:

The aim of this study was to determine the frequency of HPV genotypes in cervical cancer tissues of women in Serbia.

Materials and methods:

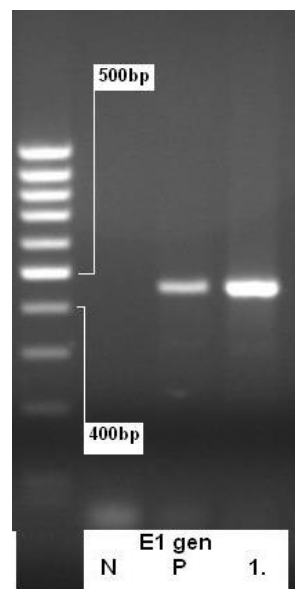
The study included 24 tissue samples from cervical cancer of women aged 36 to 75 years. The presence of HPV in the tissue samples was determined using PCR method for the detection of HPV DNA with GP1 and GP2 primers for E1 gene. The procedure involved deparaffinisation of tissue sections, DNA extraction, PCR, gel electrophoresis for visualization of the PCR product and genotyping of HPV using direct DNA sequencing method [2, 4, 5].

Results:

Out of 24 analyzed cervical cancer tissues the presence of HPV DNA was demonstrated in 70.83% samples. Genotyping revealed the presence of 6 HPV types 16, 18, 33, 45, 53 and 58. The most frequent genotype was HPV 16 (70.5%).

Conclusion:

The results of this study and further research will provide more detailed information about the distribution of HPV genotypes in cervical cancer tissues of women in our population. These information can be very useful in cervical cancer prevention.



Picture No.1 – Gel electrophoresis for PCR products analysis (N - negative control; P – positive control; 1. – sample)

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The influence of creatine on athletic performance of young adults

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1. Introduction

Creatine is a natural substance which is formed in the liver and the kidneys. In the mitochondria the creatine functions as an phosphate-acceptor. After the creatine has bound phosphate it can release the phosphate to an ADP and by doing so form an ATP. If an ATP releases its phosphate, and forms ADP, there is an energy transfer. By releasing the phosphate, creatine provides a higher concentration of ATP and a higher available storage of energy in the human body. This allows the muscles to perform better and make the muscle contractions last longer. For this reason creatine is widely used by athletes.

2. Objectives

The aim of the study was to examine the influence of creatine on the athletic performance of young adults.

Our hypothesis was that creatine would have a positive impact on the athletic performance of young adults.

3. Method

The study consisted basically of four parts: the selection of the participants, the conduct of the research, gathering the measurement results and the processing and analysis of the measurement results.

The first part involved the selection of the participants of the study. This was an essential part, because the participants had to have as few differences as possible in their physical appearance to make us able to draw the right conclusions. The participants were all boys in the age group 16-18 years of an approximately equal length and an approximately equal weight. Also diseases, allergies and other deviations that could affect the results of the study were taken into account. The participants who had these deviations had been excluded from the study. After we had selected 20 participants we divided them into two equal groups. One of these groups had to follow a carefully selected training program during the study.

The second part of the study was the way the study was conducted. The study was double-blind, placebo-controlled, randomized conducted with 20 participants. This means that both the researchers and the participants did not know who was classified in the creatine group (treatment group) and who in the placebo group (control group). This ensured that the placebo-effects that occur in a study in which drugs are dispensed in the two groups are equally high and by being so cancel each other. In order to carry out the study as accurately as possible, we have obtained help of a pharmacist when producing a placebo.

The third part concerned the collection of measurement results. We have tested the participants at the beginning of

the study at seven different aspect, a so-called baseline measurement .

The seven control tests were designed to assess the athletic performance of the participants. The tests were repeated after 28 and after 56 days.

The fourth part of the study was the processing and analysis of the measurement results. We have incorporated the measurement results in bar graphics so the eventual progression was easy to observe. We also have tested the average increases of the groups for statistical reliability. By comparing the t -values, which were found with the Eq.(1), with a value from a corresponding table ($t = 1.860$), it was determined whether the difference between the increase in a treatment group, and the increase in the control group was significant. We tested at a significance level of 5%.

$$t = \frac{\frac{\sum x_1}{n_1} - \frac{\sum x_2}{n_2}}{\sqrt{\left(\frac{\sum x_1^2}{n_1} - \frac{(\sum x_1)^2}{n_1} \right) + \left(\frac{\sum x_2^2}{n_2} - \frac{(\sum x_2)^2}{n_2} \right)}} \quad (1)$$

4. Results

The t -values for the seven control tests, which have been found for participants who have completed the training, are successively: 0.843, 0.827, 0.503, 0.308, -0.678, -0.013, 0.032 with a one-sided test at a significance of 5%.

The t -values for the seven control tests, which have been found for participants who have not followed the training program are successively: 1.055, -0.395, 0.429, 0.256, 1.014, 0.278, -3.147 with a one-sided test at a significance level of 5%.

5. Conclusions

The progress was, both in the training and in the non-training part of the treatment group at five of the seven points higher than in the control group.

However, progress in these five points was not significant enough to accept the declared hypothesis

The fat percentage increased significantly in participants who used creatine and did not follow the training program, compared to the control group. This was contrary to the declared hypothesis.

This study shows that creatine has no significant impact on the athletic performance of young adults after two months. However, it was found that creatine significantly increases the fat percentage of non-training young adults.

The Phi Sequence In Conifers Injuries

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1. Introduction

The golden ratio, also known as Phi is an irrational number, that can be found nearly everywhere in nature. Plants, animals and even the human beings are characterized by dimensional proportions which tend to Phi. These proportions represent the achievement of an optimum and a maximum of efficiency.

2. The idea of the project

The idea of the project started when I noticed that most of the conifers from the surroundings of Turda both from the mountains and hills began to dry. But more important, can the golden ratio represent an early method of diagnosis of the injuries and diseases of a coniferous tree?

3. Theoretical aspects

A healthy growing coniferous tree must have the ratio between the bigger and the smaller twig from the same branch and the ratio between the diameter of the bigger spiral and the diameter of the smaller spiral should be close to the Phi number.

The Phi number is easily obtained by making the ratio of two consecutive terms of Fibonacci's sequence or using this formula:

$$(1+\sqrt{5}) / 2=1,618033...$$

4. Experimental part

I started measuring the branches and twigs of the dried coniferous trees.

I chose two spruces- a healthy growing one and a dried one.

Healthy spruce h=230 cm	Branch(cm)	Twig(cm)	Ratio
	140,6	87,3	1,61
	54	32,1	1,68
	19,8	12,2	1,62

Dried spruce h=210 cm	branch(cm)	Twig(cm)	Ratio
	112,3	90,4	1,24
	49,7	24	2,07
	19	9,7	1,95

At a slightly big aberration from the Phi sequence, I took into account possible causes of the drying. Some of them might include:

The increasing of the temperature in the air and as well at the level of the soil

- The type of the soil
- Humidity
- The amount of the rainfall

I calculated the level or aridity of the surroundings of Turda with the Martonne Aridity Index:

$$Ia=P/T+10$$

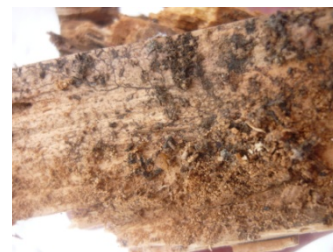
Ia=aridity index;

P=the annual amount of rainfall;

T=the annual average temperature;

Using, the formula, I obtained an index $Ia=33,4$. Considering the fact that for an optimal development of a coniferous tree, the index should be between 40 and 45, this might be the main cause of the drying of the coniferous trees. The lack of water and the high temperatures, especially during summer, attract different insects that harm the dried trees even more and attack the healthy coniferous trees.

After that, I looked under the dried coniferous tree's bark and at a closer look, it can be easily seen that the coniferous tree is suffering an injury caused by an insect. I identified the insect by the galleries the insect made and as well by the larva that was found under the bark.



The insect is the large pine weevil, *Ips typographus* and is characteristic to the spruce. The damages are produced by bugs and larva.

The development of the insects occurred in conditions of aridity, which were not noticed at the right time.

5. Solutions

As solutions, I suggest planting autochthonous species of conifers as well as improving the quality of the soil so it will retain the humidity.

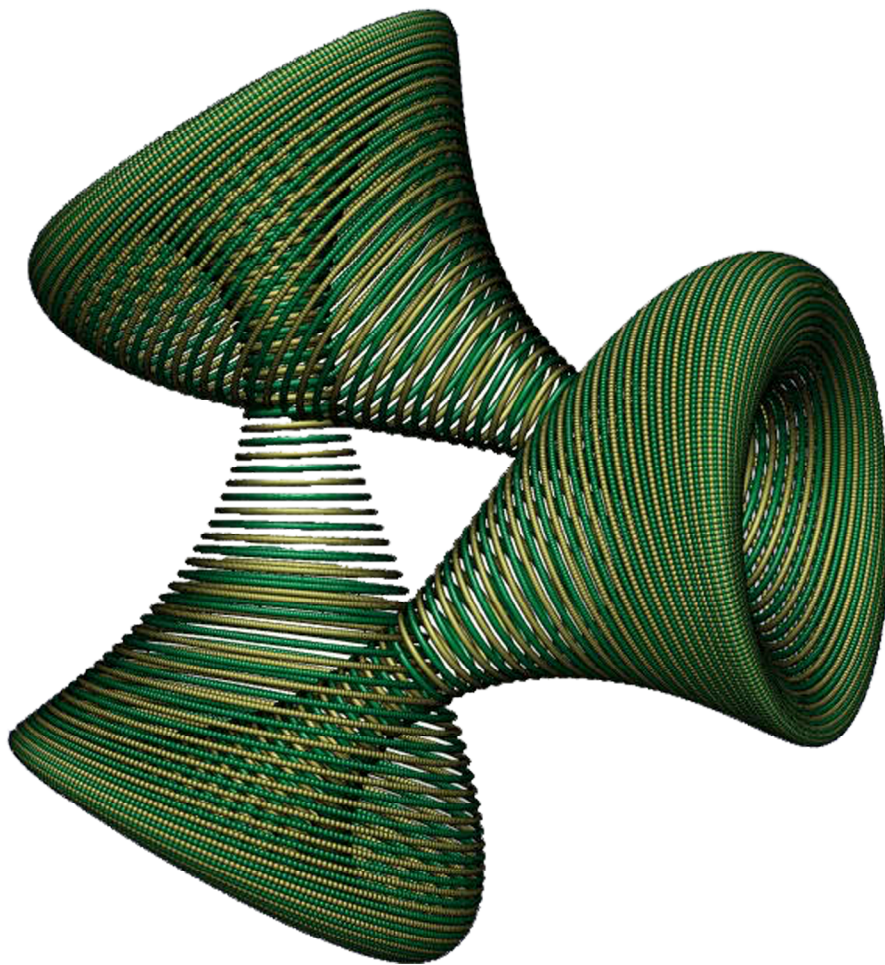
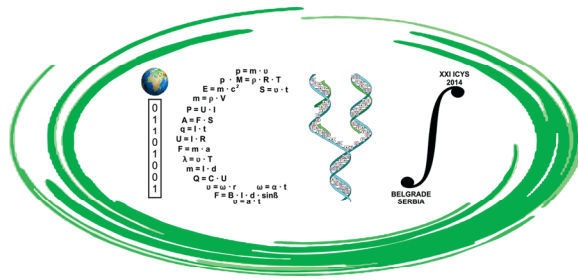
Also, cutting on time the dried coniferous trees so the attack of the pests won't have enough time to develop. Last but not least, monitoring permanently the health of the coniferous by measuring the branches and applying the golden ratio, which is a non-invasive measure that can be done at all times by anyone.

6. Conclusions

My observations have proved that the Phi sequence can represent an index of health condition of a coniferous tree. Noticing the aberrations in the calculus of the golden ratio can help us take action in advance and use the proper treatment. Also, the Phi sequence can determine, if used properly, if the coniferous tree is suffering of an injury or a disease.

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Mathematics

Amazing Property of Cyclic Polygons

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Japanese mathematicians have an old tradition: they write their own discoveries on small boards and then they hang it in monasteries [1]. In 1800 a remarkable theorem appeared on one of the boards in one Japanese monastery [2]: if we divide a cyclic polygon into triangles by drawing diagonals from one of the vertex and then inscribe circles in each triangles, the sum of radii of these circles doesn't depend on the initial choice of polygon vertex.

In our project we prove that the above-mentioned sum of radii of circles is constant for arbitrary division of polygon into triangles i.e. it is not necessary to divide polygon by diagonals from one vertex; we can take any division of polygon into triangles.

Theorem. For arbitrary division of cyclic polygon by triangles the sum of radii of the inscribed circles of these triangles is constant.

