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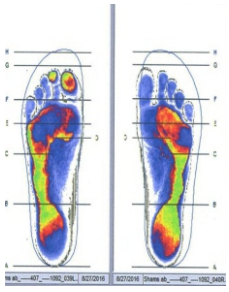

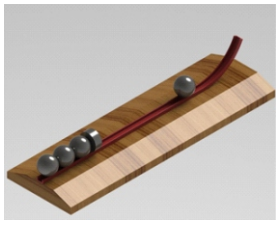

Young Scientist Research

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Ball in a Tube

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Abstract

In this article we want to analyze the motion of a ball in a rotating tube of water .We start with calculating the pressure in a rotating tube and finding the overall shape of water in rotating cylinder ,considering the conservation of the water inside it. Finally, after finding the volume that is occupied by the ball in the water ,We write the motion equations for the ball .Here ,we figure out that when the tube is accelerating the ball starts oscillating on a straight line related to the tube and this oscillating motion is extremely dependent on the viscosity number of the fluid or generally speaking, it depends on the coefficient of the friction force .The other thing that happens is that when we put the ball inside the rotating tube (with constant speed)the ball oscillates around it's equilibrium point and its motion damps and gets steady in its equilibrium point eventually .In our experiment we accelerate the cylinder and find out the oscillation of the ball and we also measure the equilibrium point of the ball and compare it to our theoretical data and plot the graph related to the shape of water and the equilibrium point of the ball in respect to our known parameters .Generally, we can completely describe the motion of the ball by solving the motion equations numerically .During this process we use our knowledge of geometry and calculus to find out the relation between the parameters.

Keywords

Ball, Oscillation, Rotating tube, fluid dynamics

Introduction

In this research we studied the motion of a ball in an inclined tube, which is filled with a liquid and moves in a conical surface.
The general form of fluid's movement is shown by Navier-Stokes equation. There are forces acting on the ball such as Gravity, centripetal force, and buoyancy (the force acted from the fluid) which should be investigated by analyzing the experiments.

Experiment and Theory

According to the Navier- Stokes equation, general form of fluid's movement is found .

$$\rho\left(\frac{\partial}{\partial t}+\boldsymbol{v}.\boldsymbol{\nabla}\right)\boldsymbol{v}=\rho\boldsymbol{g}+\boldsymbol{\nabla}p+\frac{\mu}{3}\boldsymbol{\nabla}(\boldsymbol{\nabla}.\boldsymbol{v})+\mu\nabla^2\boldsymbol{v}$$

Where 'ρ' is density of fluid, '$\boldsymbol{v}$' the velocity of our fluid, 'μ' viscosity coefficient and '$\boldsymbol{g}$' the gravitational field in that area. Since the velocity is constant, the differential velocity is zero so we can write:

$$\rho\boldsymbol{g}+\boldsymbol{\nabla}p=0 \;:\; \vec{g}=-g_0\,\hat{z}+r\omega^2\hat{r}\ ,$$

$$p=p_0+\frac{}{2}[\omega(r-r_0)]^2\rho-\rho g(z-z_0)$$

The pressure in the rotating cylindrical tube in respect to its radiuscan be found.
Now we are going to find the shape of water when the tube is rotating; so we write the motion equations for a differential matter on the surface of the water.

$$dF\,cos\theta=gdM\ ,\ \ dF\,sin\theta=dM\,r\omega^2$$

By dividing the two equations:

$$tan\theta=\frac{dz}{dr}=\frac{r\omega^2}{g}\quad\Rightarrow\quad z-z_0=\frac{r^2\omega^2}{2g}$$

This equation gives us the general form of the surface function of the water. All we need to find is z_0 .

We define a new parameter $l = L + z\,cot\varphi$ (Fig.1) and from the geometry of the shape we can write:

$$r_2 = L + \frac{r_2^2\omega^2}{2g}cot\varphi$$

$$r_2 = \frac{g}{\omega^2 cot\varphi}\left(1 \pm \sqrt{1 - \frac{2L\,cot\varphi\,\omega^2}{g}}\right)$$

$$z_1 = \frac{{r_1}^2\omega^2}{2g} + z_0 \Rightarrow z_0 = r_1 tan\varphi - \frac{{r_1}^2\omega^2}{2g}$$

According to conservation of volume:

$$V = \int_{r_1}^{r_2+r_1} \frac{1}{4}\pi(l-r)^2 dz + \frac{z_1\pi L^2}{4} =$$

$$\int_{r_1}^{r_2+r_1} \frac{1}{4}\pi(L + Zcot\varphi - r)^2 \frac{r\omega^2}{g} dr + \frac{r_1 tan\varphi\,\pi L^2}{4}$$

$$\Rightarrow \boxed{V_0 = \int_{r_1}^{r_2+r_1} \frac{1}{4}\pi\left(L + \left(\frac{r^2\omega^2}{2g} + r_1 tan\varphi - \frac{{r_1}^2\omega^2}{2g}\right)cot\varphi - r\right)^2 \frac{r\omega^2}{g} dr + \frac{r_1 tan\varphi\,\pi L^2}{4}}$$

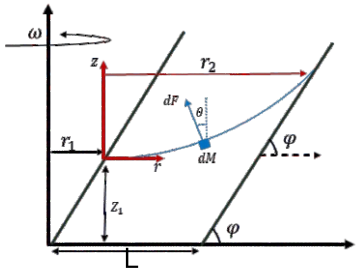

Fig.1-shape of water in the cylinder

By solving this equation $z_0$numerically could be found.

Here, we should calculate the water floating in the tube .First ,we use Archimedes law to find the volume that is occupied by the ball (fig.2).

$$Mg = \rho_w v g \;\Rightarrow\; v = \frac{M}{\rho_w}$$

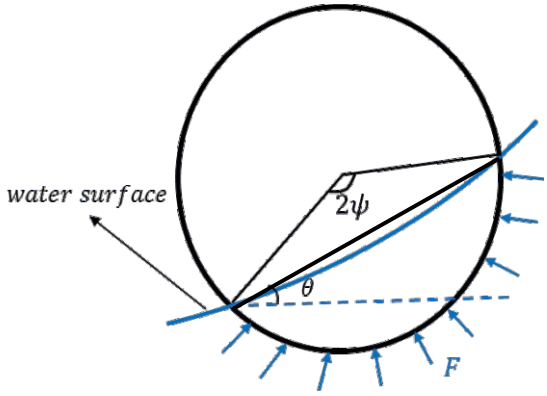

Fig.2-The amount of water occupied by theball

The area of a skullcap could easily calculate.

$$v_{sc} = \int_0^{2\pi}\int_0^{\psi} R^2 sin\theta\, d\theta\, d\varphi - \frac{1}{3}\pi(Rsin\psi)^2(rcos\psi)$$

$$v_{sc} \cong v \;\Rightarrow 2cos\psi + \frac{sin\psi^2\,cos\psi}{3} + \frac{M}{\rho_w\pi R^3} - 2 = 0$$

$$\Rightarrow v_{sc} = \pi R^3\left(2 - 2cos\psi - \frac{sin\psi^2 cos\psi}{3}\right)$$

As you see we use an approximation that the occupied volume is nearly equals to the volume of the skullcap. Figure (3) describes figure (2) more.

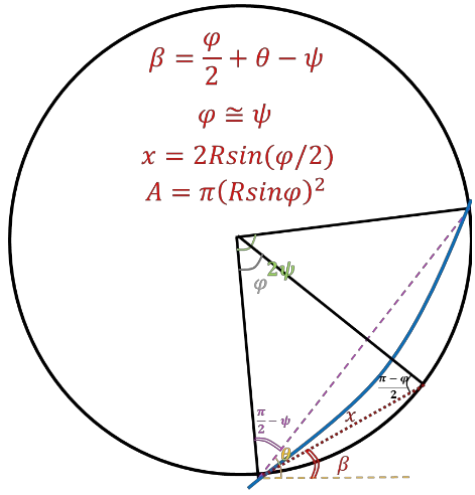

Fig.3-A geometrical sketch of finding the net force

The net force in the fig.3 is on the bisector of 2ψ

$$tan\theta \cong \frac{dz}{dr} \Rightarrow sin\theta = \frac{1}{\sqrt{1 + (\frac{dr}{dz})^2}}$$

$$F_x = \left[\frac{1}{2}\rho\omega^2\{x\,cos\beta + r\}^2\right]\pi sin\theta(Rsin\psi)^2$$

and also We will take $-M\alpha V\,\hat{V}$ as the friction force applied to the ball and write the movement equations of the ball by using $\hat{V} = \vec{V}/|V|$.so we can analyze movements of the ball completely.

$$\boxed{\ddot{r} - r\omega^2 = -\frac{1}{M}\alpha\dot{r} - \left(\frac{1}{2M}\rho\omega^2\pi sin\theta(Rsin\psi)^2\left\{r + Rsin\psi\cos\left(\theta - \frac{\psi}{2}\right)\right\}^2\right)}$$

If the ball's velocity related to water becomes zero, then it's at equilibrium ,so:

$$2Mr = \frac{\rho\pi(Rsin\psi)^2\eta\omega^2}{\sqrt{(g^2+\eta^2\omega^4)}}\left\{r + \frac{gRsin(\psi)\cos\left(\frac{\psi}{2}\right)}{\sqrt{(g^2+\eta^2\omega^4)}} + \frac{\eta\omega^2 Rsin(\psi)\sin\left(\frac{\psi}{2}\right)}{\sqrt{(g^2+\eta^2\omega^4)}}\right\}^2$$

$\eta \coloneqq r - Z_1 cot\varphi$

$\alpha = 6\pi\eta R(1 - cos\psi) \quad (stoke's\ formula)$

Materials and Method

To do our experiment we need some equipment (fig.4).First we make a hole in a carton. To make the carton steady so that it doesn't bend we connect a wooden board above and attach them to the motor by the shaft. We stick two Styrofoam to the board and connect the sticks and the bottle with an elastic band. By changing the place of sticks the angle of the bottle in respect to the horizon changes and we can do our experiment in a range of angles .Now, to control the velocity of the cylinder we use a dimmer and to find ω we calculate the frequency of the cylinder with camera and multiply it to 2π .
By solving the previous differential equation numerically we get to an important conclusion ;that the motion of the ball damps when our cylinder is accelerating ,and this motion is dependent on the coefficient of friction force. We can observe this phenomenon in our experiment several times .We can also find equilibrium radius of the ball, the shape of the water and the value of the Z_1 from equation above and compare it to the experimental data(fig.4).

Fig.4-experiment equipment

Experiments and analyzing data are explained and found completely in Figures(5,6, & 7).