In the process of proving we use Lazare Carnot's (1753-1823) theorem [3]:

In any triangle, the (algebraic) sum of the distances (suitably signed) from the circumcenter to the sides, equals to the sum of the circumradius and the inradius.

To prove Carnot's theorem we use well-known Ptolemy's theorem:

In a cyclic quadrilateral, the product of the diagonals is equal to the sum the products of the opposite sides [4].

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Chaotic Bare-Bones Particle Swarm Optimization

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1) Introduction

In many cases, finding the optimum value is very crucial. Traditional method such as gradient based traditional method can be applied in order to find the optimum value. However, there are many complex cases that are not able to be solved using the traditional method. Metaheuristic is a coordinated strategy mathematics and is effective in finding the optima.

2) Experimental report

In this experiment we are using a metaheuristic method known as PSO (particle swarm optimization). However, there are flaws in using the PSO, the method requires manually inserted parameter tuning (c1&c2). As PSO depends on production of random values it can sometimes result a cluster of swarms stuck in a local optima. To overcome these, another concept known as "chaos" is applied to the iteration that fulfills the parallel criteria. This is also known as chaotic bare-bone PSO. Normal distribution is used to replace the manually inserted parameter. Based on the chaos theory, the purpose of applying chaos to the PSO is to re-spread each particle to take the chance of find better optima. The new formulation is tested using the bench mark function, to determine the effectiveness of the new method.

3) Theoretical model

PSO:

$$\vec{v}_i(t+1) = w \times \vec{v}_i(t) + r_1 c_1 (\vec{x}_{pBest} - \vec{x}_i(t)) + r_2 c_2 (\vec{x}_{gBest} - \vec{x}_i(t))$$

$$\vec{x}_i(t+1) = \vec{x}_i(t) + \vec{v}_i(t+1)$$

Bare-Bones PSO:

$$\vec{x}_i(t+1) = N \left[\frac{\vec{x}_{pBest} + \vec{x}_{gBest}}{2}, \left| \vec{x}_{pBest} - \vec{x}_{gBest} \right| \right]$$

Chaotic Bare-Bones PSO

$$: \vec{x}_i(t+1) = \mu \vec{x}_i(t) (1 - \vec{x}_i(t))$$

4) Result

The following result shows that by re-spreading the coordinates using the chaos prevent the formation of premature convergent, thus, we can have the chance of finding better optima. The table below shows that CBBPSO outperformed PSO and BBPSO.

Benchmark Function	Minima	PSO		BBPSO		CBBPSO	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Beale's	0	2.11E-02	2.25E-02	5.10E-31	1.70E-30	1.59E-30	6.67E-30
Bochachevsky1	0	1.04E+00	7.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Griewank	0	8.56E+01	3.08E+01	1.42E-02	1.37E-02	7.55E-03	8.56E-03
Ackley	0	1.48E+01	1.37E+00	3.27E-01	7.30E-01	3.92E-01	8.29E-01
Quartic	0	4.70E+00	3.08E+00	2.30E+00	1.31E+00	7.06E-03	2.28E-03

Table 1 Comparison Result

5) Conclusion

By using the chaos factor, we answer to the earlier problems of using PSO. The Chaotic bare-bone chaos method no longer requires manual insertion of parameter in the equation and also able to prevent the swarm to stuck in local optima.

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Cohomology of finite groups without homological algebra.

N.N Mostovskiyy and D.R. Fialkovskiy

This note is devoted to a proof of explicit formulas for the homology and cohomology of a finite group that uses only simple operations such as quotient, tensor product and G -invariants. These formulas are interesting because they do not use the notion of a complex. In other words, they do not use homological algebra at all. At the end of the note we prove a few well-known statements in order to show how these formulas can be used.

The main goal of this note is to prove the following “elementary” formulas for homology and cohomology of a finite group

$$H^n(G, M) \cong \frac{\left((\mathbb{Z}G/\mathcal{N})^{\otimes n} \otimes M \right)^G}{\mathcal{N} \cdot \left((\mathbb{Z}G/\mathcal{N})^{\otimes n} \otimes M \right)}, \quad H_n(G, M) \cong \frac{\left(\Delta^{\otimes n+1} \otimes M \right)^G}{\mathcal{N} \cdot \left(\Delta^{\otimes n+1} \otimes M \right)},$$

where $n \geq 1$. Moreover, we prove similar formulas which do not look so elementary but they still do not use notion of a complex.

$$H_n(G, M) \cong \frac{\text{Ann}_{\mathcal{N}}\left(\Delta^{\otimes n} \otimes M \right)}{\Delta \cdot \left(\Delta^{\otimes n} \otimes M \right)}, \quad H^n(G, M) \cong \frac{\text{Ann}_{\mathcal{N}}\left((\mathbb{Z}G/\mathcal{N})^{\otimes n+1} \otimes M \right)}{\Delta \cdot \left((\mathbb{Z}G/\mathcal{N})^{\otimes n+1} \otimes M \right)},$$

where $n \geq 1$. The proof of these formulas is essentially based on the Tate cohomology theory of finite groups.

Growing Trees in Padovan Sequence For The Enhancement of L-System Algorithm

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$P(n)$ is the value of the n th term in Padovan sequence, $S(n)$ is the sum of the values from $P(0)$ until $P(n)$.

1. Introduction

I have a lot of interests in two things: sequences and trees. Therefore, I studied deeper about sequences and I found out that sequences aren't just arithmetical and geometrical sequences. Above all sequences, I was intrigued about Padovan sequence. Then, I was thinking whether we can model the tree and plant structures using sequences, and I found the Lindenmayer System during my research. To be innovative, I tried to combine the Padovan sequence and Lindenmayer System.

2. The Purpose of The Investigation

The purpose of my investigation is to innovate the conventional L-system, growing some trees and plants in my surroundings. I expect that mathematical sequences, like the Padovan sequence can be used to do so, computationally.

3. Method of The Investigation

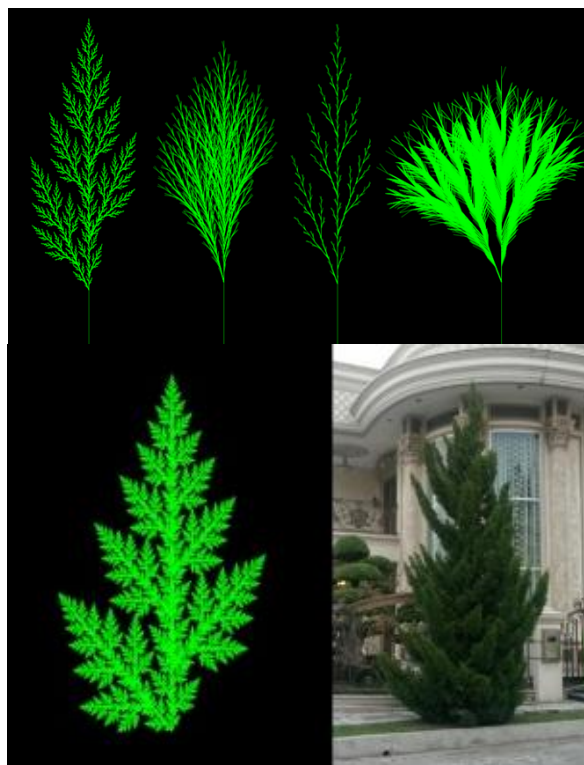
In order to change the conventional L-system algorithm into the Padovan L-system, I commanded the computer to draw another branch in the middle and made the conditional of the left or right rotation depending on the n th iteration. After that, I changed the parameters in the coding as well, so that the mathematical calculation, which is checking whether it is a Padovan tree or not, would fit the generated tree.

4. Theoretical Review

Lindenmayer system is a parallel rewriting system which consists of an initial alphabetic symbols string "axiom" and rules of production. Padovan sequence is a sequence that is in the generalization form of Fibonacci sequence, a famous sequence that is related closely to natural geometry. These are Padovan sequence first few values: 1,1,1,2,2,3,4,5,7,9,12,... (sequence A000931 in OEIS). The sequence is described by the sum of the third and second value before the $P(n)$. One best "new" formula that I've discovered is

$$P(n) = S(n-5) + 2 \quad (1)$$

5. Result of the experiment



The results of my experiment are various generated trees from the Padovan Lindenmayer System. I have matched some of them to the trees in my surroundings too. However, some of them might not exist in real life as well.

6. Conclusion

From this experiment and research, I can see that, through algorithms and computation, my interest in sequences and trees has given some interesting results for growing trees and plants in my hometown. This, I believe, may lead to more interesting and further advancement in computing of the visualization of the complex shapes in nature, such as trees and plants. A possible contribution to the fascinating and amazing recent trend of computation is for animations of real objects, as celebrated in many applications - be it movies or pictures etc.

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Factorization by Difference of Squares

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Factorization of large numbers into prime factors is a fundamental problem for modern mathematics. The largest prime number is known to be

$$2^{57,885,161} - 1$$

which was found in 2013 [1]. This number consists of 17,425,170 digits. The prime numbers which consist of more than 1000 digits are called titanic primes [2]. To find titanic prime the formula of a French scientist Mersenne (1588 – 1648) is used:

$$M_n = 2^n - 1$$

According to his hypothesis there are infinitely many prime numbers in this set. Obviously not all M_n is prime. The above mentioned number is only the 48th Mersenne prime. To find Mersenne prime a special mathematical branch is formed with a name – Great Internet Mersenne Prime Search – GIMPS [3]. Evidently, to find such primes powerful calculating machines are used.

But what was happening in the old times? No computers, no calculators...

Our project concerns one historical problem, which was given to a well-known mathematician Pierre de Fermat (1601 – 1665) [4]. He received a letter in which he was asked:

is the number

$$100,895,598,169$$

prime or composite number?

The author of this question probably should be Mersenne. Fermat found the solution; he stated that the given number is a product of two primes:

$$898423 \text{ and } 112303.$$

Unfortunately history does not have any known way or method to how Fermat solved this problem.

In our project we represent the method according to which it is possible to solve Fermat's problem. We call this method Factorization by Difference of Squares.

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Integer Triangles

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A Pythagorean triangle is a right triangle with integer side lengths. A Pythagorean triple is a triple of positive integers a , b , and c such that a right triangle exists with legs a , b and hypotenuse c [1]. By the Pythagorean theorem, this is equivalent to finding positive integers a , b , and c satisfying

$$a^2 + b^2 = c^2$$

It is well-known that Pythagorean triple is given by arbitrary integers l , m and n as follows:

$$a = (n^2 + m^2)l; \quad b = 2mnl; \quad c = (n^2 + m^2)l.$$

These formulas are obtained by rational parameterization of the unit circle [2]. For this geometrical method is used. The main idea of which implies to draw a secant line from the point $(-1; 0)$ on the coordinate plane and find another intersection point with unit circle $x^2 + y^2 = 1$.

In our project all integer triangles with 60° and 120° angles are investigated. Formulas are obtained for sides of such triangles explicitly.

Theorem 1. The sides of integer triangles with 120° angle are expressed by the following formulae:

$$a = (n^2 - m^2)l;$$

$$b = (m^2 + 2mn)l;$$

$$c = (m^2 + mn + n^2)l;$$

where n , m , l are integers.

Theorem 2. The sides of integer triangles with 60° angle are expressed by the following formulae:

$$a = (n^2 - m^2)l;$$

$$b = (n^2 + 2mn)l;$$

$$c = (m^2 + mn + n^2)l;$$

where n , m , l are integers.

In our project we use algebraic method of rational parameterization, by which obtaining of Pythagorean triple is also possible. Our method is different from the above mentioned geometrical method and it is not known in mathematical literature.

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Mixed Stirling Numbers of the Second Kind

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Accepted by Ariaian Young Innovative Minds Institute, AYIMI

Abstract:

The Stirling numbers of the second kind $\binom{n}{k}$ count the number of ways to partition a set of n labeled balls into k nonempty unlabeled cells. As an extension of this problem we consider $b_1+b_2+\dots+b_n$ balls with b_1 balls labeled 1, b_2 balls labeled 2, \dots , b_n balls labeled n and $c_1+c_2+\dots+c_k$ cells with c_1 cells labeled 1, c_2 cells labeled 2, \dots , c_k cells labeled k and then we count the

number of ways to partition the set of these balls into nonempty cells of these types. We give a recursive formula for the answer of the latter problem. As an application, for a positive integer m we evaluate the number of ways to write m as the form m_1, m_2, \dots, m_k , where $k \geq 1$ and m_i 's are positive integers greater than 1.

Pareto analysis of maternal deaths

Identifying effective decisions to reduce maternal deaths

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1. Introduction

For the past few years, Romania has made significant progresses in reducing the maternal deaths, considering that in the '90s the rate was 26.9%. After 2000 the rate reaches below 20% and continues to decline steadily to 16.7% in 2003. Despite this generally positive trend, our country has continued to have the highest rate of maternal deaths of all European Union countries.