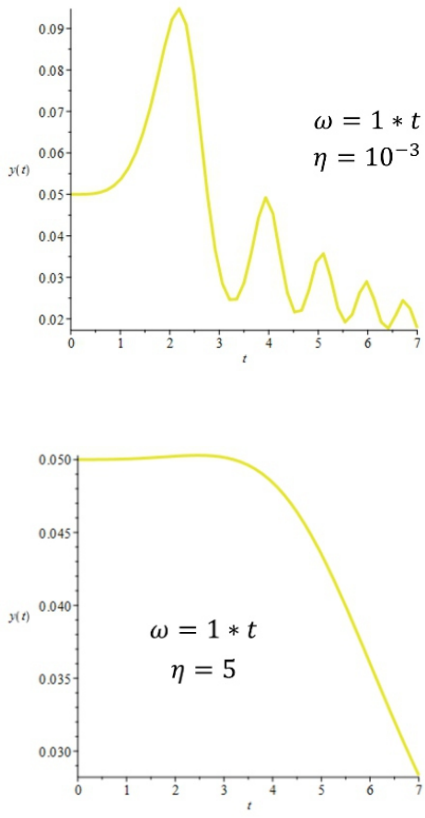

Fig.5-How the motion damps in two different viscosity number

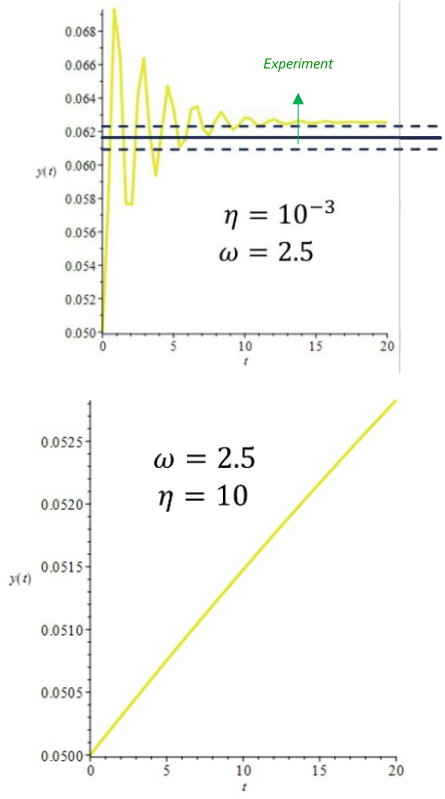

Fig.6-the equilibrium radius of the ball for two different viscosity number (omega is constant)

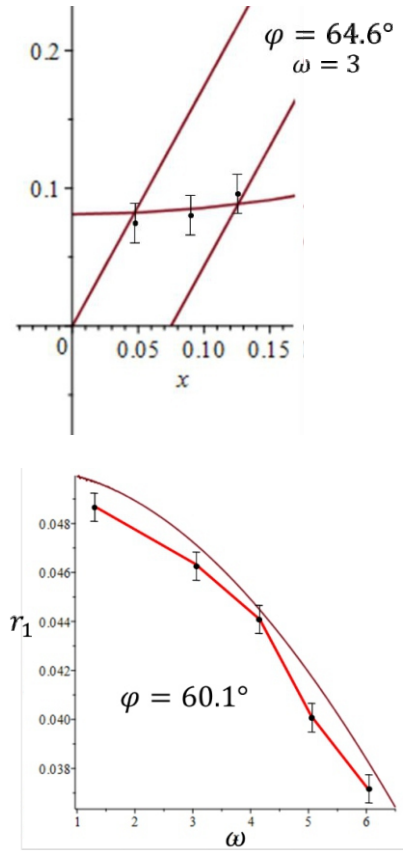

Fig.7: the value of r1 respect to the omega-the shape of the water

Conclusion

After analyzing balls motion theoretically and experimentally we found that the ball has an oscillating movement and that there is a relation between the motion and coefficient of the ball. Meanwhile some of the errors were:

- § We ignored the density changes
- § The integration elements weren't completely circular
- § Approximation of volume (in Archimedes law)
- § Straightness of the tube
- § The surface of the tube isn't completely on the ground
- § Ball changes the shape of water in tube

But despite of these errors you can see that the motion of the ball was well described by related equations.

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IYPT 2017 problem

A sealed transparent tube is filled with a liquid and contains asmall ball. The tube is inclined and its lower end is attached to a motor such that the tube traces a conical surface. Investigate the motion of the ball as a function of relevant parameters.

Constructing a Petri Dish with Capping Ability and the Ability of Adjusting inside Aeration

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Introduction

Standard Petri dishes have bubble-free construction to evenly spread cell growth. High-quality plates have a translucent longevity for high-resolution microscopic studies Disposable or reusable petri dish surfaces come non-treated or treated for cell attachment. Multi-well designs allow simple side-by-side comparisons. Petri dishes, as shallow cylindrical glass or plastic lidded dish, are used by biologists to culture cells, such as bacteria. They are consisted of container and lid that loosely attached to each other. This increases the probability of contamination and leads to drying out of culture media. We aimed to resolve the deficiencies through designing a new Petri dish. Graduated models easily locate specimen even in large culture media colonies. Tight fitting lids protect sample from contamination and may be vented. Aspetic, sterile, and non-sterile Petri dishes come in any growth area size needed.

Experiments

In this study, diagonal threads on the wall of lid and container were precisely created and a screw structure dish capped with a whole turn was constructed. Staphylococcus aureus sensitive to vancomycin and resistance to penicillin and cotrimoxazole was cultured in the designed (with a half turn rotation) and control Petri dishes for 24 h. Also, moisture retention capability of the designed Petri dish was evaluated by incubating at 50˚C for 120 h. The growth rate of aerobic bacteria and moisture retention capability were calculated by measurement of cell volume after centrifuging and evaluating macroscopically, respectively.

Results and Conclusion

The results of bacterial growth showed the same rates in the both dishes while the designed Petri dish indicated significant superiority in moisture preservation compared to the control Petri dish. Findings of the study suggested the designed Petri dish is suitable for biological researches.

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ساخت پتری‌دیش با قابلیت بسته نگه داشتن درب و تنظیم هوادهی به داخل آن

پتری دیش ها ظروفی بشقاب مانند و درب دار بوده که عموما از آن برای کشت میکروارگانیسم ها استفاده می شود. بین دو کفه این ظروف هیچ اتصالی موجود نیست و به راحتی از هم جدا می شوند به همین دلیل هنگام باز کردن بسته های استریل پتری دیش ، باید نهایت دقت در حمل آن ها و نگهداری کلیه پتری دیش های مصرفی و باقی مانده در بسته، انجام شود تا با باز شدن درب آن آلوده نگردد. به همین منظور امروزه از ابزارهای متفاوتی مانند نوارهای مخصوصی برای بسته نگه داشتن درب استفاده می شود. از طرف دیگر گاهی برای خشک نشدن محیط یا عدم ورود آلودگی به درون آن، در نگهداری طولانی مدت، اطراف پتری دیش را با این ابزار مسدود می کنند، که علاوه بر تحمیل هزینه اضافی، سختی کار را بالا می برند. در این پژوهش، ایجاد رزوه هایی مورب در دیواره کفه ها باعث شد تا با یک نیم پیچ، چرخش درب بر کفه زیرین، بتوان علاوه بر بسته نگهداشتن آن، هوادهی را برای رشد میکروارگانیسم های هوازی به داخل پلیت انجام داد نتایج رشد باکتری در هر دو پلیت آزمایش و شاهد مطلب فوق را تایید نمود. و از طرف دیگر، وجود یک حلقه آب بند در سطح داخلی درب منجر به کاهش عبور هوا به داخل ظرف، هنگام پیچش کامل دو کفه بر روی یکدیگر شد. و از خشک شدن محیط کشت و ورودآلودگی احتمالی در نگهداری طولانی مدت ممانعت نمود.

Studying the Effects of Nigella Sativa and Honey on the Rat Immune System

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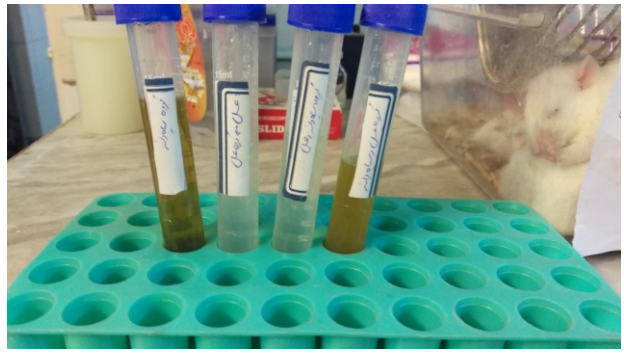
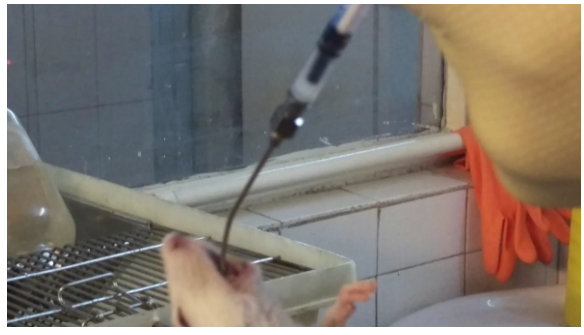
Introduction

The immune system is a host defense system comprising many biological structures and processes. It must detect a wide variety of agents, known as pathogens. Since the advent of communication technology, as humans are exposed to diversified kinds of pollutions including air, water, soil, etc, their immune system can be threaten by causing different types of disorder and deficit. Consequently, consumption of medicine is the reasonable procedure which is really prevalent. As the drawbacks of synthetic drugs outweigh the benefits, consumption of herbal medicines are superior to them. Furthermore, some herbal medicine such as Nigella sativa is an Iranian endemic plant which has a host of various properties as much as honey.

Results and Conclusion

The aim of the present study was to investigate the effectiveness of combination of Nigella sativa and honey in reduction of inflammation and strengthen the immune system. Twenty male mice aged 45 days were divided in to the four groups. Inflammation was induced by the gavage needle. Then they were treated orally for 17 days. The first group was the negative control and was given distiled water. The second, third and fourth groups were given honey, Nigella sativa oil and combination of both respectively and equally. The reduction of Tnf-α in the last group is more significant versus others. In the final analysis, the potential combination of honey and Nigella sativa oil in augmentation of the immune system is higher than others.





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بررسی اثر سیاهدانه و عسل بر سیستم ایمنی موش

امروزه بشر برای درمان بیماری های در ارتباط با سیستم ایمنی از داروهای شیمیایی بسیاری استفاده می کند که علاوه بر تاثیرات مثبت عوارضی را هم دربر دارندکه گاهی این عوارض جبران ناپذیر است. به همین دلیل تحقیقات علمی موجود در عصر حاضر رو به سوی استفاده از داروهای گیاهی و جایگزینی آن با انواع داروهای شیمیایی دارد. از آنجا که گیاهان دارویی دارای سابقه ی مصرف طولانی بوده و عوارض جانبی آن در مقایسه با انواع شیمیایی کمتر بوده و هم چنین از آنجایی که سیاهدانه از گیاهان بومی ایران بوده و تحقیقات انجام شده برآن حاکی از خواص فراوان آن اعم از: ضد سرطان ، ضدالتهاب ، ضدمیکروبی وضدتومور می باشد و همچنین تعدیل کننده ی سیستم ایمنی بدن است و عسل نیز دارای خواص آنتی باکتریال و آنتی اکسیدانی است از این رو در پژوهش‌صورت گرفته ازعسل و سیاهدانه برای بررسی میزان تاثیر آن بر سیستم ایمنی استفاده شده است.

Green Nanotechnology Approach in Manufacturing of $CaCO_3$ Nanoparticles from Eggshell

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Introduction

Nanotechnology is a broad term that refers to all the advanced technologies in the field of work at the nano scale. Green nanotechnology is the study of how nanotechnology can benefit the environment such as by using less energy during the manufacturing process, the ability to recycle products after use and using eco-friendly materials. Eggshell is a part of waste products which is found in household and industrial waste in abundance and despite its low value, its biocompatible calcium carbonate in nano scale can produce a great value added.

Results and Conclusion

In this study, a green, top-down procedure for making CaCO3 nanoparticles from eggshell was investigated. Waste eggshells were used as a raw material to produce high surface area biocalcium carbonate nanoparticles using a combination of mechanical and ultrasonic irradiation techniques. High resolution transmission electron microscopy (HR- TEM) and X-ray analysis showed that the synthesis process was effective and yields only CaCO3 nanoparticles with high porosity.

Coarse powder gained from hot water treatment followed by grinding was passed from a leach at size of about 300-400 microns. In the next step colloidal particles in a solution of distilled water were repeatedly exposed to a programmable ultrasonic homogenizer device. Particle size was determined using a DLS Particle Size Analyzer. The samples were centrifuged to remove large particles and samples supernatant were then converted into powder by freeze-drying. The final powder was characterized by UV-Visible and DLS size analyzer. The results showed that sizes of the particles were in micrometer scale after grinding but were below 100 nano meter after ultrasonic and centrifuge. Nano calcium carbonate powder in this study was produced without the use of any chemical substance and from this aspect; it can be called green nanotechnology.

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The Intelligent Amelioration System for Postural Deformities

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Introduction

Postural deformities are spreading among people at the meantime. In postural deformities, there is an imbalance in the loads imposed on different areas. Various types of postural deformities are Spinal curvature, Flat foot, Knock knees, Bow legs, Round shoulders. Where loads exceed normal physiological limits consistently and over prolonged periods of time, structural changes occur in the skeletal bones. These structural changes cause postural deformities, such as: genu valgum, genu varum, asymmetric shoulders, kyphosis and etc. Diagnosing and curing these deformities instantaneously not only optimizes the treatment, but also reduces the remedial expenses. Yet many people ignore these deformities for several reasons like: lack of knowledge, lack of time or heavy fees for the doctor's referral.

Lordosis is the inward curvature of spine which creates problem in standing and walking and 'Bow legs' is also a postural deformity which the knees are widely apart (Figure 1).

Our purpose for doing this project was to present a proper solution, to simplify and promote the quality of both diagnosis and treatment phases of the postural deformities and still is more accessible than other solutions. In the diagnosis phase the system is programmed to receive the coordination of the joints of user's body by connecting a computer device to a Kinect camera, and also by using a marker-based method recognition for the joints that weren't recognized meticulously by the Kinect device. So combining these two methods and using the most accurate results obtained in each, has improved the accuracy of the diagnosis. Having the coordination of one's joints, the system diagnoses the deformities based on medical standards.

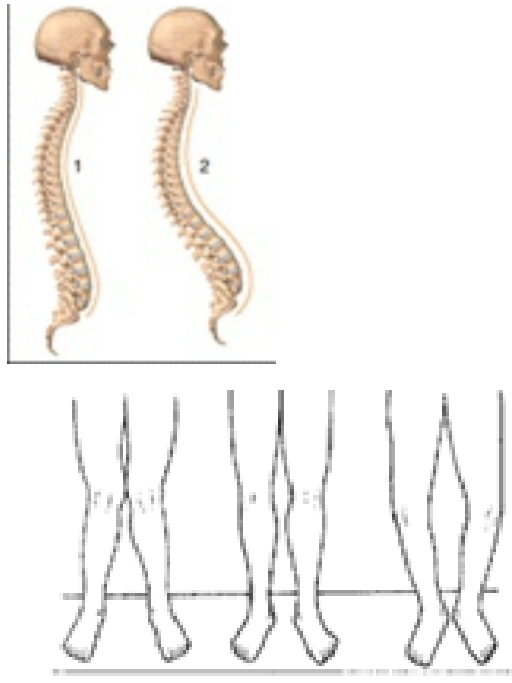

Fig. 1: Lordosis and Bow legs as postural deformity

Conclusion

The implementation of the treatment phase is based on the diagnosis part, which means suggesting a treatment for a postural deformity is related to what we diagnosed in the diagnosis phase. The treatment is usually accomplished by doing some specific exercises for the deformity; these exercises are called therapeutic exercises. According to the fact that Kinect camera is able to monitor the user's movements, we control the

suggested exercises to see whether they're done correctly by the user or not. By these methods every user can do the whole process of the diagnosis and treatment intelligently and without the supervision of any expert.

The expansion of this system can raise the velocity and accuracy of the diagnosis and treatment process, and also can decrease the requirement of an agent as far as possible. This system can be used as a replacement of the doctor in places with the large number of users such as schools which can prevent the waste of time and money.

طراحی سیستم تشخیص ناهنجاری های بدن بدون نیاز به اپراتور

امروزه ابتلا به ناهنجاریهای ارتوپدی شیوع بسیار یافته است. تشخیص و اقدام به درمان این ناهنجاریها در زمان مناسب، میتواند علاوه موثربر ساختن اقدامات درمانی، هزینه های درمانی را نیز کاهش دهد. هدف از انجام این پروژه، ارائه راهکاری برای تسهیل و ارتقای کیفیت فرایند تشخیص و درمان ناهنجاری های یادشده، بوده است. در فاز اول، تمرکز بر تشخیص ناهنجاری ها قرار گرفت. بدین منظور ازطریق ارتباط کامپیوتر با کینکت، اطلاعات مربوط به مختصات مفاصل اصلی بدن کاربر را دریافت کرده و با بررسی آنها، مبادرت به تشخیص ناهنجاری های ارتوپدی کند.

Designed Shoes to Prevent Disease Progression Based on the Pattern of Pressure Sensitive Parts of the Foot

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Introduction

The ability to walk properly is necessary to prevent injury. Strong muscles and joints with the mobility are needed to create an efficient and appropriate cycle.

Walking is one of the easiest cardio exercises you can do, and it's an exercise that comes loaded with health and fitness benefits. As well as helping you maintain a healthy cardiovascular and respiratory system, walking keeps many important muscle groups working, key muscles that you use every day. As your feet hit the floor, normally with a heel-to-toe movement, your calves interact with your ankles to allow each foot to be pulled back on forth.

Trauma, disease and injuries are the most likely causes of foot pain. Poor biomechanical alignment and the type of footwear can also cause pain or discomfort. Shoes that fit tight or are tied too tightly can cause pain on the top of the foot. High heels can cause pain around the ball of your foot just below your toes. Pain and tenderness in a specific area for a prolonged period of time is telltale sign of a possible problem. A few insights into when you feel the pain will be helpful in identifying the problem and finding a possible solution. Is the pain affected by weight bearing, or do you feel it when there is movement of the foot? Does it affect the way you walk?

According to the common foot diseases among most of people I decided to design kind of shoes to prevent progression of this disease. Pressure sensitive sensors, to alert the person, are used.

Experiments

To design the shoes, pressure points were identified by scanning the foot. Vibrating motors placed in replica shoes .

This plan not only avoids making the wrong foot in healthy volunteers, but also helps patients with diabetes who have neuropathy. For diabetics LED warning system is applied instead of vibrating motor.

The advantages of this system: low-volume, light weight, low cost, usability for everyone, reducing health care costs.

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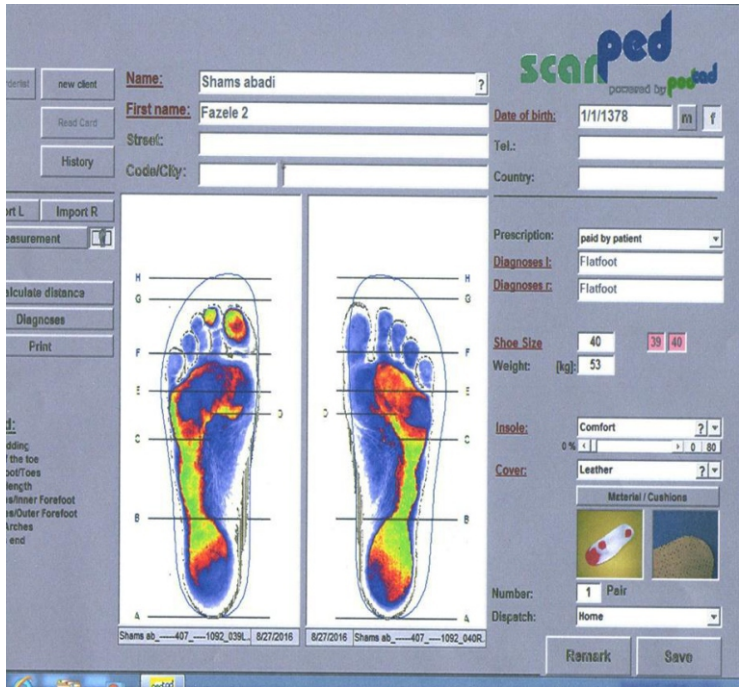

کفش طراحی شده بر اساس الگوی فشاری نقاط حساس کف پا،به منظور جلوگیری از پیشرفت بیماری های پا

با توجه به بیماری های شایع پا که در تمامی سنین و افراد به وجود می آید، طرح ارائه شده می تواند از پیشرفت بیماری و هزینه های بالایی که در پی دارد،جلوگیری نماید..فشـار زیاد وارد شده به پا در به وجود آمدن عوارض مربوط به این عضو نقش اصلی را دارد،به همین دلیل از سنسورر های حساس به فشار استفاده شده است.اسکن دیجیتالی کف پا، یک ارزیابی کامل و جامع از کف پای بیمار به همراه دیگر عوامل حائـز اهمیت، ارائه مـی دهد. در طی این عمل، یک نقشـه از کف پای بیمار تهیه می شود که وزن او، نحوه ی توزیع وزن و فشـار وارد بر کف پا همراه با هرگونه اختلال موجود در کف پا، در این نقشـه در نظر گرفته شده اند. انجام این اسکن تنها چند دقیقه زمان برده و پس از آن یک ارزیابی جامع از هر یک از سه قوس در هر پا، ارائه خواهد شد . در این طرح ابتدا،نقاط حسـاس به فشـــار پا در کفش زنانه و مردانه طراحی وبه صورت سه بعدی نشـــان داده شد.در مرحله ی بعدی حسگر ها در نقاط از قبل تعیین شده داخل کفش اصلی جاسازی گردید.در صورت فشار غیر متعارف حسـگر ها فعال شده وفرد را از نحوه قرار گیری بد پا آگاه می کنند.

An Optical Device to Measure the Glass Properties

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Introduction

An optical device has been constructed to determine the properties of a glass sheet such as refractive index and thickness without direct contact. One of the standard methods to determine the refractive index is semicircle shaped glass. But here it is a method to overcome the disadvantages of the previous devices and to provide thickness measuring apparatus which is able to determine the thickness of a transparent workpiece in a high degree of accuracy and more inexpensively, due to its construction

Methodology and Experiments

Laser Light is impinged on the glass to provide a pair of beams reflected from the front and back surfaces of the glass plate respectively. These two points on the front of the device are detected by Pixycam which takes successive photos. These photos are sent to Arduino board which by using different theories in Matlab the characteristics of glass can be obtained by MATLAB programm. Then these data are shown on a LED screen. Several glasses have been applied to find the results of this setup successfully.

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وسیله اپتیکی برای اندازه گیری خصوصیات شیشه

دستگاه شناسایی ضخامت انواع شیشه و اجسام شیشه ای با استفاده از لیزر و دقت بسیار بالا بدون برخورد با سطح شیشه و بدست آوردن ضخامت از یک طرف شیشه هدف از انجام این پروژه می باشد. توانایی سنجش شیشه باضخامت ۱میلی متر تا چندین سانتی متر با استفاده از دوربین پیکسی و برد آردوینو و نمایشگرLCD , برنامه ریزی شده با استفاده از برنامه هایMATLABوARDUINO تمام آزمایش ها انجام شده و تمام نتایج نمودار بندی شده است.

کاربردهای آن در صنعت هواپیما سازی برای تست ضخامت شیشه های هواپیما (پنجره های هواپیما باز نمی شود)وشیشه های آسمان خراش ها(برج ها) می باشد.