2. The idea of this research

The idea of the project is about that maternal deaths are unexpected and hardly warned. This study takes into account all possible causes of other maternal deaths and examines one each of them and conduct them into an efficient and mathematical analysis.

3. The aim of this research

The aim of this research is to determinate a study that started from the idea that the maternal deaths are determined by many factors among which plays a special role for supply-related causes. Starting from this premise the study was designed to achieve the following objectives:

- identifying social, health, economic and cultural risk factors that affect chances of survival of children at birth;
- identify the causes of under-utilization of health and social services to children families in the target group;

4. Theoretical aspects

To find out the exact causes and their influences, I used The Pareto Analysis. The Pareto analysis is a mathematical creative technique of looking at causes of problems because it helps stimulate thinking and classifying tasks, small in number, but with a significant effect. It is based on the Pareto principle (also known as the 80/20 rule, formalized by the Italian economist, Vilfredo Pareto, in the 20th century), under the assumption

that, in all situations, 20% of causes determine 80% of problems.

5. Method of investigation

As methods of investigations I have been monitored the local situation from February to April 2014 at the Statistical Office of The Municipal Hospital Turda and I have been centralized the data (like number of deaths in this period, their causes and what role played the parents into this); then I used the dates to conduct my analysis following the Pareto Rule.

In conducting a Pareto Analysis, applied to the risk of maternal deaths, the first phase is concerned with identifying possible causes which can cause a maternal death. I have applied the idea of brainstorming. The aim is to obtain a result which is inferior as quality. The second phase consists of choosing an appropriate period of time that I would like to carry out my analysis and then perform the evaluation. The objective is to make sure that time is precisely measured while the quality control measures will be taken.

The third phase is limited and represented by designing the graphs. In designing the graphs I used several defined functions starting from the experimental data to find the best solution which will lead to the decreasing of number of the maternal deaths. After subtotaling numbers for each of the causes of low quality, these numbers are summed to obtain the total number of defects. The fourth and last phase is concerned with the interpretation and application of the results plotted.

6. Conclusion

This study confirmed that the causes of maternal deaths are vast and varied. The main causes of maternal deaths are influenced by the demographics data and the socio-economic level. To find out the optimal solutions and the efficient decisions take into account these issues.

Solving a cubic equation using a single radical

Ahtyamov Danil

The calculator used contains the following buttons $1, +, \times, \div, \sqrt[n]{}$ for any n . The calculator calculates numbers with absolute precision and has unlimited memory. When dividing by 0 and when extracting a root of an even power from a negative number, the calculator returns an error message. Then it is interesting to find out, roots of what cubic equations with rational coefficients we can find on the calculator used, considering that the finding of the radical occurred only once and in the power of three.

Lemma: *The numbers that can be found on the calculator used, considering that the finding of the radical occurred only once and in the power of three, is in the form of $a + br + cr^2$ where r is real and a, b, c and r^3 are rational.*

Theorem: *Cubic equation $x^3 + px + q = 0$ with rational and it is not rational. It is sufficient to that $\frac{1}{a+br+cr^2} = h(r)$ for some polynomial h with rational coefficients. As polynomials $x^2 - r^2$ and $a + bx + cx^2$ are mutually simple, polynomials like coefficients has a root in the form of $a + br + cr^2$ with rational a, b, c, r^3 and real r , if and only if it has either a rational root, either $D \geq 0$ and number \sqrt{D} is rational (where $D = (\frac{p}{3})^3 + (\frac{q}{2})^2$).*

This theorem can be used to check whether the cubic equation $wx^3 + ux^2 + vx + s = 0$ with rational coefficients has a root in a form of $a + br + cr^2$, where the numbers a, b, c and r^3 are rational and r is real.

Triangle Sides Inequalities

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The project is dedicated to the inequalities, which contain triangle sides. By using our method such type of inequalities are solved. The following inequalities are proved for triangle's sides a, b and c :

$$1. \frac{a}{b+c-a} + \frac{b}{c+a-b} + \frac{c}{a+b-c} \geq 3;$$

$$2. (a+b-c)(b+c-a)(c+a-b) \leq abc;$$

$$3. 2(ab+bc+ca) > a^2 + b^2 + c^2 ;$$

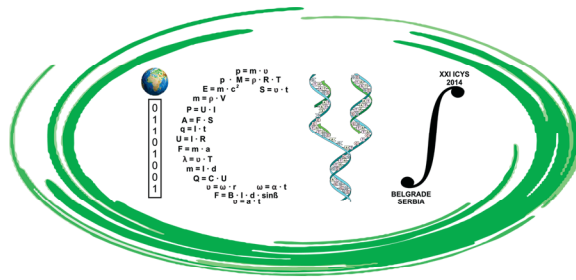
$$4. 2\left(\frac{a}{b} + \frac{b}{c} + \frac{c}{a}\right) \geq \frac{a}{c} + \frac{b}{a} + \frac{c}{b} + 3;$$

$$5. a^2b(a-b) + b^2c(b-c) + c^2a(c-a) \geq 0.$$

The problem 4 is the problem № M1107 from the journal [1]. The solution of which is given in [2] by using graph of function and derivative. The problem 5 was given at XXIV International Mathematical Olympiad in France [3], which was the most difficult for participants. With the method represented by us all above mentioned problems are solved relatively easily. Also by using our method it is possible to get new inequalities for triangle sides.

References:

1. Журнал "Квант" №6, 1988
2. Журнал "Квант" №10, 1988
3. <http://www.imo-official.org/>



$$\begin{aligned}
 & p = m \cdot v \\
 & p \cdot M = \rho \cdot R \cdot T \\
 & E = m \cdot c^2 \qquad S = v \cdot t \\
 & m = \rho \cdot V \\
 & P = U \cdot I \\
 & A = F \cdot S \\
 & q = I \cdot t \\
 & U = I \cdot R \\
 & F = m \cdot a \\
 & \lambda = v \cdot T \\
 & m = l \cdot d \\
 & Q = C \cdot U \\
 & v = \omega \cdot r \qquad \omega = \alpha \cdot t \\
 & F = B \cdot I \cdot d \cdot \sin\beta \\
 & v = a \cdot t
 \end{aligned}$$

Physics

Analysis of the main parameter changes generated by laser trimming of electronic components

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1. Introduction

In the twenty-first century, our society has grown in such a matter, that the evolution of the electrical components that sustain our growth has not met the needs of the rapidly increasing technological demands of the modern man. Due to a large industrial growth, the industry is in need of smaller and more efficient components. In that miniaturization of the components, their quality decreases also. One of the most economical and accurate methods to reach a components best performance, is the method of laser trimming^[1], which is the subject of this paper. In the research, different types of capacitors and resistors were trimmed with an Nd³⁺:YAG laser. The samples were measured before the irradiation, after, and after they cooled down. Their characteristics were later graphed in MatLab R2012b, and the interaction area examined by a MBS-9 light microscope. The goal was to achieve a change in the component's resistivity and capacity, respectively.

2. Method

The equipment consisted of a Q switch Nd³⁺:YAG laser, microscope, a focusing system, measuring equipment, and a sample holder. Single and multipulse regimes (1-10 pulses) were used in the experiment. The lasers wavelength was $1.064\mu\text{m}$, and the energy of a single pulse was $E = 19.4\text{mJ}$, the duration of the pulses was 8 ns. The number of exposures to the laser beam, and the allocation of the same, differ from component to component, depending of their size, type, and isolation. All resistors were exposed to 13 pulses, and all capacitors except C_2 , were exposed to 6 pulses. Capacitor C_2 was exposed only once. Due to different regimes used in the experiment pulses per component, are seen in different patterns.

Table 1. Trim parameters by component

Trim:	A	B	C
R_1	1 x E	2 x E	-
R_2	3 x E	10 x E	-
R_3	1 x E	2 x E	10 x E
C_1	1x E	2 x E	3 x E
C_2	1 x E	-	-
C_3	1 x E	2 x E	3 x E

3. Results and Discussion

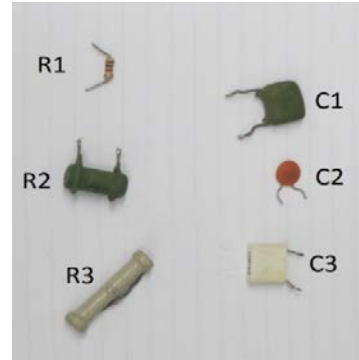


Figure 1. Macroscopic view of the components



Figure 2. Microscopic view of trims A, B, C of C_1 (M=56x)

The key parameters of all the components have changed. The nichrome-wire resistors (R_2 , R_3) haven't experienced an large increase in resistance, similarly the carbon-based resistor's resistance increased, but slower, due to the firm ceramic coating protecting the component. All of the resistors, after the first interaction, decreased in resistance, and from that point started increasing, while the capacitor's capacities started increasing immediately. The capacity of the components, has increased significantly in all cases.

4. Conclusions

The efficiency of this productive and post-productive method is strongly dependent from the type of the component, its size, power, and significantly, its isolation and principal material. In the case of R_1 , which is a carbon-based resistor, a minimum change of resistivity has been detected. This is due to the resistors thick isolation, although an increase in resistivity of this type of carbon due to laser trimming has been noticed in numerous researches.

5. References

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Big drops

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1 Introduction

Destinies of raindrops flying from sky to earth are very different. Some of them falling down in warm air layers may evaporate, others can unite and work together to reach the ground. But there are no big drops among all raindrops. But it happens that hailstones can be the size of a fist, why are not there same large drops? I decided to understand the reason of not existence of heavy rain.

2 The purpose of the investigation

The initial purpose of the work was to obtain large drops and to observe their behavior at falling. Also we had to observe the droplet shape and the process of decay, which occurs at its flight.

Many people consider that the drop in flight looks the way artists draw it, encyclopedias say that the drop takes the form of "buns" flattened at bottom. As a result, I found that to some extent both are right.

3 Method of the investigation

The experiment consisted of several parts:

1. creation of a very large drop and watching its fall ;
2. watching ordinary drops fall, and watching the fall of large droplets and their division.

In order to get a very big bubble I filled the water to the balloon and broke the balloon. Ball shell bursts at sonic speed, so the water initially has the shape of a drop, but it divides during falling into much smaller droplets. That droplets, in turn, greater speed dialing begin to disintegrate. After experimenting with small drops, I noticed that very small balls remain in the fall because the force of air resistance is much less than the Laplace pressure, but their size increases, they become like "buns". Large droplets flatten "cakes" and inflated as parachutes. As this miniature water chute inflated with air, the film forming it becomes thinner, and eventually breaks, pierced by air jet. And then it breaks down into small droplets, which already have its own destiny.

But there is another type of decay drops. It can be called streaming, since the second drop formed from the merger of two tailings left by a drop when flying in the air layer. After their union they tend to come off due to the fact that the surface tension forces tend to minimize the surface. We could see this effect by experience.

Results and conclusion

As a result, I empirically found that droplets can be large, but they divide during the flight. shooting pictures demonstrate division of the droplets and how they form small droplets in flight.

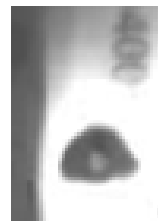


Fig.1 Shape of a falling drop.

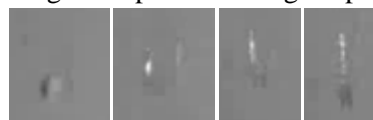


Fig.2 Division of falling drop.



Fig.3 Very big drop.

Chocolate hysteresis

Marcin Taton

Creative Group Quark, Katowice Poland

1. Purpose

In chocolate we can observe the phenomenon of thermal hysteresis what means that once it is molten, it will not solidify again in the same temperature but it will remain in a state of liquid even if overcooled to much lower temperature than the first melting temperature. In my experiments I was trying to determine what factors and conditions the hysteresis depends on and what is the inner structure of chocolate.

2. Experiments

2.1 Practical part

The experiments were carried using differential scanning calorimeter (DSC). (Nearly) All the experiments were carried in same conditions in cycle in which the chocolate sample was melted, solidified and melted another time. Results are presented on plots generated by DSC. The peaks on these plots represent in this case phase transitions.