Research: Int. Conference of Young Scientists, ICYS 2016, Romania
Bronze Medal , Life Science
STEM Fellowship Journal, 2017,3(1): 7-14, http://doi.org/10.17975/sfj-2017-002

بررسی اثر عصاره ی الکلی پوست بادمجان بر مرگ سلول های سرطانی معده در انسان

هدی سراج، فاطمه افشاری، زهرا سادات هاشمی،مرضیه تیماچچی، انسیه علمافر، لادن قطبی
مدرسه راه شایستگان، تهران

چکیده

آپوپتوز، مرگ فیزیولوژیک سلولی است که در شرایط طبیعی سبب حذف سلول های پیر، آسیب دیده، اضافی و مضر می شود و برای تکامل و هوموستاز بافتی ضروری است . سرطان بیماری است که در آن سلول های آسیب دیده آپوپتوز انجام نمی دهند و تقسیم کنترل نشده سلول ها نهایتاً منجر به شکل گیری تومور بدخیم می گردد .سرطان معده با حدود ۷۷۵۱ نفر فرد مبتلا شده در سال ۱۳۸۷یعنی حدود ۱۰/۱۷ درصد جمع کل زن و مرد در سال ، یکی از شایع ترین سرطان ها در ایران است و متاسفانه راه های درمانی موجود غالباً تهاجمی بوده و اثرات جانبی سوئی را برای فرد مبتلا به همراه دارد. در این تحقیق ما مایل بودیم از ترکیبات طبیعی دارویی ضد سرطان تهیه کنیم و از آن جایی که پوست بادمجان سرشار از ترکیبات حاوی آنتی اکسیدان است آن را انتخاب کردیم. . فرضیه ی اولیه ی ما در این مطالعه این بود که با توجه به وجود ترکیبات حاوی آنتی اکسیدان در پوست بادمجان، عصاره ی آن باید قادر باشد سلول های سرطانی را از طریق فعال کردن آپوپتوز در آن ها ، از بین ببرد. برای آزمودن فرضیه ی تحقیق ، اثر عصاره ی الکلی پوست بادمجان بر روی روند آپوپتوز دو رده سلولی سرطان معده (AGS) و سلول های نرمال پوست (FIB) با روش رنگ سنجی MTT مورد بررسی قرار گرفته است. در این روش ملح MTT که زرد رنگ است، توسط آنزیم های دهیدروژناز موجود در میتوکندری سلول های فعال به ترکیب غیرمحلول و ارغوانی رنگ فورمازان تبدیل می شود. جذب این ترکیب پس از حل شدن در DMSOدر ۵۷۰ نانومتر قابل اندازه گیری است. اثر غلظت های مختلف عصاره پوست بادمجان (۲۰ ، ۱۰ ، ۵ ، ۲/۵ ، ۱/۲۵ ، ۰/۶۲۵ ۰/۳۱۲ ، ۰/۱۵۶، ۰/۰۷۸) بر روی رده سلولی های سرطانی معده (AGS) و رده سلولی نرمال فیبروبلاست (FIB) بررسی شد .

نتایج

با افزایش غلظت عصاره پوست بادمجان اثر سایتوتوکسیک آن بر سلول های سرطانی معده افزایش می یابد ولی بر سلول های نرمال اثری ندارد. نتایج حاصل از این تحقیق نشان داد که پوست بادمجان در غلظت های ۲/۵ میکرومولار اثر سایتوتوکسیسیتی بالایی بر روی رده ی سلولی سرطانی معده دارد که می تواند به علت القای آپوپتوز در این سلول ها باشد و در همین غلظت کمترین اثر را بر روی سلول های نرمال فیبروبلاست دارد . نتایج به دست آمده از آزمایش نشان دهنده تاثیر مثبت عصاره پوست بادمجان بر روی آپوپتوز سلول های سرطانی دارد و می توان از عصاره پوست بادمجان در ساخت داروهای ضد سرطان معده استفاده کرد.

STEM Fellowship BIOLOGY

Effect of Eggplant Skin in the Process of Apoptosis in Cancer Cells

10.17975/sfj-2017-002

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Editor's note: This project was a submission at the 2016 ICYS event, through the Araian Young Innovative Minds Institute, AYIMI, where Seraj was awarded a Bronze medal.

Abstract

The process of programmed and physiological cell death, or apoptosis, is generally characterized by distinct morphological characteristics and energy-dependent biochemical mechanisms. Apoptosis normally removes old, damaged, excessive and harmful cells and is essential for tissue homeostasis. Cancer is a disease in which damaged cells do go through apoptosis and ultimately uncontrolled cell division results in the formation of a malignant tumor. Stomach cancer is the most common cancer in Iran with about 7751 affected in the year of 1387. This is about 10.17% of the total male and female population per year. Unfortunately, existing treatment options are often aggressive with harmful side effects for the patient. In this study, we decided to prepare anti-cancer drugs from natural ingredients such as eggplant skin which is rich in antioxidants. The primary hypothesis of this study was that due to the presence of compounds containing antioxidants in eggplant skin, the extract should be able to destroy cancer cells by activating their apoptosis. This hypothesis was examined by MTT colorimetric method in two series of cells: gastric cancer cells (AGS) and normal fibroblasts cells (FIB). The yellow MTT salt becomes an insoluble purple formazan by dehydrogenase enzymes in the active mitochondria of cells. The results of this study show that eggplant skin extracts in concentrations of 2.5 μM have a high cytotoxic effect on gastric cancer cell lines, which could be due to the induction of apoptosis in these cells and the least effect on normal fibroblasts cells. Therefore, eggplant skin extract has a positive effect on the apoptosis of cancer cells and can be used in the production of stomach cancer drugs.

Key Words

Apoptosis, Cancer, Eggplant Skin, MTT Colorimetric Method

Optimizing Maximum Ejecting Speed for a Gaussian Accelerator Cannon

10.17975/sfj-2016-001

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Abstract

This paper aims to find the maximum speed of an ejected steel ball from a magnetic cannon and determine its relation to other setup parameters. A magnet induces dipole moments in steel balls inside a magnetic cannon and makes them stick together along a straight line. At the moment of collision, this attraction reduces the motion of the balls in other directions. This creates a more efficient momentum transfer along the series of steel balls and consequently, a higher sped for the ejected ball. The striking ball was released from a height of 6 cm above the rail and and collided with two magnets, followed by three balls. The speed was calculated using the projectile range formula. The speed was found to be a damping non- monotonic function of the number of balls after the magnet. The effective parameters were studied and the maximum velocity obtained under experimental conditions was cm/s. Figures were made using Solidworks Software and data were analyzed using Microsoft Excel 2016 and Gnuplot software.

Key Words

Gauss rifle, neodymium magnets, Steel balls

Introduction

The magnetic cannon also known as gauss rifle is a series of steel balls connected to a strong magnet. The balls and magnets lie on a nonmagnetic rail. Another ball with a known initial momentum collides with the sequence of balls and magnets , causing the last ball to eject with a high velocity. This paper aims to determine the conditions under which the final speed of ejecting ball is maximized. When experimenting with magnetic cannons, it is important to ensure that the magnets are fixed in place to avoid any backward movement. Balls should be aligned along a straight line for optimized momentum transfer. It is preferable for better alignment to use magnet and balls with the same diameter.

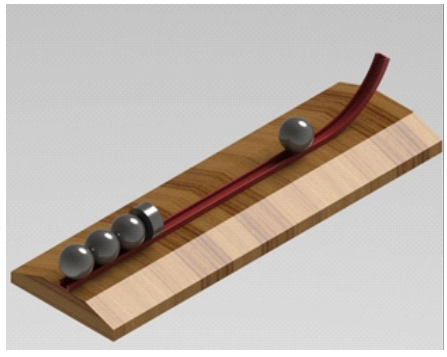

Figure 1 : Gauss rifle

این مساله در مسابقه دانشجویی فیزیک سال ۲۰۱۶ ارائه گردید و در ژورنال STEM Fellowship کانادا به چاپ رسید.

Mohammadreza Noormandipour

Physics, Shahid Beheshti University; Research Fellow at CERN- LHCb-(EP_LBD); STEM Fellowship Journal - Student Editorial Board Member

First place in Iran Physicists' Tournament, IRPT,

Participated in IPT 2015, Poland

Wavelike-fire extinguisher

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Abstract

In this research by simulation and several experiments the parameters which are important to be considered in building a wavelike-fire extinguisher as a new device have been investigated. The most complete hypothesis is based on the phenomenon of vortex or fluid flow. According to this hypothesis, the transmitted audio forms several vortex flows of air with frequency and amplitude, which leads to an increase in the vibrations of oxygen and its removal from the fire environment. By experiments and data analysis, future models are introduced as fire extinguisher too.

Key words

fire extinguisher, acoustic waves, automotive systems

Introduction

There is a lot of fire damages in all over the world, for instance in jungles, cities & … but how can we avoid these damages by extinguishing fire very quickly, from distance? A new plan as fire extinguishers is sound. "DARPA" or America's Defense Advanced Research Projects Agency launched the Instant Fire Suppression (IFS) research program, tasked first with finding out more about the actual nature of fire, and then using this new model, found knowledge to develop novel fire suppression techniques. Instead of chemical reaction, DARPA's main realization was that flames are *cold plasmas*, and thus could be manipulated with physical forces such as electromagnetic radiation and acoustic waves. In this research by simulation and several experiments I have found the parameters are important to be considered in building a wavelike-fire extinguisher as a new device and develop this device by electromagnetic waves; and use it for firefighters. To compare with other fire-extinguishing equipment, it is compact and lightweight which proves its superiority. This scheme can be used in future automotive systems, mechanical equipment, residences or as a supplement to extinguish the fire.

Basic Theories and Hypothesis

Hypothesis 1: Damping Energy of gas fluid will be given as (Eq. 1):

$$\sum E = 0 \Rightarrow E_{sound} = E_{fluid} \Rightarrow E_m sin^2(kx - \omega t_1) = \frac{1}{2}k's^2 \quad (1)$$

and coefficient of oscillation for gas fluid (Eq. 2) is:

$$k' = m\omega^2 = \rho V\omega^2 = 4\pi^2 f^2 \rho V \quad (2)$$

Energy and power of sound wave (Eq. 3 & 4) are, respectively:

$$E = \int P.t = 2tA\pi f \Delta p_m s_m sin^2(kx - \omega t) \quad (3)$$

$$P = \frac{A(\Delta p_m)^2}{\rho v} sin^2(kx - \omega t) \quad (4)$$

K	number of wave
K'	coefficient of oscillation
ρ	density of gas fluid (in condition of fire)
V	volume of gas
Δp_m	maximum pressure difference
s_m	maximum displacement of sound wave
A	surface of gas
F	frequency of sound wave
T	time of extinguishing fire
λ	wave length

the frequency can be found as (Eq. 5 & 6):

$$E_m \sin^2(kx - \omega t_1) = 2\pi^2 f^2 \rho V s^2 \quad (5)$$
$$\Rightarrow \; 2tA\pi f \Delta p_m s_m sin^2(kx - \omega t) = 2\pi^2 f^2 \rho V s^2 \Rightarrow t\Delta p_m$$
$$= 3.14 f s_m \Rightarrow 1.7584 f = t * 289845.4871 * \frac{6.28}{\lambda} \Rightarrow$$
$$f = 579690.9742 * \frac{t}{\lambda} \quad \Leftrightarrow \quad t = H \; (even\ number) \quad (6)$$