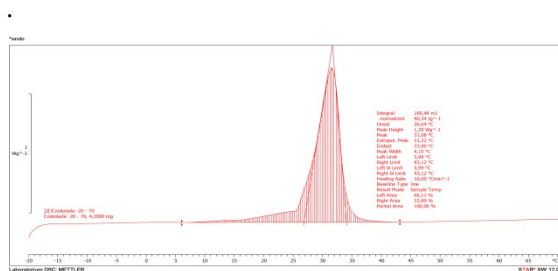


Fig. 1 Melting

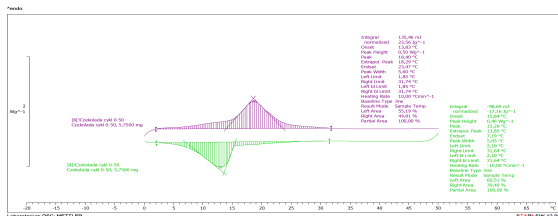


Fig. 2 Solidification and second melting

Beside confirming hysteresis occurrence in chocolate, in my experiments I also proved that none of chocolate ingredients degrade during the experiment and that the main ingredient responsible for hysteresis is cocoa butter. I also tempered the chocolate and checked if hysteresis depends on heating/cooling speed.

2.2 Theoretical explanation

On the base of my experiments and other resources. I managed to draw some conclusions about chocolate's structure. One of the most important is that inner structure of leaving factory chocolate is metastable. In melting process chocolate's structure is destroyed and when it solidifies it endeavours to reach fully stable structure. As the ingredient responsible for hysteresis is cocoa butter, the way in which its molecules are arranged mainly decides about type of chocolate's inner structure and also on its physical properties. Cocoa butter contains triglycerides which can take different configurations. In case of chocolate they take so called tuning fork configuration. Stability of inner structure and some of chocolate properties will vary depending on the way cocoa butter's molecules are packed, and even on their gradient.

3. Conclusion

Hysteresis occurs in chocolate and in cocoa butter. There also is change in lipid molecules arrangement and in physical properties of sample. Cooling and heating rate have significant influence on the process. Also ingredients of chocolate have great influence on the phenomenon but because of their great diversity it is hard to state which ingredient in what way affects hysteresis.

Resources

- H. Szydłowski „Pracownia Fizyki”
- http://www.courses.psu.edu/fd_sc/fd_sc400_jnc3/lipids/Tempering.ppt
- http://luluschocolate.com/raw_chocolate_physics.html

Chua's Circuit

Przemysław Słota

Supervisor: Urszula Woźnikowska-Bezak

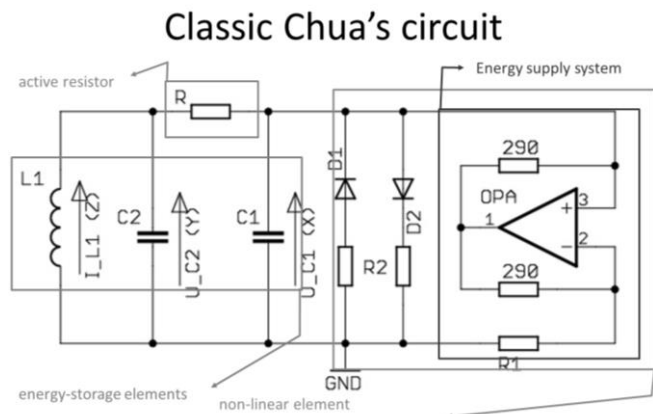
Creative Group QUARK, The Youth Palace in Katowice, Poland

1 Introduction

It is known that a few of electrical circuits shows chaotic behavior. So, how does it work? Which parameters are the most important?

2 Theoretical part

What is the Chaos? It is often described as instability of results of the system equations, on its initial parameters. This extraordinary behavior is caused by characteristics of the nonlinear element



<http://pl.wikipedia.org/wiki/Plik:Chuacirc.png>

Fig. 1. Schematic view of a Chua's Circuit

Characteristics of nonlinear part is given by this formula:

$$G(X) = \begin{cases} -X, & |X| \leq 1 \\ -[1+b(|X|-1)] \cdot \text{sign}(X), & 1 < |X| \leq 10 \\ [10(|X|-10)-(9b+1)] \cdot \text{sign}(X), & |X| > 10 \end{cases} \quad (1)$$

Where b is a factor based on circuit parameters.

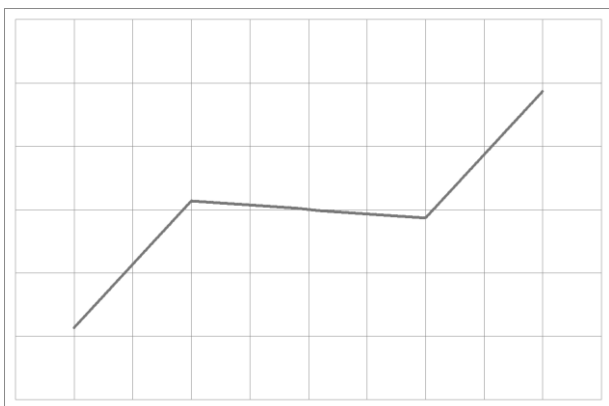


Fig. 2. Graph of characteristics of the nonlinear element

3 Experimental part

3.1 Own version of Chua's circuit

My version of Chua's circuit is made on a prototype board, which allows me to easily change parts. After some adjustments it is able to generate oscillations. The most important adjustments are changing the value of R and R1.

3.2 Experiments

The most important experiment is check if waveforms which are generated in XY plane (voltage on the capacitors (C1 and C2)), are actually form a non-periodic attractor. It is possible only when circuit shows chaotic behavior. For some parameters, my circuit generate attractor which is shown on Fig. 3. (it is similar to The Lorenz attractor).

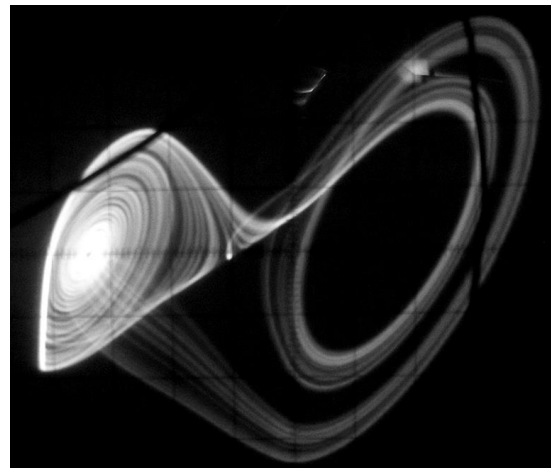


Fig. 3. Attractor in XY plane

Other experiments are: determining of the I(U) characteristics of the nonlinear element (diodes part), and synchronization of chaotic circuits.

4 Conclusion

The main source of nonlinearity in the system are diodes connected antiparallel.

Electrocaloric Effect in SbSI

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1 What are caloric effects?

Stages of electrocaloric cooling:

1. Electric field is adiabatically applied, working body becomes electrically polarized, polarization entropy decreases.
2. Heat entropy has to rise – rises the temperature of the body.
3. Working body radiates its excessive heat to the environment.
4. Electric field is adiabatically removed – polarization entropy rises
5. Heat entropy decreases –temperature of the body drops below its initial value.

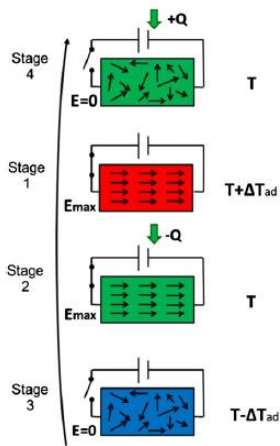


Fig. 1. Stages of an electrocaloric effect process [1]

2 Why SbSI?

In May 2013, M. A. Hamad published an article on „Detecting giant electrocaloric properties of ferroelectric SbSI at room temperature”. He prognosed that SbSI electrocaloric cooling efficiency may be nearly 10 times as high as it is in case of other materials used in such processes. Hamad based on literature data, the main goal of my work is to check his predictions experimentally.

3 My Research

I have made two kinds of experiments: I have used formulae derived by Hamad and experimentally obtained SbSI parameters and I have directly measured temperature change when electric field is applied (1000 V, sample length 0.01 m).

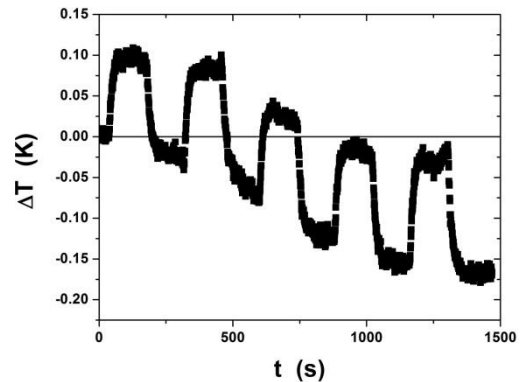


Fig. 2. My experimental data on SbSI electrocaloric temperature changes ($\Delta E=0.1$ MV/m)

4 Conclusions

Experimentally measured electrocaloric temperature changes are even higher than theoretical predictions on SbSI efficiency as an electrocaloric cooling working body [2]. SbSI may be an extremely effective electrocaloric cooling working body, especially when low voltages are applied.

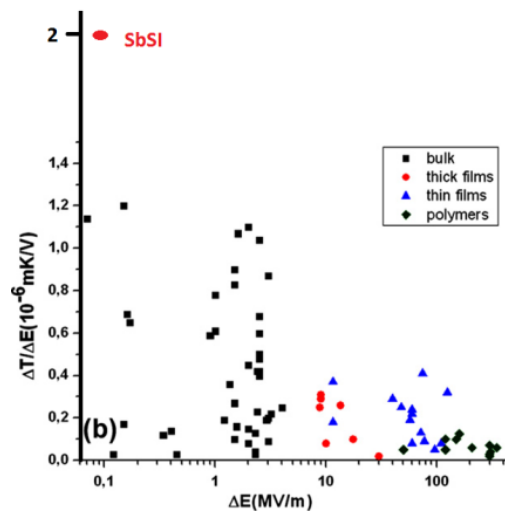


Fig. 3. EC temperature change for various materials [1] with SbSI placed according to my experiments.

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- [1] M. Valant, Electrocaloric materials for future solid-state refrigeration technologies, Progress in Material Science (2012) 980.
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Experimental determination of KDP crystal growth conditions using home-made equipment

Students: Maria BABAN, Gabriel BABAN

Advisor: Alexandru IOVANOVICI, Ph Dc., Sandu GOLCEA, Ph D

I. INTRODUCTION

CRYSTALS are a special type of solid substances with a broad range of applications from fine mechanical movements to high power lasers and not to forget mentioning decorative and aesthetic purposes. Most of the modern applications of crystals require a highly pure and stable structure free of any mechanical stress in the crystalline network. Industrial requirements pose a significant pressure on the design and validation of various tools and methodologies for obtaining a perfect balance between the quality of the final product and speed of growth, not to forget the size of the final product. A large variety of substances can be crystallized with various results regarding outer morphology and in the same time chemical, mechanical and optical properties. Of these, literature mentions most of the time the Ammonium Dihydrophosphate (KDP) as a substance of preference [1]–[8].

Industry and science is growing crystals in a systematic and controlled manner for more than a century but the liberalization of the markets and easier access to literature and technology has made in the last years possible for individuals to enter into this research with quite good chances of success.

II. PURPOSE OF THE INVESTIGATION

Our research is geared towards a multifactorial experiment for investigating the impact of various parameters over the quality of the final crystal and in the same time determining a methodology which can yield a high quality product using the so-called “home-made equipment”. A cursory perusing of the literature suggests that the key factors which influence the quality are: purity of the substance and solvent, temperature slope, rate of revolution, seed purity and cutting profile and not at last the selection of one of the two big methodology: constant temperature or constant concentration [9], [10].

III. METHODOLOGY

Our experiments are carried out using a custom deigned and built installation with advanced regulation and logging possibilities for each of the key identified factors: temperature slope and rate of stirring.

The main methodology we used for growing crystals the Czohralsky method, based on decreasing the temperature of the liquid until compounds of the KDP will start to form a solid crystal structure. A saturated solution of medical grade KDP was heated at $80^{\circ}C$ and various cooling profile (slopes) were selected, from $2^{\circ}/h$ and up to $0.5^{\circ}/h$. The final temperature was the room one, at 20° . A high precision PID control loop was implemented on dedicated embedded hardware build around an Arduino platform. Logging and reporting was done using sensitive I2C thermometers placed in key points of the installation and data were transmitted via an industrial grade XBee connection for real-time monitoring and charting.

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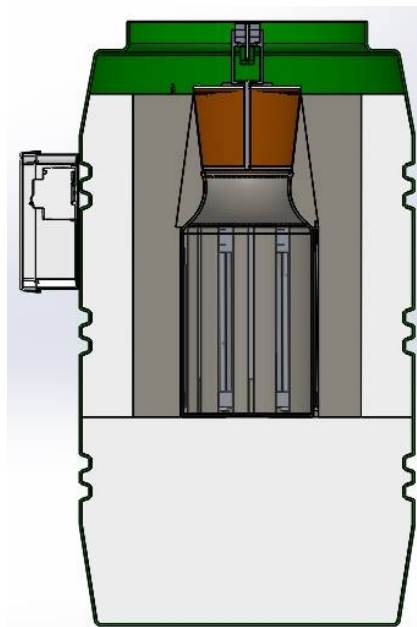


Figure 1. Section view of the custom built growth installation

IV. RESULTS AND CONCLUSIONS

Current research is part of a larger ongoing endeavor in exploring and quantifying the impact of various parameters on the quality of the final crystal. Experiments were designed and carried out on a highly pure KDP solution and the temperature slope was swept in a $[0.5 - 2]^{\circ}C/h$ range. The obtained crystals a consistent with the expected results. Further investigation are going to be carried out on the inner structure of the crystals by means of X-Ray topography.

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FABRICATION OF LIQUID LENS IN WHICH MAGNETIC FIELD ADJUSTS FOCAL LENGTH

Göksu Özdemir

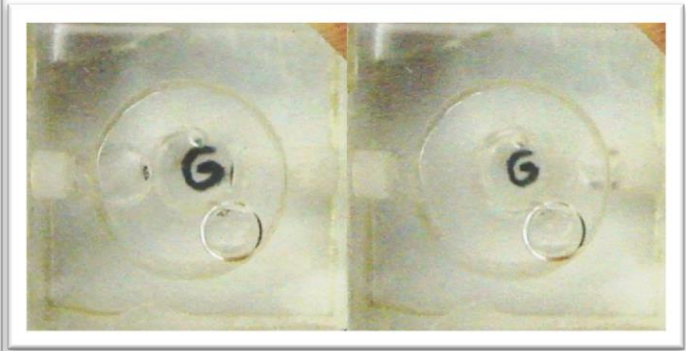
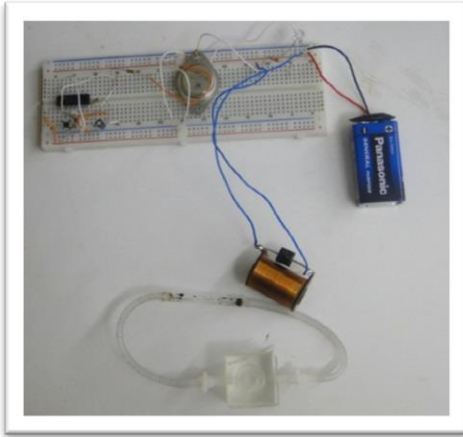


Lenses are sourced from the refraction of light through the transparent material which is rigid. In this project, we aimed to generate quick adjustable focus with liquid lens which is controlled by iron balls in magnetic field and surrounded by magnetic liquid.

According to our purpose, two transparent immiscible liquids which have different refraction indexes were determined. In trials, these transparent liquids show that they are not dissolved in water. The selected liquids are brought together with serum nozzle and glass pipe into a narrow channel. Movement occurring due to magnetic force is made more stable by addition of metal balls in magnetic liquid stayed into the glass pipe. Triggered circuit formed by magnetic force activates the magnetic piston system.

In our system, the most important innovation is the usage of iron ball which is surrounded by magnetic liquid as a piston. Iron ball under magnetic field affect should act more determined and hinder magnetic liquid to move away from the intended area.

Key words: Magnetic liquid, liquid lens, adjustable lens.



Liquid lens

Gas analysis using ultrasonic

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1 Introduction

To date, there is no simple sensor for direct real time measurement of the concentration in gas mixtures. While there are a variety of different probes for gas measuring, these are usually limited to a particular gas or a group of gases. For example with a lambda probe it is only possible to measure oxygen, as metal oxide semiconductor gas sensors are only suitable for certain flammable gases. Although it is possible to examine a variety of different gases by a gas-phase chromatograph, this measurement takes some time so that the concentration determination is not performed in real time. In addition, such analyzers are usually very large and expensive, which makes mobile use or integration in chemical plants very difficult.

The aim of this project is the development of a small as possible, sensitive and inexpensive sensor for determining the concentration of gas mixtures. Moreover, within certain limitations the measuring method is suitable for direct determination of the molar mass and the type of a clean gas. Due to the small size and the high sensitivity the sensor is suitable for both of these, measurements in industrial plants, as well as for detecting the change of a gas composition. Thus, especially in Occupational Safety little sensitive detectors and environmental measuring instruments for determining air quality and composition can be realized.

2 Measurement principle

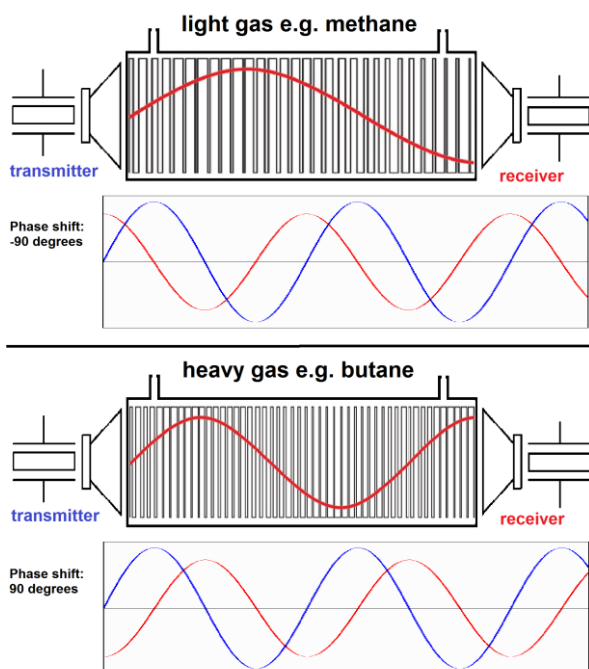


Fig. 1: Measuring principle of phase measurement

Indeed there are already ultrasonic measuring devices for measuring the concentration in liquids. In this application, the speed of sound is determined by time-of-flight measurement, which is less problematic in liquids due to the high speed of sound. However, to achieve certain sensitivity in gases, a measured distance of several meters is required.

Measuring the phase shift, hence the degree of delay of the received signal relative to the transmitted signal, allows the continuous transmission of the ultrasonic wave, whereby the distance can be reduced to a few millimeters even at a high sensitivity.

3 Implementation

In order to reduce chamber resonances and interferences the probe is build out of sound-absorbent foil. A 32bit microcontroller programmed in C measures the phase shift and shows the value as well as the calculated gas concentration on a 3.2" lcd.

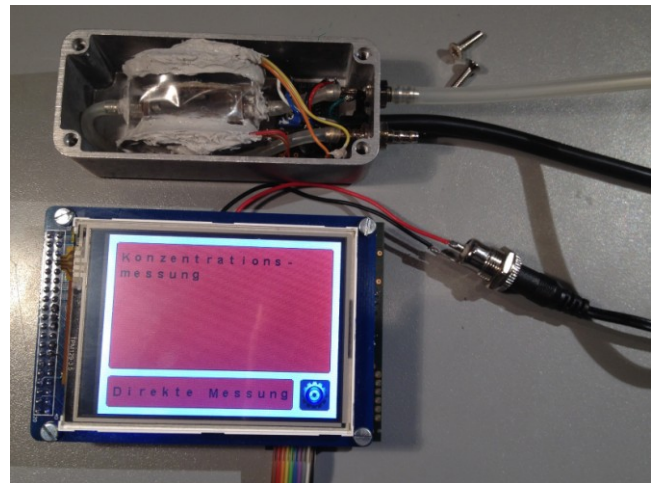


Fig.2: Measuring setup

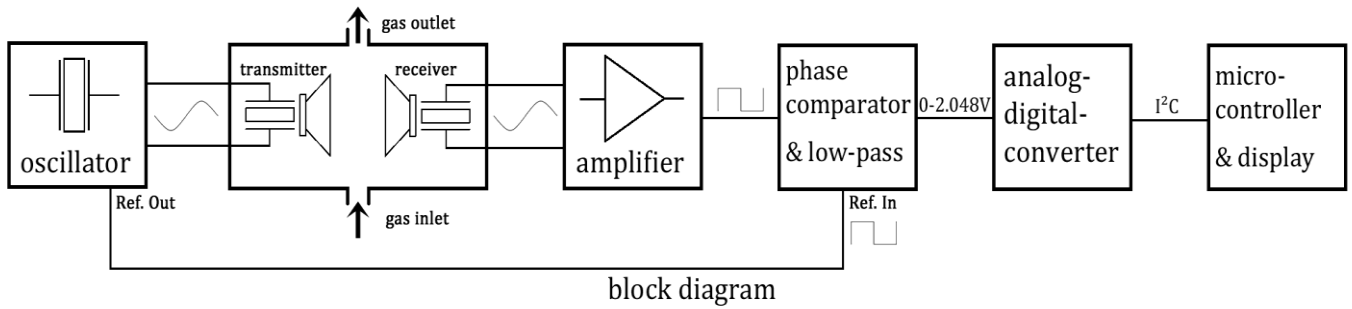


Fig.3: Block diagram

4 Results

Overall it was shown that this method is very good for concentration measurement. As seen in the chart below very nice characteristic curves for the sensor arise. Due to the small chamber volume only very small amount of gas is needed for measurements. The measured values are very consistent and reproducible, the measurement method is reliable.

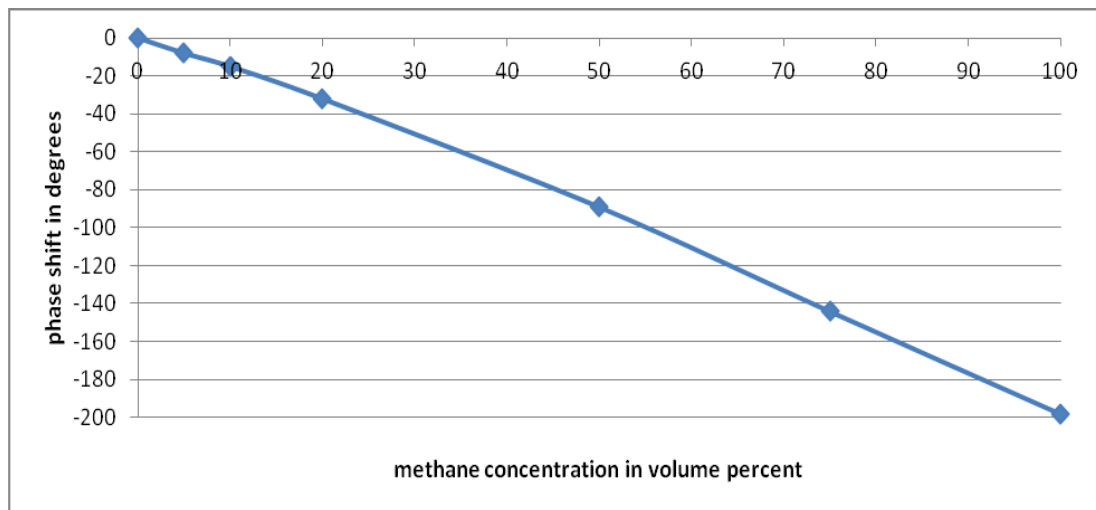


Fig.4: Phase shift in dependence to methane concentration

5 Applications

There are many applications for a small, accurate and real time gas sensor:

Safety technology: e.g. explosion protection (methane and carbon monoxide detection in mines); fire alarm

Process monitoring: e.g. gas control of binary mixtures in chemical reactions

Comfort: e.g. indoor air quality monitoring (CO₂ measurement)

Quality assurance: e.g. leak Detection

How strong is Spaghetti Bridge?

Rafał Chałupnik

Zespół Licealno-Gimnazjalny w Długolece, Grupa Twórcza Quark

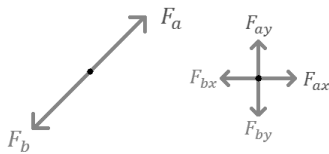
1. Introduction

A lot of architects use spaghetti bridges as models to test their resistance on forces. But how strong the model really is? What kind of forces are affecting?

2. Theoretical part

My model must fulfill few restrictions: maximum length must be within 70 centimeters, load plate's dimensions are 10 x 5 centimeters, singular glue point radius must be within 1 centimeter and maximum depth must be less than 30 centimeters.

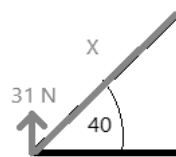
The forces affecting on construction must balance each other, as it is said in first Newton's law. So the sum of X components of forces and Y components must equal zero.



$$\sum (F_{ax} + F_{bx}) = 0$$

$$\sum (F_{ay} + F_{by}) = 0$$

Lastly, I had to calculate the force affecting on each span in bridge. I used trigonometry and reaction forces to create proportional diagram of bridge.



3. Experimental part

I had to decide how to construct my bridge. What type of span is most effective in each force type (compression, tension, shear), create the model and make research for spans resistance.