Hypothesis 2:
Vortex formation (air flow) with specific frequency is the most complete hypothesis. According to this hypothesis, the transmitted audio forms several vortex flows of air (as the ring) with frequency and amplitude, which leads to an increase in the vibrations of oxygen and its removal from the fire environment. The frequency will respond at a specific interval and depending on the characteristics of the wave, the time for the shutdown of the fire is different.
Velocity of the ring as a function of distance (Eq. 7) is:

$$V = Vo\, e^{-cx} \quad (7)$$

Velocity of the ring as a function of time (Eq.8):

$$V = \frac{Vo}{(1 + Voct)} \quad (8)$$

Radius of the vortex ring (Eq. 9) is:

$$R = \sqrt[3]{\frac{3Ro^L}{4\gamma}} \quad (9)$$

And distance traveled by the ring in time t (Eq. 10) is:

$$X(t) = \frac{1}{c}\ln(Voct+1) \quad (10)$$

so energy of a ring (Eq. 11) will be:

$$E = \frac{1}{2}\rho \Gamma^2 R \Lambda' \qquad \Lambda' = ln\left(\frac{8R}{a}\right) - \alpha \quad \alpha = 2.05 \quad (11)$$

Where the parameters are:

L , T	stoke length and stoke time
Vp = L/T	mean velocity of sound source
L/Do = Vp T/ Do	dimensionless formation time
L/Do = 4	formation number
Do , Ro	diameter and radius of the pipe
V	kinematic viscosity of the fluid
γ	eccentricity of the air
K	Bessel added mass factor
Cdc	measured drag coefficient on a ring

Experimental setup, tools and Results

The instruments were used in our setup are included as signal generator, power supply, amplifier, pipes, aperture, subwoofer and fuel (Fig. 1). ANSYS, CATIA, MATLAB, and Proteus Professional were software for data analysis. Multi meter, Oscilloscope, dB meter and ruler were measuring tools.

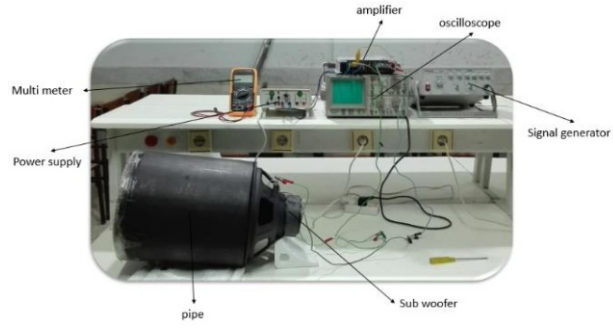
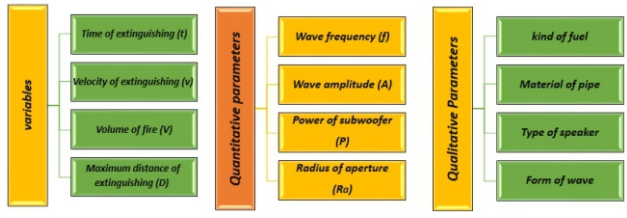


Fig 1: Experimental Setup

Variables, qualitative and quantitative parameters are separately clarified in table (2).

Table 2: Different parameters in this investigation



In constant volume of fire, length of the pipe, radius of aperture, power of woofer with oil as fuel and changing the frequency, time of extinguishing in different distances are calculated and the relation are shown as (Fig. 2 & 3).

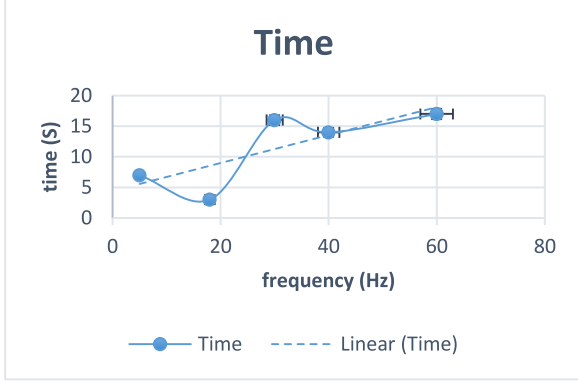


Fig. 2: Time vs frequency

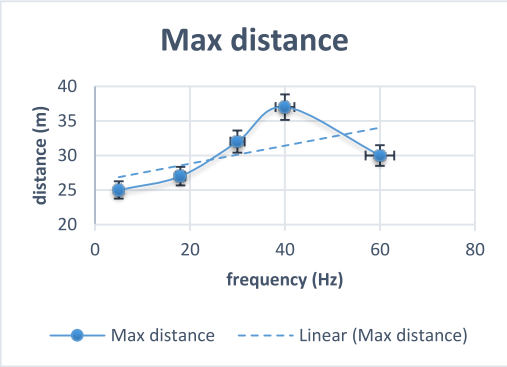


Fig. 3: Distance vs frequency

Radius of aperture, the amplitude and power of speaker are parameters have been investigated too (Fig. 4 -7).

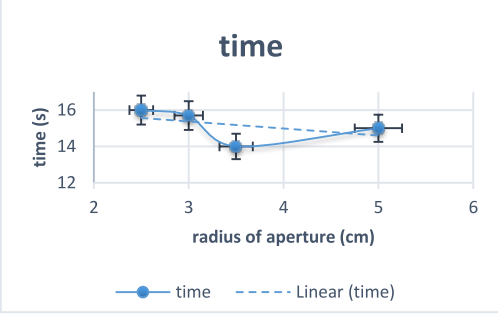


Fig. 4: time vs radius of aperture

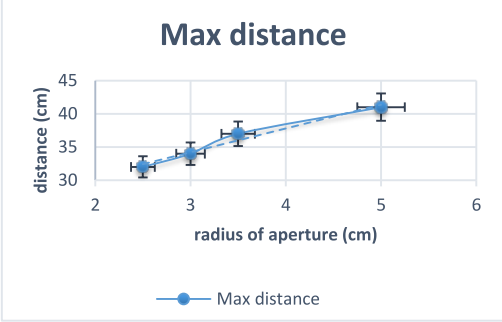


Fig. 5: Distance vs radius of aperture

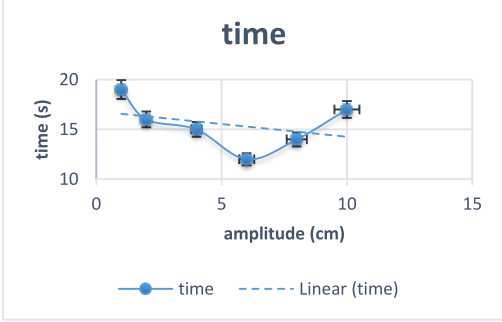


Fig. 6: Time vs amplitude

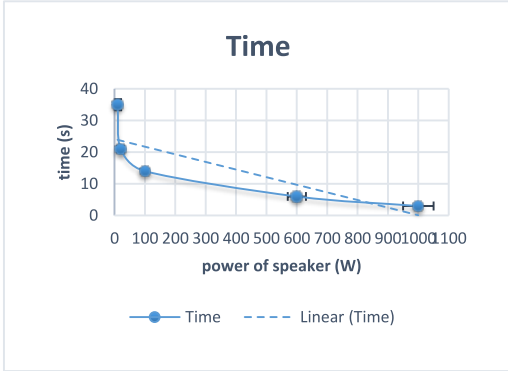


Fig. 7: Time vs power of speaker

Conclusions and Discussion

As the result we found how changing frequency, radius of aperture, amplitude and power of speaker will effect on time and maximum distance of extinguishing.

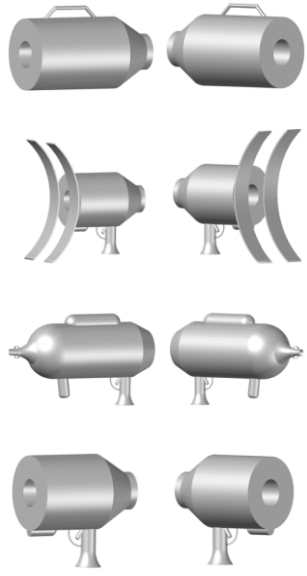
$$t \begin{cases} \propto \frac{1}{A} \\ \propto P \\ \propto f \\ \propto \frac{1}{r} \end{cases} \qquad D \begin{cases} \propto \frac{1}{A} \\ \propto P \\ \propto f \\ \propto r \end{cases}$$

What are the flaws of this model and how we can solve these problems (table 4)?

Table 4: Flaws and solutions

Flaws	Solutions
bad noise	using ultrasonic or electromagnetic waves
Inability to eliminate heat	using liquid nitrogen cool pad or use CO_2 gas instead of a
non-portable	using ion battery instead of power supply and making signal generator which use DC electricity
Heavy weight	using subwoofer made by Ferro-fluid or light materials, and miniaturize the materials

Future Models



Models	Features
Sound wave model	frequency domain (5-60 Hz) _ power of subwoofer (100-1000 watt) _ length of pipe (30 cm)
Electromagnetic wave	frequency domain (very high) – having antenna – control by app(available) – length of pipe(20 cm)
Ultrasonic wave	having horn (acoustic lens) – frequency domain(very high) – cooling pad – length of pipe (30 cm)
Fire extinguisher along (sound wave)	length of pipe (20 cm) – frequency domain (5-60) – control with app – having Wi-Fi and blue tooth – portable – having lithium ion battery

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Resonating Glass

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Abstract

To investigate how the resonance of a glass partially filled with liquid depends on various parameters when it exposed to the sound from a loudspeaker our experiments have been done. It is well known that the pitch of the sound produced by an excited glass shell can be tuned by adding some liquid in it. This investigation is approached through recording the frequencies due to change each parameters by two different methods. The PC software tool FFT – Properties was used to calculate the frequency . Also NCH Tone Generator software was used to produce the sound with a constant frequency. In other method microphone was placed approximately 2 cm below the glass rim and at a distance of about 2 mm from the glass. Then by hitting the glass and recording the sound, the natural frequency of glass was found by MATLAB . By analyzing the theories and results of testing, we concluded the intensity and frequency of sound affect on the resonance of glass . Also volume and density of liquid which is poured in glass, have influence on this phenomenon. The intensity and frequency of sound has a direct relationship with the resonant frequency of the glass but volume and density of liquid and the glass resonant frequency are related inversely with each other.

Introduction

By rubbing your moistened finger around the rim of a water glass besides enjoying a generally rather pure tone emitted by your singing glass, you might even take pleasure in observing some ripples on the liquid surface that follow your rotating finger. On a less playful level, many famous composers such as Mozart, Berlioz, or Saint-Saëns have written master music pieces for instruments based on glass vibrations, also called "musical glasses". Unlike materials such as quartz or iron, the molecules in glass are arranged in an amorphous structure rather than a crystal. The lack of a crystal lattice structure makes glass very brittle, and it shatters via a conchoidal fracture that does not exhibit planes of separation. Most ordinary glasses used in windows and jars are soda-lime glasses, while many drinking glasses are made from borosilicate glass to protect them from the thermal strain of hot beverages. Force exerted by the finger is rich in harmonics only the fundamental component match the frequency of vibrational mode despite the bowing with violin bow and stick slip mechanism whose mode frequency are harmonically related . Most glasses will contain microscopic cracks that serve as the seed crack from the fracture. For a thin sheet of material in a glass, the weak material properties of glass substantially ease the ability of sound pressure waves to meet the energy threshold of a fracture. The vibrations of a glass which is in front of a speaker vibrate the air molecules and continue their propagation by vibrating the molecules of glass wall .When they pass the glass wall, continue their vibration by shuddering the molecules of the liquid that is poured in the glass. But what happens when the sound waves arrive to the end of the first environment (the border between the two environments). Actually some of the waves pass the common border between the two environments and enter the second environment and rest of them are reflected from the common border and return the first environment. When the energy is applied to the

glass, it will be vibrated at its natural frequency. The main approach in this research is measuring the resonant frequency of glass in different conditions.