4. Conclusion

After calculating theoretical maximum load and building whole construction, I compared two results. Results are nearly equal – that means that this method of calculating is effective.

Iran's energy sector and exergy analysis

Roozbeh Salmani

Rahe Danesh School

Accepted by Ariaian young Innovative Minds Institute, AYIMI

In this paper we analyze exergy model and energy sector in the country, taking into account the energy flow and energy of the four main areas of domestic, commercial, industrial, transportation and the production of electricity has been presented. Energy and exergy efficiency analysis leads to the calculation of the first and second laws of thermodynamics for four major portion of energy consumption in our country. Based on the output of the first and second sections, charts and tables the energy flow and loss of energy is presented. Given the amount of losses in energy efficiency has been calculated.

In thermodynamics, the exergy of a system is the maximum useful work possible during a process that brings the system into equilibrium with a heat reservoir. Exergy analysis is performed in the field of industrial ecology to use energy more efficiently. Electricity generation from fossil fuels and hydro potential is studied here. The efficiency of a fuel to generate electricity is given by:

$$\eta_{e,f} = \frac{W_e}{m_f H_f}$$
$$\Psi_{e,f} = \frac{E^{W_e}}{m_f E_f} = \frac{W_e}{m_f \gamma_f H_f} \cong \eta_{e,f}$$

And the efficiency of electricity generation from hydro potential:

$$\eta_{e,hy} = \frac{W_e}{m_w (\Delta k_e + \Delta p_e)_w}$$
$$\Psi_{e,hy} = \frac{E^{W_e}}{m_w \Delta E_w} = \frac{W_e}{m_w (\Delta k_e + \Delta p_e)_w} = \eta_{e,hy}$$

To determine the electrical energy consumed by the equipment and the use of fossil fuel, the percentage of total expenditure represents the total energy consumed by individual devices on percent and the proportion of total energy consumption in the sector. Other equipment includes devices such as water heaters, lights, pumps, air conditioning, television, etc.

Applying energy efficiency and energy dissipation rate in different sections, total loss of energy and exaergy are obtained in Iran.

Kinetics of polyelectrolyte binding studied by precision ellipsometry

Kawin Swaddiwudhipong, Chun Sheng Tan, & Dr Nikolai Yakovlev

Abstract

Structural properties and phase behaviour of long-chain polymers vary greatly from that of small molecules. Moreover, the study of polyelectrolytes has numerous useful applications in the development of solution-based polymer materials, including the synthesis of polymer multilayer capsules. The conformation and attachment kinetics of the model polyelectrolyte poly(styrene sulfonate) (PSS) under varying concentrations of PSS, acid and NaCl were studied using precision ellipsometry, a cost-effective technique that measures changes in thickness in real-time to a sensitivity of 0.01nm. Attachment of

molecules to a substrate in a cuvette was monitored by measuring changes in the rotation of the polarisation vector of a polarised laser beam reflected off the substrate, which correspond to changes in the thickness of the attachment layer. To adapt the technique for an aqueous system, cuvettes were constructed, tested and optimised for efficient introduction and displacement of reagent solutions to allow for precise control of molecular attachment on the substrate. Results indicated that increasing polyelectrolyte or acid concentration both resulted in faster binding; using higher salt concentrations formed thicker polyelectrolyte layers, indicating that the concentration of small ions affects the conformation of polyelectrolytes in solution.

Negative radio components

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1 Introduction

Main characteristics of radio components as resistance, capacitance and inductance are positive (except small ranges of dynamic values). The main purpose of this project is to invent the components with negative effective values. For example, the electric current should flow from lower to higher potential when the current passes the “negative resistor”. The connection between the current and electric pressure in this case is described by formula

$$U = (-R)I, U > 0, R > 0.$$

Analogically, there should be negative capacitance C or inductance L in basic formulae for capacitor and inductor, which connect current and electric power (or their derivatives).

2 Method of the investigation

The method to invent such components is to arrange inside them a special potential which is depended on the input signal by the special way. This “way” should provide input and output current, which corresponds to requiring negative characteristics, when inputs of the resistor are connected to this potential. There were constructed two inner potentials because of one special potential can provide flowing of the right current to only one input,.

This idea was realized by use of the operational amplifier with negative feedback. If to substitute resistors in the scheme of negative feedback by capacitors, obtained component would operate like negative capacitor or inductor (in case of substituted resistor).

By the fact that components were created using operational amplifier, there appear many restrictions for input signal. It is explained with output potential of operational amplifier cannot be higher or lower than maximum and minimum of supply. In case of resistor to find these restrictions there was received the volt-ampere characteristic, which shows maximal and minimal value of input signal. Negative resistor also has frequency restrictions (gain of op-amp depends on frequency). To obtain this dependence there was hold and experiment.

In case of capacitor and inductor there become frequency restrictions: capacitor has restrictions for maximal acceptable frequency and the inductor - for minimal. The range of acceptable frequencies depends on the amplitude of input signal and the supply.

In literature there was described a variant of a model of the negative resistor, however this model wasn't general and provided the requiring current only to one input. Model of negative capacitor and inductor wasn't met by the author before.

3 Results and conclusion

Negative radio components, offered by author, were constructed. The behavior of each component was investigated theoretically and tested experimentally. Also the theoretically prescribed restrictions, particularly maximal and minimal operative frequencies, were obtained and analyzed.

In fact, these components have a wide range of acceptable frequencies, approximately from 100 Hz to 1 MHz. This range depends on supply.

There were founded and prescribed operating restrictions for an every component, particularly maximal and minimal operative frequencies depending on input signal and supply of op-amp.

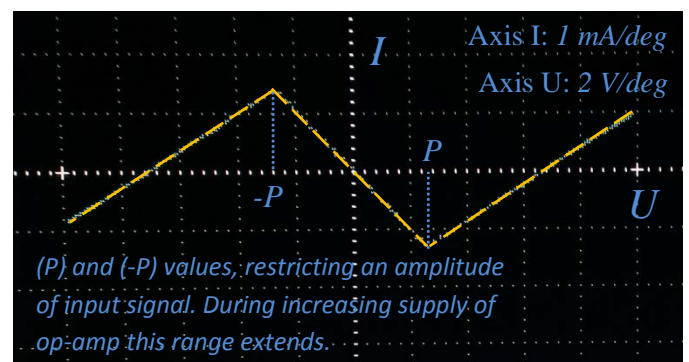


Fig. 1 Volt-ampere characteristic of the negative resistor

New approach to water purification and treatment

Viktor Kurylenko

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Introduction

Every year a question of water purification is becoming more and more urgent. That's why the studying of the ways of increasing the efficiency and capability of the process of water purification with the help of electrolysis is one of the current interests. The aim of the study was to suggest and examine a new method and device of electrochemical water treatment. The investigated phenomenon experimentally illustrates the difference in the electric current passage through conductors of different types - electronic (conductors and metal electrodes) and ion (electrolyte).

Material and method of the investigation

To investigate the influence of the electrode material and shape on the efficiency of the electrolysis several types of electrodes were assembled: in the form of grates and plates from aluminum, copper and steel (Fig.1).

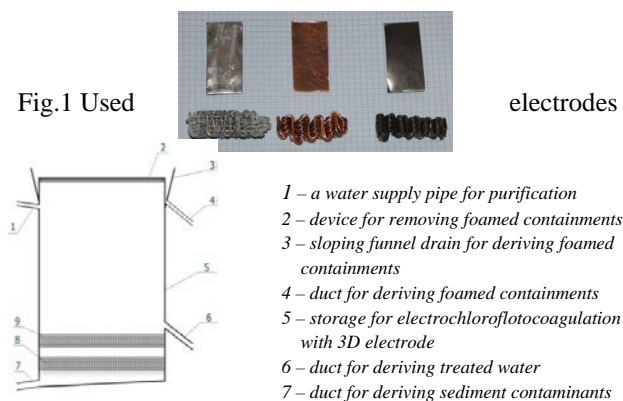


Fig.2. Elektrochloroflotocoagulator with 3d electrodes

A new device for water purification with new electrode type was also invented (Fig.2).

The volume of hydrogen on the cathode was calculated according to Faraday law:

$$V_{H_2} = k_e(H_2)I\tau \quad (1)$$

The statistical analysis of the obtained results was done by Microsoft Excel program. The Pirson coefficient, relative error and other factors were calculated by built-in Excel function.

Results of the experiment

There were invented during the research: the 3D electrode, the method of water purification and the Elektrochloroflotokoagulator with 3D electrode (Fig. 2).

Series of experiments were conducted to research the influence of material nature, electrode shape, amperage,

electrolyte concentration and distance between electrodes on the efficiency of electrolysis process.

The result of the conducted experiments proved, that the electrode form influences the electrolysis efficiency and also the gas formation velocity on cathode. Values are higher due to the expanded free surface of the electrode in the case of three-dimensional grate.

The highest efficiency of electrolysis process obtained with an aluminium 3D electrode at amperage of 1.4A, electrolyte (NaHCO₃) concentrations of 16.4 g/l H₂O and distances between electrodes - 2 cm.

The efficiency of water purification with the help of 3D electrodes from the cuprum ions and the location of the ions in the solution was investigated with the help of the photocolometric method.

The results of conducted statistical processing of the experimental data are introduced in Table:

	3D*	Sheet**
Number of values, n	5	5
Mean value, X _m	0,55	0,65
Standart deviation, S	0,0158	0,0239
Confidence interval, CI	0,0196	0,0296
Relative error, δ	0,0357	0,0458

Conclusions

The Elektrochloroflotocoagulator with 3d electrodes provides an opportunity of water cleaning from organic contaminants, suspended solids, oil, emulsions, surfactants etc. Technical and economic advantages are provided by combining several methods of water purification at once. That leads to improvement of water quality in a larger range of parameters.

Such combination of several processes enables to solve the following problems: shorten the time of water purification; the products of one way of water purification increase the efficiency on the other way of water purification; the device can work independently (solar panels, hydrogen energy) and it doesn't need numerous staff. Given device makes it possible to purify water according to maximum parameters. Statistical analysis of the obtained results proved the efficiency of water purification with 3D electrode, so as the Pirson coefficient is almost equal to one. This device can also be used to treat the water of enterprises for further use within the technological process, i.e. using water in a closed cycle. The continuation of this work will be realized in the investigation of water purification efficiency at industrial enterprises of our city and testing my device under real conditions.

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Oil stars

Wojciech Grędel

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Creative Group QUARK, The Youth Palace in Katowice, Poland

Introduction

I used oil placed in container of various shapes and sizes and mounted it on a shaker. The oil experienced a vertical sinusoidal motion with a frequency range 8-20 Hz. As a result of this vertical shaking different shapes appear on the fluid surface. What is more the symmetry of the star is independent of the container form and size.

Fig.1: Polygonal wave with symmetry of 3th order

Theoretical part

Observed patterns (see Fig. 1) are large standing cnoidal waves. It is known [1] that the waves on the liquid surfaces in vertical motion can be modeled by a damped Mathieu equation.

$$\frac{\partial^2 \zeta}{\partial t^2} + 2\sigma \frac{\partial \zeta}{\partial t} + \omega_0^2 [1 - F \cos(\Omega t)] \zeta = 0, \quad (1)$$

In my experiments wave vector was much smaller than $1/\text{capillary length}$ so surface tension effects are negligible compared to gravity effects therefore I deal only with gravity and forcing acceleration.

Star waves are similar to the faraday waves and they also appear after exceeding the stability threshold.

Experimental part

1.1 Set up

To create a shaker I used loudspeaker. It is connected to the amplifier which is able to strengthen low frequencies. I get sinusoidal signal from function generator. It allows me to change the amplitude and frequency of the oscillations. Range of driving frequencies was limited by the maximal output power of the amplifier. Experiments were conducted with containers of various shapes (circular, rectangular).

1.2 Creating a Star-Shaped Waves

When a container with an oil was experienced by vertical motion I was able to observe beautiful patterns. The

number of symmetries depends on oscillation frequency and amplitude and filling level. I also notice that system is hysteretic.

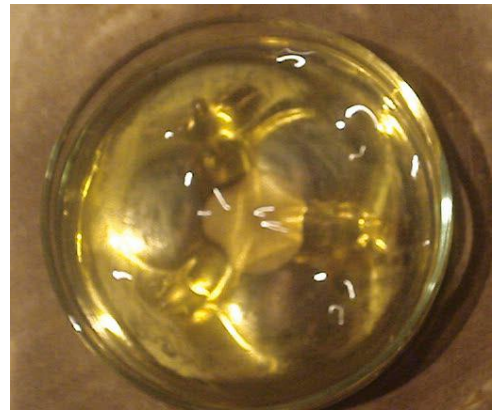


Fig.1: Polygonal wave with symmetry of 3th order

1.3 Rectangular container

It looks really impressive when stars with the same symmetries appear in non-circular container. It turns out that those patterns are independent on the container shape. Stars in rectangular shape look like honeycomb cut in such way to fit to the container.

Conclusion

During my research I found out that patterns are hard to predict and mathematical model requires a highly nonlinear theory. I also noticed droplet effect which is not described in known to me literature.

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Optic Device via Tongue

Hilal Nur Işcen and Merve Torun

The purposes of The Optic Device Via Tongue is to make a visual device for visually impaired people by using transformation of light to electric energy and to improve the effectiveness of the device.

As a result of the research and applications, the regions of the human body that have nerve endings were determined and the five regions which were most appropriate for usage of the visual device have been chosen. According to the experiments, pressure was applied to the five regions equally. The ratio of pressure tested was felt greatest by the tongue region.

Secondly, testing of the conductive structure of the tongue and saliva is determined that the correct amount of voltage to be used was 9V.

A correlation has been established between the photo diode number, tongue dimensions and the circuit board.

It is expected that visually impaired people perceive the changes in light by the help of the circuit. From early ages, it would be effective for continued use by a special education program. The device has the special features that make it possible to perceive the different currents of the light. The studies are targeted for further improvement and development.

Research on solidifying liquid droplets

Smirnov Alexey

The purpose of the investigation

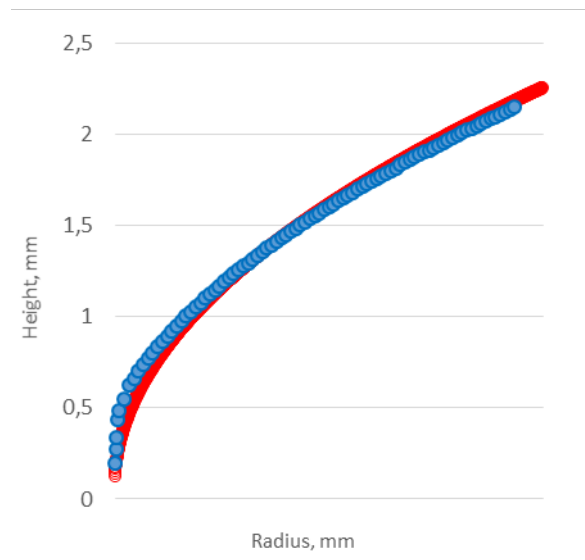
An understanding of solidification dynamics is crucial to predict the behavior of freezing liquid. This research is aimed to discover the proper way to model the appearing singularities (or ice pikes' at top of liquid droplet during freezing) in different liquids, in various conditions, e.g. small liquid droplets (with radius less than 1 mm), greater droplets and surfaces, covered by liquid. The final shapes of liquid systems can be found from the liquid-solid-vapor trajectories in time, thus giving us the generatrices of frozen droplets.

Method of the investigation

The cooled metal (aluminum) surface was used to freeze liquid droplets and the digital camera to get the images of eventual frozen shapes. Solidification was observed at -15, -24, -78 and -196 degrees Celsius. Lower temperatures made process go faster: solidification continued up to several milliseconds, that's why video filming wasn't possible. The theoretical model was developed and numerically calculated using the MATLAB. The results of the experiments were compared to the model and verified. The noticed effects were explained.

Results of the experiment

On the graph below you can notice similarities in theoretically predicted generatrix of small frozen droplet (red curve) and approximated generatrix derived by digital photo analysis (blue dots over the line), axis have equal scale.



When defining the shapes of small solidified droplets, precision is quite good, but the larger droplets we take, the larger the mismatch becomes. Consequently, the simplified geometrical model stops working for large area surfaces, covered by solidifying liquid. It was found out that, sharp ice pikes form only in solidifying liquids, which have their solid/liquid density ratio from 0.75 up to 1, not including 1.

Conclusion

Summing up, results of this research are quite surprising. Empirical results prove that the shape of frozen liquid doesn't depend on temperature of cooled surface. Experiments also prove the existence of inflexion point near the top or ice pike; which relates to gravity, which we neglected in small droplets investigation. Solidifying liquid puddles can't have several points of singularity, where pikes form, they behave like axis-symmetrical droplets near the singularity point, where the pike appears.

Reviews on the Effectiveness of Certain Ropes' Type and Length towards the Reduction of Fruits Bats' Rejecta Pellets

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1. The Purpose of the Investigation

Fruits Bats is a common animal that can easily found in some areas in Indonesia. It helps plant spreads the seed and pollen the flowers. Although it is so important part of ecology but it disturbs people by its habit. It likes to spews rejecta pellets (remnant of its food form sucked seed and flowers) everywhere, including people's house. This habit was annoying and makes people hunt them. Besides of hunting, people in some region in Indonesia have a method to repel the bat and reduce the quantity of the rejecta pellets, which is by hanging a pair of rope on the place where the bat spews the rejecta pellets. The effectiveness of the method wasn't proofed yet, and there is no scientific explanation for this method.

2. Method of the Investigation

To know whether the method is working or not, the method tried with the same method that has been used by people. First a location (terrace of a building) with rejecta pellets that can be found daily cleaned, after that the rejecta pellets were collected and measured daily. Next the rope hang horizontally throughout the location with height 3.2 m from the floor, henceforth the rope called horizontal rope. On the horizontal rope there was a rope hung vertically on certain point, henceforth the rope called vertical rope. The variable that has been tried was the length of the vertical rope (3,2, and 1 meter), the point on the horizontal rope where the vertical rope hung, and the type of the rope (metal and non-metal rope but both vertical and horizontal rope are the same type). From this method it can be finding whether the method is working or not and how this method gives the best result (the least rejecta pellets found).

Remembering that bat commonly use echolocation, so the deterrent is from the frequency produced by the rope. The frequency produced is standing wave because both of the rope's ends were tied. From the standing wave equation[1] (Eq. (1)) it can be find the lambda needed/ harmonic to produce the frequency heard by the bat.

$$f_n = \frac{v}{\lambda_n} \quad (1)$$

3. Result of the Investigation

The method is proved that it can reduce the rejecta pellets from the bat. The table here shows the result:

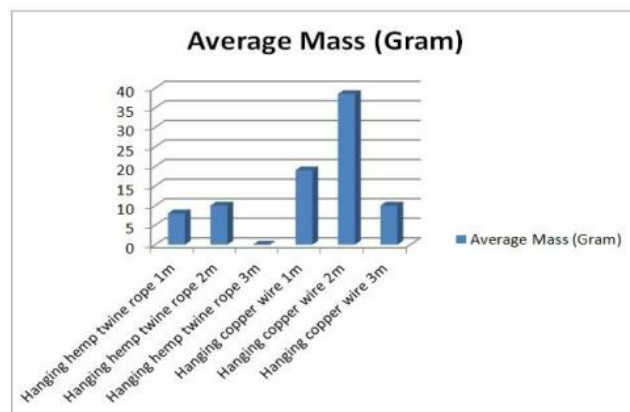


Fig. 1 Graphic of Rejecta Pellets average mass

From the equation of the standing wave (Eq. (1)), it can be calculating the possible harmonic that occurs in the rope (with the frequency heard by the bat about 18 kHz):

$$f = \frac{30.82}{\lambda_n} \quad (2)$$

$$n = 8410 \quad (3)$$

Eq. (2) and Eq. (3) can lead us to decide the type and length of the rope to repel the bat/ reduce the quantity of rejecta pellets.

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Scheibenschlagen – A Physical Analysis of an Ancient Custom

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1 Introduction

Scheibenschlagen is a very old custom in Central Europe. In a certain night at the end of winter small wooden discs on a long stick are lit in a fire until they glow. With the aid of a wooden ramp the discs are flung from a mountain side into the valley below. The challenge is to cover a long distance at a long time of flight. We analysed the physics behind that custom.



Figure 1: *Left:* Glowing discs are flung into the valley. *Right:* Disc with a square base

2 Analyses and Results

2.1 The disc – a spinning top

When dragged along the ramp, the disc is set into rotation. As a spinning top the disc precedes in flight direction. We estimated the angular velocity of precession and verified it by experiments.

2.2 The ideal shape

We investigated the effect of variation of vertices on the aerodynamic characteristics of a disc by measuring the lift-to-drag ratio of discs with triangular, square-shaped and circular bases in a wind tunnel. We discovered that the addition of vertices brings only minor improvement about.

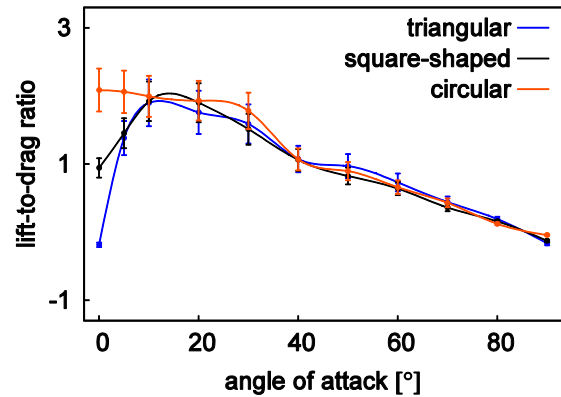


Figure 2: Lift-to-drag ratio of various shapes, $v = 15 \text{ m/s}$, $Re = 8,1 \cdot 10^4$

2.3 Flight curves

We used the computer algebra system Maple to simulate the trajectories of discs. This enabled us to investigate the optimal initial conditions such as the most favourable launch angle. We verified our simulated flight paths by an extended video analysis on our school sports field.



Figure 3: Experimental setup for video tracking

SOME PECULIARITIES OF THE MOVEMENT OF EULER'S DISK

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Introduction

Euler's disk is a scientific educational toy, used to illustrate and study the dynamic system of a spinning disk on a flat surface (such as a spinning coin), and has been the subject of a number of scientific papers. This phenomenon has been studied since Leonhard Euler in the 18th century, hence the name.

A spinning disk abruptly comes to rest, the final stage of motion being accompanied by a whirring sound of rapidly increasing frequency. As the disk rolls, the point of rolling contact describes a circle that oscillates with a constant angular velocity. Precession rate of the axis of symmetry approaches a finite-time singularity modeled by a power law with exponent approximately $-1/3$ (depending on specific conditions).

Theoretic Modeling

There are two conspicuous dissipative effects: rolling friction when the disk slips along the surface, and air drag from the resistance of air. The behavior (precession rate) depends systematically on the coefficient of friction. In the limit of small angle (i.e., immediately before the disk stops spinning), air drag (specifically, viscous dissipation) is the dominant factor, but prior to this rolling friction is the dominant effect.

Experimental Data

We have conducted a series of experiments to explore the mechanic and sound effects present during the spinning. We have used two disks of different radiuses, and found that small or overlarge disks do not produce more distinct effects. Our experiments have confirmed that the total time of spinning depends on the disk's mass and radius.

Conclusions

1. We have studied the movement of Euler's disk with different parameters.
2. The sound effects produced by the spinning of Euler's disk are similar to those that precede explosions.
3. The precession rate of Euler's disk depends mostly on the coefficient of friction.

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Strength and strain mechanical observation using Holography Interferometry

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1 Introduction

Holography is a technique that enables three-dimensional images to be formed. Holography, with its unique depth of field and interferometric capabilities, is a powerful new tool for the study of strength and strain properties of materials. Strength and strain properties of materials are very important physical characteristics. Each material has different physical properties. In our modern world those characteristics are very important for materials and their applications. Holography enables us to observe their unique characteristics and their weak points. In this observation I tested various materials throughout Holography Interferometry technique. Holography provides very accurate results, which are essential for complex material analysis.

2 Purpose of Investigation

The purpose of investigation is to analyze and investigate various materials and their strength and strain properties using Holography Interferometry technique. Holography enables three-dimensional observation of materials, which is very essential feature for complex material examination. This technique will significantly improve our understanding of materials properties, and their weak points. Also this technique provides very fast and accurate results, which can be used as essential diagnostic tool for material study.

3 Method of the investigation

A Schematic view of the real-time holographic setup is shown in Figure 1. Long coherence length, 532 nm second harmonic Nd-YAG, laser was used. A beam was split and one beam was used to illuminate an object recorded, while the second beam was utilized as a reference beam to irradiate CCD sensor. Materials and components used in this investigation are dental composite resins, and mechanical components used in industry. Mechanical components are different types of gear wheels, bearings, and various metals. Mechanical components are exposed to different mechanical stresses and observed through interferograms. Dental resins used in this investigation are light-activated, which cure and quickly harden when exposed to specific light spectrum. Blue LED, (450-480nm wavelength) lamp is used to activate resin. It was necessary to use filters, in order to reject LED lamplight, and transmit 532 nm interference patterns. CCD camera and computer detected and recorded the interference pattern of resins and mechanical components.