Theory and Experiments

When waves travel towards each other, instead of breaking the rhythm totally, they travel through each other. There are two types of superposition, constructive, where the net sum of the waves gives a positive displacement, and destructive, vice versa. When the sound source is speaker, the sound waves are distributed in spherical form. This kind of source distribute waves in the form of concentric spheres (The center of all the waves is from the source) around its space. When the waves get away from their source, the energy of sound will be distributed on a larger surfaces of radius r . If the power of the produced waves is constant, then wave intensity will be proportional to the inverse square of the distance from the source. So if we double the distance between a point and sound source , the sound intensity will be a quarter of the first case (Fig. 1).

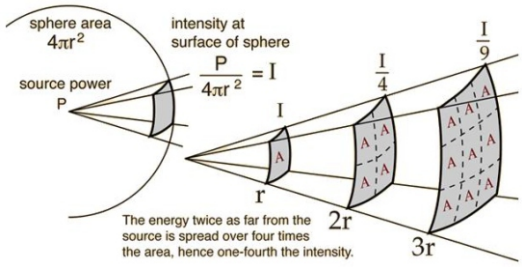

Fig. 1: the relationship between the sound intensity and wave area, http://whatmusicreallyis.com/research/cymatics/

A rigorous treatment of the vibration of liquid-loaded glasses is a complex matter for several reasons. Even for an empty glass, the profile is not simple and is different for every glass type. In addition, the wall thickness varies progressively from relatively thick at the base to thin at the top edges (Fig. 2a). In vibrating glasses the fundamental mode distorts the circular rim into an ellipse (Fig. 2b). A solution for mode shape and frequency could, of course ,be obtained for an arbitrarily shaped partly filled glass by using finite-element numerical analysis, but this would lead to specific rather than general understanding.

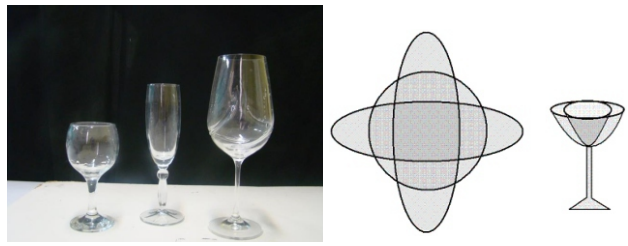

Fig. 2: a) several types of glasses, b) how vibration makes distorting in glass

The experimental setup consists of 3 types of glasses, some liquids such as Honey ,Water Glycerin ,something to hit glass which doesn't make sound itself and of course should be something doesn't add obtrusive frequency and also NCH Tone Generator software was used to produce the sound with a constant frequency (Fig. 3).

Fig. 3: Experimental setup

The frequency of a simple harmonic motion like a mass on a spring is determined by the mass m and the stiffness of the spring expressed in terms of a spring constant k (Hooke's Law) (Fig. 4).

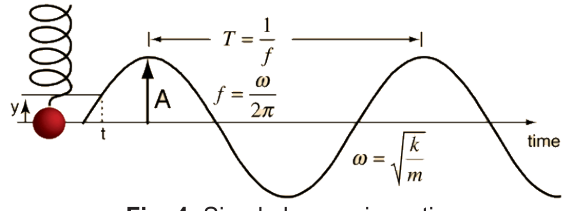

Fig. 4: Simple harmonic motion

f_0= frequency of empty glass
f_d= frequency of partially filled glass (Hz)
β = a constant
ρ_l = density of liquid
ρ_g= density of glass
R = radius of water
a = glass thickness
d = distance from top of glass top water
H^*= effective height of glass

$$\left(\frac{f_0}{f_d}\right)^2 \approx 1 + \frac{\beta \rho_l R}{5 \rho_g a}\left(1 - \frac{d}{H^*}\right)^4 \quad (1)$$

$$\left(\frac{f_0}{f_d}\right)^2 = 1 + kX^4 \quad (2)$$

For visualizing glass vibration , the laser beam was used (Fig.5).

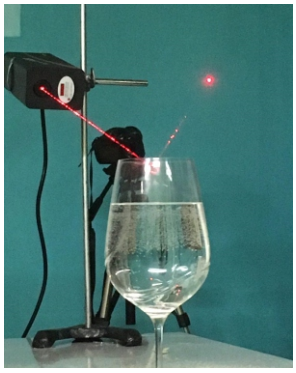

Fig. 5: Detection glass vibration by laser

In the first experiment the frequency of the glass filled with different liquids were investigated.

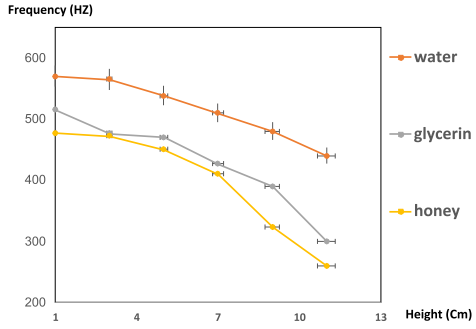

Fig. 6 : Frequency of glass with different liquids

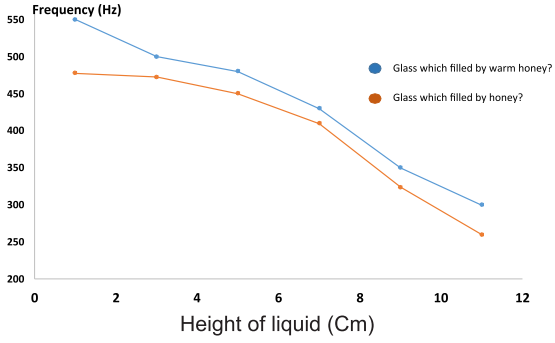

Fig. 7: Frequency of glass with honey but in different temperatures

The power of the sound is steady and we changed the area by changing the distance between the speaker and the glass to investigate the effect of sound intensity on the resonant frequency of the l glass (Fig. 8).

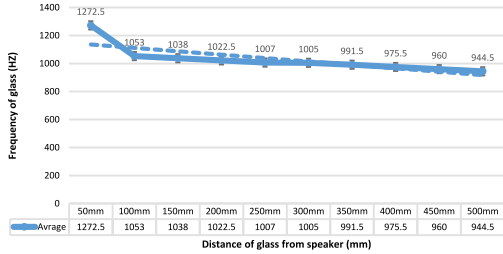

Fig. 8: t frequencies of the glass in different distances

The relationship between the sound intensity and the area was investigated too (Fig. 9).

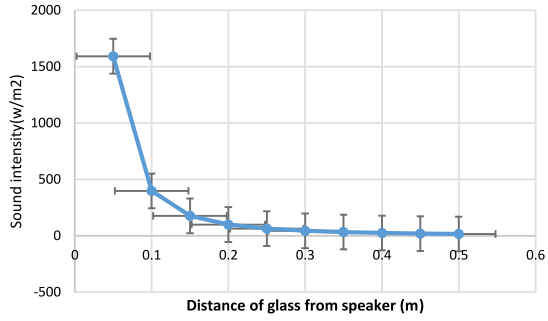

Fig. 9: sound intensity in different distances of the glass

When a wave passes the environment, in dealing with it, vibrate its first particle. After that, that particle starts to vibrate the nearest bit to itself with the same frequency which it has received from the wave. So that transferring the energy of the sound will be done by transferring the energy of the sound will be done by transferring the wave frequency to every single bits of environment. In high-frequency the number of vibrations per second is much more than the low-frequency sound. Thus, we can conclude that high-frequency waves transfer more energy than the low-frequency sound. In other experiment we have investigated the effect of frequency of played sound on resonant frequency of glass by changing the frequency of sound (Fig. 10).

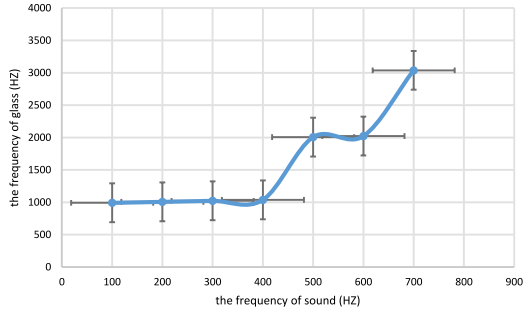

Fig. 10: frequency o the glass in different speaker frequencies

The effect of liquid density on resonant frequency was investigated by four kind of liquids with different densities, water, dense salt water, glycerin and alcohol (Fig.11).

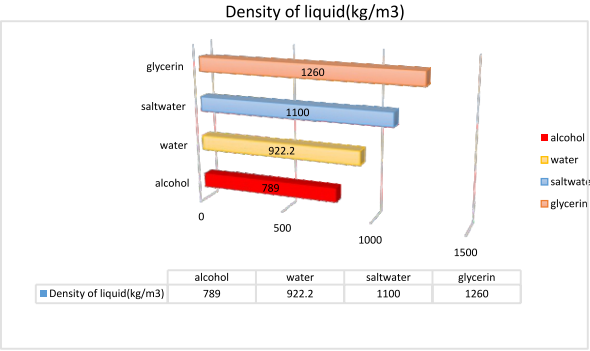

Fig. 11: frequency o the glass in different densities of liquid

The relation between the frequency of glass and depth of liquid was investigated too. First of all we found small amounts of liquid do not significantly change the pitch level. Thus, the pitch is nearly constant at about 1395 Hz as the glass is filled up to the quarter of its total height, i.e. about 4 cm. As more and more water is poured into the glass, its effect on the pitch lowering is more important. It decreases regularly and significantly down to 703 Hz as more liquid is added into the glass shell (Fig. 12).

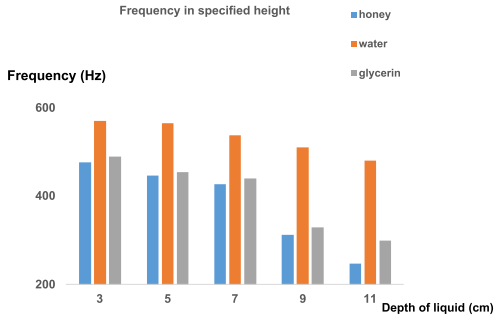

Fig. 12: frequency of the glass in different depth compared in different liquids

Conclusion

According to the experiments and the theories, the following conclusions can be reached:

-Sound intensity and its frequency have a direct relationship with the resonant frequency of the glass which means by increasing these parameters, resonant frequency of the glass will increase too.

-The lowering effect of the liquid is simply due to the added vibrating mass in the glass–liquid system as mentioned earlier. In order to understand the increasing effect of water on the pitch level as more and more liquid is added, it is necessary to take into account the vibrating profile of the shell. Since the bottom of the shell cylinder is clamped, its vibration is very small in the lower part of the glass inducing negligible oscillations in the liquid.

As the water reaches higher heights, it comes into contact with parts of the shell which vibrate with larger amplitudes Therefore, the upper part of the liquid contributes more significantly energy of the liquid–glass system. Indeed, the frequency shift versus the liquid level in the glass shell is very sensitive to the vibrating mode profile. The frequency of the sound is plotted versus the upper water level reached for various initial amounts of water in the glass. From any initial resting amount of water, the rotation of the liquid clearly lowers the pitch level by a significant amount. For instance, a glass filled with an initial level of h = 10 cm has a pitch level of 800 Hz.

-Experiments give evidence of ,if liquid has more viscosity it has less frequency and deeper tone but of course natural frequency of glass changed from specified height , the part of glass which filled by liquid doesn't vibrate as quickly as the part which doesn't filled by any liquid .

-The results clearly confirm the weak contribution of the central part of the liquid because of the decaying radial amplitude of the vibration. Although our simple model permits us to give a good description of the observed influence of the cylinder on the pitch lowering, it cannot explain the small differences measured for each cylinder.

-The presence of a liquid does not change the vibrational structure of a singing water glass in a first approximation in spite of the obvious lowering of the resonance frequency, i.e., the vibrational movement of the glass continues nearly undisturbed below the level of the liquid. A more

detailed analysis of our experimental results reveals, however, that the nodal line becomes modified near the glass rim: using time-average holographic interferometry, however, in the case of immersed cylinders, the acoustic impedance must be taken into account for a more accurate analysis. The additional pressure on the glass shell induced by the lateral liquid flow is not negligible any more. Although all liquids have less viscosity like water change natural frequency from specified height and some liquids which has more viscosity like honey , glycerin change natural frequency from the first, but we can say all liquids in glass are like damper in spring that is reason why liquids change frequency. That's one of the parameters influences on resonance of glass. The other parameters are shape of glass , glass thickness, density of liquid, radius of the bowl, rim of the glass and height of the stem of glass.

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Ultra-Hydrophobic Water

10.17975/sfj-2017-004

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Abstract

When a drop of a viscous fluid is deposited on a bath of the same fluid that is vibrating, it is shown that it coalesces with this substrate or lifts off when the vibration of the surface is larger than g, leading to a steady condition where a drop can be kept bouncing for any length of time, as shown in figure 1. The phenomena that will occur depends on various parameters, such as drop impact acceleration, liquid surface tension, density, dynamic viscosity, gravity, droplet radius and impact speed, bath vibration frequency and amplitude. The effect of different parameters will conclude to a set of conditions which results in a system, called "ultra-hydrophobic water" which plays important role in chemical micro fluidic applications.

Key Words

Ultra-hydrophobic, Soapy Water, Loudspeaker, Vibrator, Small droplets

Introduction

The impact of a liquid drop on a quiescent liquid bath has been widely studied due to its visual appeal and its importance in both natural processes and industrial applications. Physicists found thatafter a droplet falls on the surface of the same liquid, it will bounce several times before merging with the liquid. Back in 2005, Couder discovered that upon placing a silicon droplet on the surface of a bath of the same liquid, the droplet will not coalesce under certain conditions and will instead stay on the liquid surface for a period of time. Such a lubricating film can delay or completely avoid coalescence, as shown in figure 2.

This phenomena depends on various parameters such as drop impact acceleration, liquid surface tension, density, dynamic viscosity, gravity, droplet radius and impact speed, bath vibration frequency and amplitude.

In this study, the theory of this phenomenon will be explained both theoretically and using an experimental set up, where different parameters were investigated.

Materials and Methodology

Using high speed cameras, it has been shown that when a liquid droplet falls on the surface of the same liquid, it doesn't submerge immediately; it will bounce several times, go in and come out of the liquid and finally submerge into the liquid. This all happens within a very short period, which is why coalescence is the only observation made at the impact time.

To extend the duration of time during which the droplet will stay

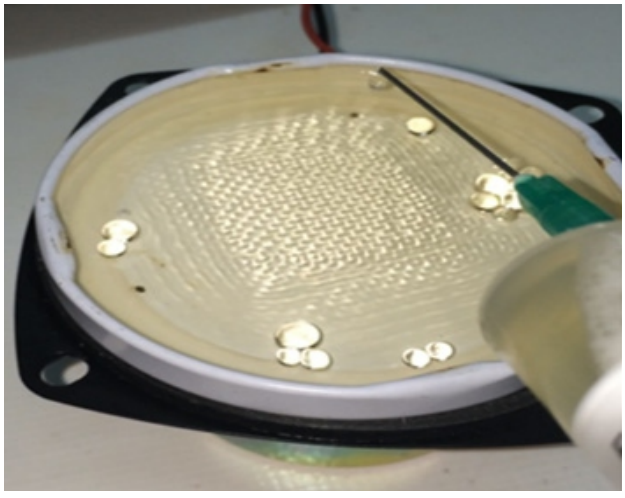

Figure 1: Smaller drops stay (bounce) more and longer on the water surface.

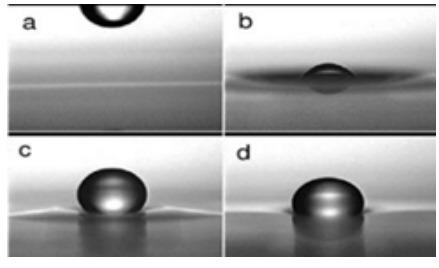

Figure 2: Four steps of sitting a droplet on the liquid surface after impact [1].

Twisted Rope

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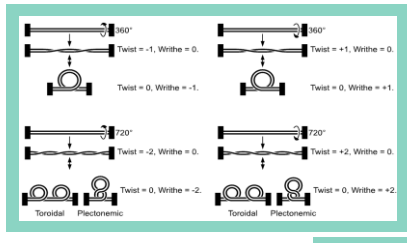
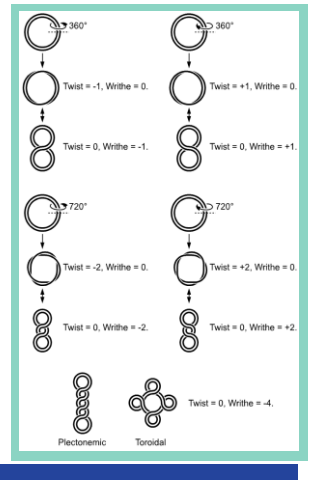
Abstract

Twisting a piece of string at some point causes the string to become buckled. Further twisting that piece of string will eventually cause it to coil around itself forming a Helix-Like structure. In this research, we investigated the formation of the first loop , (and measured the distance of the two ends of the rope towards each other (D) and the rotation angle (R). Displacements are controlled and the corresponding forces and moments remain passive. Several plastic ropes with different lengths are used. One of the ends of the ropes was fixed and the other end was rotated. Once the first loop occurred, the distance between the two ends of the ropes was measured. The Experiment's Error was nearly 10% and we only surveyed the mathematical model in two dimensions. The gravity effect is neglected. We concluded that, by using the mathematical model, we can understand when a loop occurs with regards to specific (R) s and (D)s.

Introduction

Twisting a piece of string at some point causes the string to become buckled. Further twisting that piece of string will eventually cause it to coil around itself forming a Helix-Like structure. This is something that all of us have observed at some point in our real life. Born , carried out some elegant large deflection bending experiments by hanging weights on the end of a rod (i.e., dead loading) [1] . Yabuta,using an energy method, assumes an initial helical deformation (which is Love's solution [3]) and obtained the Greenhill,formula for the onset of looping, which in fact describes the primary bifurcation for a rod with zero bending moments at its ends. Modeling the loop as a circle, he also derived a formula for the point at which it reopens (i.e., pop-out), which he compared with his experimental results [2]. Goss and coworkers by using varied R (Rotation) and fixed D (slack) ,found that if a loop forms in a rod, then unwinding the twist may instigate a dynamic jump as the rod pops out of self-contact [4]. The importance of this phenomenon is comprehended in several aspects of science. For example: In **“engineering”** , Marine cables under low tension and torsion on the sea floor undergo a buckling process during which tensional energy is converted to flexural energy . The cable becomes highly contorted with loops and tangles, this can permanently damage the cable. In **“textile industry”**, and the study of multi-filament structures such as yarns is interesting.





A Mechanical Random Number Generator

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School: Farzanegan 2

Introduction

Truly random numbers are a very valuable and rare resource. Design, produce, and test a mechanical device for producing random numbers. Analyse to what extent the randomness produced is safe against tampering. So many ways were in use to generate random numbers until now .There were simple ways like throwing a dice or flipping a coin and some complex ways like lotto machine .Also there are many ways to generate random numbers in computer.

Random numbers are rare, useful and valuable resources and they are used for gambling, statistical sampling, computer simulation, cryptography, completely randomized design, and other areas where producing an unpredictable result is desirable. There are many ways to generate them like mechanical devices as roulette wheels, lotto machine, dice and so on; and the computer methods as defining a function like rand function in quick basic programing language and so on. But how random are they and how can we get sure that no one can cheat?

Experiments

To solve this problem two ideas were closer to reality. The first one was to make an icosahedron dice and the second was to prove that a disk gives us numbers randomly. So I have two ways to test the randomness of the numbers; first is the practical way which is to get a large amount of random numbers of the device and calculate the percentage of numbers, and the second is to theoretically prove that they are random. Actually both of them were used to prove that this dice is what the question asked to make. So I made my icosahedron by magnets and then I put numbers 1 to 20 on its faces. It weights nearly 1kg and its longest diameter is about 8cm and the edges are 4cm. For the first method (to get a large amount of numbers and calculate the percentage of every number), I diced for 640 times. As we got in the practical way its tolerance of randomness is about 2%. If we use the method of having the highest and the lowest percentage difference as our tolerance, that it should be less than 5%, if we want to assert that it gives us random. The second method is to calculate the average of tolerances of each number. By this way it will become 0.45% and if we want to assert that it's randomly, it should be less than a limit between 1% and 2% (according to how much random do we expect it to be); that the dice lives up to this too.

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Building Antibacterial Banknotes by Adding Nanosilver Particles Synthesized in the Gas Phase

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Abstract

Silver particles are able to show antibacterial and antiseptic properties at the nanoscale [1,2]. These properties result from an alteration in the binding capacity of silver atoms in the nanosilver particles which enables them to kill harmful organisms through destroying their vital enzymes. Given that currency notes are one of the major sources of bacterial contamination and might be a critical factor in enteric infections and other health problems [3,4], here we propose a new method for producing antibacterial banknotes by using silver nanoparticles.

Materials and methods

In the present study, we used formaldehyde in the gas phase to incorporate silver nanoparticles into the banknote tissue in a homogenous way. The materials and equipments used in the third method included: (1) silver nitrate, (2) ammonia, (3) formaldehyde (the reducing agent) , (4) deionized distilled water, (5) acetone, (6) a heater , (7) 3 beakers (cap., 200ml), (8) a Petri dish, (9) a banknote, divided into two halves, one of which was used as experimental and the other as control. First, we prepared a 0.025 M solution of silver nitrate and ammonia by using deionized water, so that the following reaction could occur:

$$AgNO_3\ (s) + 2NH_3\ (l) \longrightarrow Ag(NH_3)_2NO_3\ (aq)$$

We also sprayed acetone thoroughly all over the banknote to make it clean (Only the experimental part of the banknote was involved in the procedure). Note that this action is only necessary when a used banknote is experimented, but unnecessary for new banknotes that have just been printed. Then the banknote was thoroughly impregnated with the solution of silver nitrate and ammonia by putting it into a Petri dish that contained the solution. Next, 50 ml of formaldehyde solution was poured into a beaker (cap. 200 ml) and 100 ml of distilled water was added to it. The beaker was put on a heater with a temperature of 80 degrees Celsius. Then we put an aluminum net on the beaker and put the banknote on top of it to be exposed to formaldehyde vapor so that the following reaction could take place:

$$Ag(NH_3)_3NO_3\ (aq) + H_2CO \longrightarrow Ag\downarrow + NH_3\uparrow + HCOOH\uparrow + NH_4NO_3$$

According to the reaction, formaldehyde can lead to reduction of silver in the silver nitrate and ammonia. We expected that the released silver atoms would create small nanoparticles which would be placed on the banknote and penetrate its tissue. To produce an optimal amount of silver nanoparticles, the heating was continued for 20 minutes. Among the side products of this reaction, ammonia and formic acid were quickly evaporated and did not remain on the banknote. In order to remove the NH_4NO_3, the banknote was soaked in a solution of water and acetone. Thus, after evaporation of the acetone, all side products of the reaction were eliminated and only the silver was left on the banknote. Finally, the banknote was dried. According to our inquiry, the method used here for synthesizing nanosilver particles is novel. Also the way used for reducing silver in a solution of silver nitrate and ammonia is innovative.