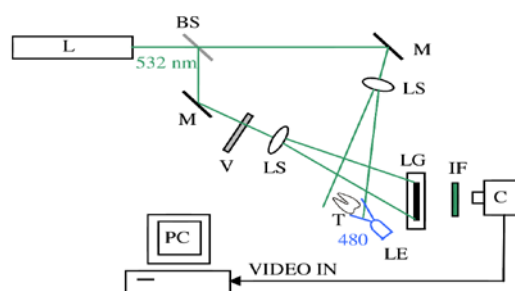


Figure 1.

4 Results of investigation

These results characterize holographic real-time measurements and analysis of material hardening and different types of mechanical stresses. While hardening process takes place I analyzed mechanical properties of dental resins. A series of 10 experimental samples were analyzed. We conclude that all 10 samples, which varied in their size, results obtain pretty much the same values without any large oscillations between samples. Throughout interferogram analysis we conclude that at the beginning of process during first seconds after material is lightened there is no recognizable change, after about 10 second obvious difference can be observed. The maximum deformation is attained at the end of process. From results I conclude that resin deformation starts to travel down from the place where it is lightened, and start to contract material which is around. Different types of mechanical components such as gear wheels, which are tested, have certain points where they excerpt more stress points than on other places. Also every type of mechanical component have their own weak points. Every mechanical component that was observed have their own properties that enable usage in specific area of industry.

5 Conclusion

These experiments represent results of Holographic real-time measurements of dental resin structure deformations and mechanical components deformations. Physical stresses which acts on them are observed through interferograms. This technique enables testing of various mechanical components, photosensitive resins and materials, with the aim to improve their mechanical properties. This technology could significantly improve materials in future, which will be more permanent and durable.

6 References

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The formation of bright light after sunlight passing through bubbles

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Introduction

Light is a type electromagnetic wave that enables us to see. People of Malaysia, Indonesia and some other countries in South East Asia have been using bubbles with the addition to sunlight to create a bright light source since there is no electricity in the rural areas. They place transparent plastic containers filled with bubbles in the hole at the rooftop of their homes and the house becomes bright as if they have placed a fluorescent lamp at the roof. This phenomenon has attracted us to run a research on how this phenomenon could happen. We aim to study on what happens to the light rays when they strike the bubbles and what causes the resulting light rays coming out of the bubbles to be bright.

Method of Investigation

In our first attempt, we used a ray box as our light source. In this way, it is easier to calculate the angles of light rays inside the bubbles. We formed the bubbles out of an ordinary detergent powder by shaking the detergent solution inside a transparent plastic container. The experiment was done in a dark room to enable the light rays to be seen clearly. The patterns of the light rays are observed and captured using a high resolution camera (Canon EOS 7D).

Next, we investigated the light rays in one bubble. We used a bubble blower from a children's bubbles toy set to form the bubble. We placed the bubble on a piece of white paper so that the light ray can be seen clearly. The bubbles formed were much bigger than the bubbles in the first experiment. Again, we firstly use the ray box as our light source. Then, we switched to the laser. The pattern and angles of the light rays are observe and captured with the same high resolution camera as the first investigation.

Results of Investigation

For the first experiment, we found that the emergent light ray is bright light. As we study the photo that we captured, we found that some of the light rays that strike the bubbles undergo refraction. The parallel light rays from the ray box strike the film of the first bubble, the light rays refract towards the normal line. As the light rays exit the water film inside the bubble, they refract away from the normal line. Then, they will pass through another film of water to exit first bubble, the light rays refract towards the normal line and then away from the normal line as they exit the bubble into the air. The emergent rays are found to be diverged by the bubble. As the emergent light rays encounter another bubbles, the same phenomenon occur

until it was found that the final emergent rays are diverged the most.

For the second experiment with only one bubble, other than refraction, we found that the light rays undergo reflection on the outer surface of the bubble and total internal reflection on the inner surface of the bubble. When the incoming ray of light strikes the outer surface of the bubble, part of the light ray is reflected immediately, while the other part is transmitted into the water film. After reaching the inner surface of the film, this transmitted light ray is reflected back (as total internal reflection) towards the outer surface. The angle of the light ray from the ray box, i and the refracted ray, r were measured to determine the refractive index.

Based on the formula, $n = \sin i / \sin r$, the refractive index can be determined. Since the light ray passes through the water films and the air inside the bubble, we can find both refractive indices. From the theory, total internal refraction occur when the light ray travels from optically denser medium which is the water film to a less dense medium which is the air inside the bubble, and when the angle of incidence, i is greater than the critical angle, c .

Based on Snell's Law :

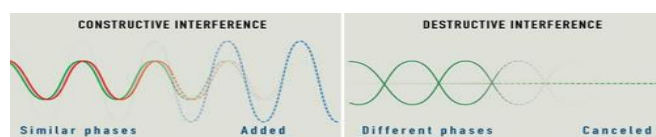
$$n = \sin i / \sin r$$

$$n = \sin 90^\circ / \sin c$$

$$n = 1 / \sin c.$$

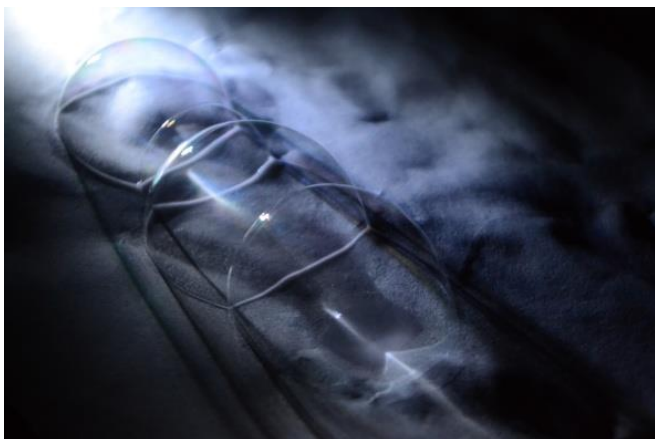
$$c = \sin^{-1} (1/n)$$

When it leaves the bubble, it travels in the same direction as the ray that was immediately reflected and is, therefore, parallel to that ray. If these two rays of light are reflected back so that their wavelengths are "out of phase" with each other, the second ray will partly cancel out the reflection of the first ray. This is called destructive interference, which results in a reduction of colour intensity. If, however, the wavelengths of the two reflected rays are "in phase," they will enhance each other. This is called constructive interference. Then, when we tried to add another bubble, we found that the light spectrum overlaps on the second bubble forming bright light since the bubble acts as a lens that converge the light spectrum and forming bright light when the light spectrum overlaps. So, this phenomenon occurs continuously with more bubbles.





The light spectrum formed when the light strikes a single layer of bubble



The light spectrum disappears when light travels through consecutive bubbles

We found that these three phenomena occur continuously that result to the formation of bright light from bubbles. The emergent light formed as bright light.

Conclusion

As a conclusion, we found that the phenomena behind the light rays passing through bubbles are refraction, reflection, total internal reflection and interference of light rays. The spectrum of light from total internal reflection will overlap and form bright light when the spectrum encounters another bubble. This phenomenon occurs continuously and the light becomes the brightest. Therefore, we can conclude that our research on the formation of bright light passing through bubbles was successful.

Walking Droplets

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Creative Group QUARK, The Youth Palace in Katowice, Poland

1 Introduction

Typically, when a drop is released on a liquid surface it bounces for a fraction of a second and then, coalesces. This process is too quick to be noticed with an unaided eye. However, it can be significantly retarded if the surface is vibrating. Then the drop remain bouncing on the liquid surface and due to wave field and droplet interaction it may perform more complex behavior, such as chaotic movement, which occurs after meeting certain boundary conditions.

2 Theoretical part

The drop can remain on the liquid surface because of the thin air layer which separates the drop and vibrating surface and thus, prevents it from coalescing. It may be renewed with every bounce for smaller droplets. The very important parameter for the ‘walking droplet’ phenomenon is peak bath acceleration γ as the result of vertical vibrations, so that the effective gravity is:

$$g(t) = g + \gamma(t) = g + A\omega^2 \cos \omega t \quad (1)$$

Where:

$$\omega = 2\pi f \quad (2)$$

Where f is forcing frequency.

Other important factor is characteristic drop oscillation frequency, which is proportional to the square root of surface tension divided by density and radius cubed:

$$f_D = \sqrt{\frac{2}{\pi^2}} \sqrt{\frac{\sigma}{\rho R^3}} \quad (3)$$

It is a good indicator in the phenomenon since it combines the properties of used liquid as well as the size of the drop.

3 Experimental part

3.1 Experimental setup

I used two experimental setups: one consisted of a speaker and tone generator, second consisted of vibrating plate. I produced the drops with syringe, using needles of variable diameter.

3.2 Relevant parameters

The ease of obtaining the phenomenon of ‘the walking droplet’ may vary significantly depending on the type of liquid used. I observed that it virtually does not occur for liquids like water, i.e. those of high surface tension. Therefore, drops of liquids like soap solution or silicone oil performed lower tendency to coalesce.

3.3 Purpose and results

The purpose of my research was to track the path of the walking drop and to relate its characteristic oscillation frequency and the forcing frequency to the droplet’s tendency to remain on the surface. I observed that the drop reversely moves forward and backward with repeatable period of this oscillations.

After analysis of collected data I observed that the drop performs greater tendency to remain on the liquid surface when the forcing frequency is a multiple of the drop’s characteristic oscillation frequency.

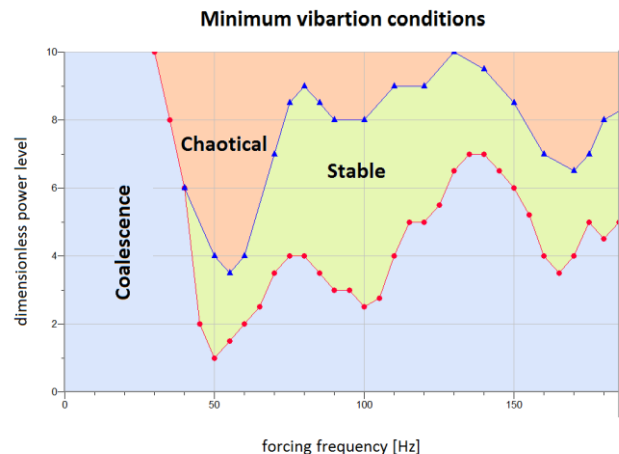


Fig. 1 Minimum vibration condition for droplet of characteristic oscillation frequency of 55 Hz

4 Conclusion

During my research not only did I find some relations regarding droplet’s capacity to remain bouncing on the surface but also observed very interesting behavior of the droplet such as self-propelling properties and droplet’s ability to regulate its size.

Water Bombs

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1 Introduction

One of very common games among children is water-balloons-war. During this game sometimes even the best thrown balloons instead of exploding simply bounce. Why is it so? That was the main question of my research.

2 Theoretical Model

The phenomenon observed when a balloon hits an obstacle is called water hammer. Water hammer is simply sudden change in fluids pressure accompanying a quick stop of its flow. Change in pressure during this phenomenon is described by Eq (1).

$$\Delta p = \rho c \Delta v \quad (1)$$

In which ρ is the fluids density, Δv is balloons velocity during the crash and c the velocity of pressure change wave in the fluid described by Eq (2).

$$c = \frac{1}{\sqrt{\rho \left(\frac{1}{K} + \frac{d}{E \cdot e} \right)}} \quad (2)$$

If the pressure inside balloon exceeds the durability of a balloon, it explodes, if not it bounces.



Fig.1 Balloon during the crash

3 Experiments

3.1 Experiment 1

The first experiment that I've conducted in this research was measuring the height from balloon had to be dropped in order to explode while hitting the ground. In order to do so I've

filled 20 exact the same balloons with 75cm³ of water and dropped them from growing heights. The average height measured in this experiment was 79cm.

3.2 Experiment 2

The next thing I did was measuring the force which applied to the balloon makes it explode. I did that by simply putting a balloon on a scales and putting growing weights on it. The average force measured in this experiment was 64 N which was equal to dropping a balloon from 74 cm. The height of drop measured in experiment 1 and calculated in experiment 2 differs only by 5 cm.

3.3 Further experiments

I have conducted many experiments to examine factors influencing explosion of a balloon such as: filling a balloon with air bubbles, filling a balloon with hot water instead of cold water, changing the surface on which balloon falls etc.

4 Conclusion

In conclusion I have determined the factors influencing the explosion of a balloon and they are:

- ❖ Velocity at impact
- ❖ Air content
- ❖ Pressure inside filled balloon
- ❖ Balloons diameter
- ❖ Fluids density
- ❖ Type of surface
- ❖ Elasticity of the balloon
- ❖ Durability of the balloon

References

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