Results

The scanning electron microscope (SEM) image showed that the silver particles on the banknote had a size of less than 90 nanometers. To examine the antibacterial property of the new product, we conducted a few challenge tests using some of the most prevalent pathogenic microorganisms (i.e., escherichia coli, staphylococcus aureus, and pseudomonas aeruginosa). In all conditions, a statistically significant higher level of antibacterial effect was observed for the treated part of the banknote in comparison with the other part. These results were obtained in spite of the very low amount of silver in the new product.

Conclusion

The proposed method can be helpful for preventing the spreading of infectious diseases, especially in countries having a high usage of banknotes. The low amount of silver used in this method ensures that it is not only economical but also safe. Note that products with a high amount of silver can be harmful for human beings [2]. The method is especially economical for higher value banknotes. Our procedure can be implemented by adding a simple device to banknote printing machines.

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ساخت دستگاه الکتروفورز عمودی چهار ژله با سیستم خنک کننده یخی

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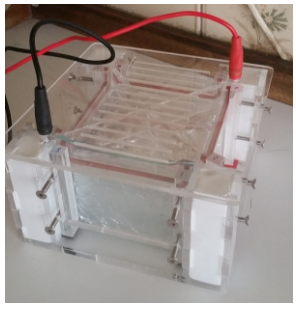
پژوهش زیست شناسی، دبیرستان فرزانگان ۶

راهنمای پروژه : حمیده حاتمی هنزا

چکیده:

دستگاه الکتروفورز عمودی دستگاهی است که در آزمایشگاه ها برای آنالیز بیو مولکول ها و برای جداسازی نوکلئوئیک اسید ها و پروتئین ها مورد استفاده قرار می‌گیرد.ذرات باردار توسط میدان الکتریکی برقرار شده حرکت کرده و از هم جدا می‌شوند استفاده می شود. عدم امکان بارگذاری هم زمان تعداد بالای نمونه، عدم امکان افزایش ولتاژ منبع به منظور بالا بردن سرعت آزمایش؛ بدون سیستم-های خنک کننده و هزینه بالای سیستم های خنک کننده یا ناکارآمدی آن ها در دستگاه های ایرانی و هزینه زیاد دستگاه های مشابه خارجی و حجم بالای بافر مصرفی در آن ها، موجب شد تا این گروه پژوهشی با اتصال چند قطعه پلکسی و آب بندی آن با کلروفرم، دستگاهی چهار طرفه بسازد که پس از سیم کشی و نصب فیش ها، بتواند علاوه بر امکان بارگذاری ۴۰ نمونه، گرمای حاصل از ولتاژ بالا را نیز به علت وجود محفظه فلزی حاوی ژل یخ در وسط سیستم تحمل کند. پس از طراحی دستگاه موردنظر، صفحات پلکسی در اندازه‌های متناسب با لیزر برش داده شد. پس از سوار نمودن صفحات بر روی یکدیگر و اتصال موقت آن‌ها با چسب کاغذی سیم‌ها و فیش‌ها متصل شد.و صفحات توسط کلروفرم به یکدیگر متصل و آب‌بند شدند. فضای خالی بین هر گوشه توسط چسب آکواریوم پر گردید. خطی u مانند در هر طرف برای جلوگیری از ریزش بافر تانک بالا توسط فیلمان سلیکونی ایجاد شد. شیشه‌های مخصوص ژل‌گذاری برش داده شد و با پیچ‌های تعبیه شده به دستگاه متصل گردید. مکعب مستطیلی فلزی متناسب با محفظه محصور شده توسط دستگاه، ساخته و قبل از جوش دادن ضلع آخر، درون مکعب توسط یخ ژل پر گردید. پس از تست‌های انجام شده به منظور اطمینان از آب‌بند بودن محفظه‌ها، دستگاه برای تست و مقایسه با نمونه‌های مشابه ایرانی به انستیتو پاستور ارسال شد.



Magnus glider

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Abstract

Stretch the free end of the elastic band and then release the glider. Investigate its motion."
Magnus effect has been seen on many flying balls and cylinders like golf balls and etc. it cause the object to curve away from its principal flight path. In base ball matches when player hits the ball, the ball moves in a certain flight path which is somehow like sagittal diagrams in mathematics. This research concludes an investigation on Bernoulli law and by solving it, a lift for a flying cylinder concerning kutta-Joukowski theorem has been obtained.
Experiments were done and by tracking the movement of the glider from the videos that has been taken, diagrams has been drawn and compared to theoretical ones and the result was a flight path for the glider.

Back ground knowledge

At first what does the Bernoulli theorem says? Briefly, Bernoulli theorem is that the fluid pressure decreases at points where the speed of the fluid increases. When something is flying through the air it changes the flow streamlines around it by changing the streamlines some forces are applied to the object. Every flying object basically has 4 forces applied on it:
Weight: is the force of gravity. It acts in a downward direction—toward the center of the Earth.
Lift: is the force that acts at a right angle to the direction of motion through the air. Lift is created by differences in air pressure.
Thrust: is the force that propels a flying machine in the direction of motion. Engines produce thrust.
Drag: is the force that acts opposite to the direction of motion. Drag is caused by friction and differences in air pressure (Fig. 1).

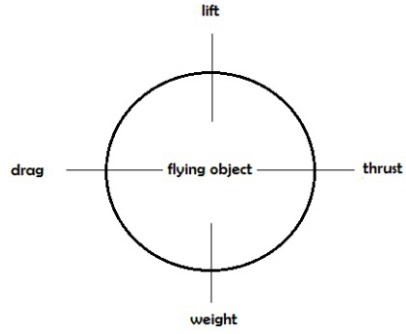

FIG.1: forces on a flying object.

The Magnus glider which has been used in this research is made of two light cups (Fig. 2).

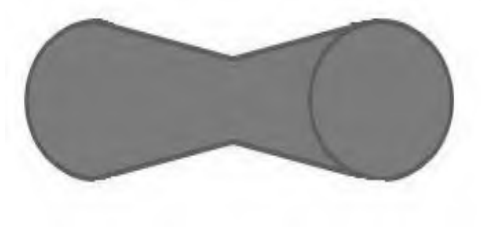

FIG.2 : Magnus glider

Then this glider was considered as two cylinders which the average of both was considered as a cylinder that contains Magnus glider so the first assumption is that the glider is a cylinder with certain accuracy.

Theoretical solution

In FIG.3, a torque will be generated by a resultant vector of force that makes an angle with the axis of rotation of the glider. If the glider has had a sphere ball shape, this torque would cause a motion in a circular path but because of its shape, weight and the axis of rotation which is x , it will deviate from this circular path. But still moves in a semicircular path according to Magnus effect which the lift force is also one of the reasons for gliders motion.

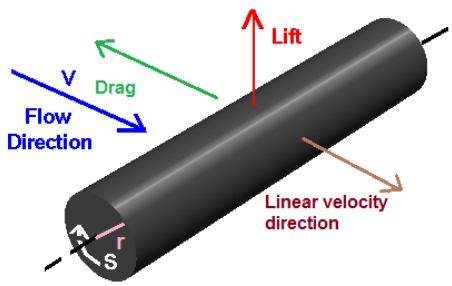

FIG.3: forces and flow directions on glider

First assumptions:

1. Glider is considered as a cylinder
2. In the beginning the flow is considered as incompressible

Assume a cylinder is flying through the air, by its motion it will change the air streamlines around it. It is clear that Reynolds number is important in this change in air flow. Reynolds number explains if the airflow is laminar or turbulent as (Eq. 1) :

$$Re = \rho UD/\mu \qquad (1)$$

By checking the Reynolds number and changes in flow it has been found that the flow around the assumed cylinder is laminar and the flow behind it is turbulent. In a cylinder flying and rotating through the air it will obviously change the air stream lines around it. If the linear velocity is defined as v ,velocity in point a is v+ωr because cylinder is rotating clockwise so in point A rotational speed which is ωr has the same direction with flow stream line. But in point B because rotational speed vector and flow stream lines are in opposite directions so the outcome of these vectors is the result of their subtraction (Fig. 4).

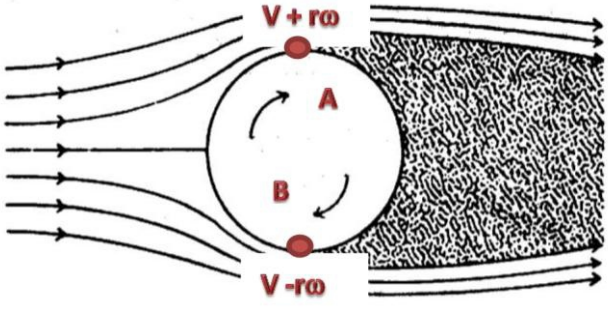

FIG.4: velocity of two points on a vertical line in air

According to Bernoulli, pressure will decrease in points where velocity increases. Velocity in point A is v+ωr and in point B velocity is defined (v- ωr). So velocity in point A is larger than point B therefore pressure in point A is smaller than point B. Flow moves from high pressure to lower pressure. Now due to this pressure gradient mentioned there's an upward force created called lift.The glider is rotating clockwise (Eq. 2).

$$\frac{1}{2}P(v-r\omega)^2 + P_1 = \frac{1}{2}P(v+r\omega)^2 + P_2 \qquad (2)$$

$$\Delta P = \frac{1}{2}P((v+r\omega)^2 - (v-r\omega)^2)$$

$$dF = \Delta P l dU$$

Bernoulli solution

To obtain the pressure distribution from Bernoulli equation after velocity distribution:

$$\frac{P_\infty}{\gamma} + \frac{U^2}{2g} = \frac{P}{\gamma} + \frac{\left(-2U\sin\theta + \frac{K}{2\pi a}\right)}{2g} \qquad (3)$$

$$\frac{P}{\rho} = \left(\frac{U^2}{2}\right) + \left(1 - 4\sin^2\theta - \frac{K^2}{4\pi^2 a^2 U^2} + \frac{2K\sin\theta}{\pi a U}\right) \qquad (4)$$

$$F_{Lift} = Y = -\int_0^{2\pi} Pa\sin\theta d\theta \qquad (5)$$

$$F_{Lift} = Y = -\frac{1}{2}\rho U^2 a\int_0^{2\pi}\left(\sin\theta - 4\sin^3\theta - \frac{K^2\sin\theta}{4\pi^2 a^2 U^2} + \frac{2K\sin^2\theta}{\pi a U}\right)d\theta \qquad (6)$$

$$\int_0^{2\pi}\sin^3\theta\, d\theta = \left[-\cos\theta + \frac{1}{3}\cos^3\theta\right]_0^{2\pi} = 0 \qquad (7)$$

$$F_{Lift} = Y = -\frac{\rho UK}{\pi}\int_0^{2\pi}\sin^2\theta d\theta = -\frac{\rho UK}{\pi}\left[\frac{\theta}{2} - \frac{\sin(2\theta)}{4}\right]_0^{2\pi} = -\rho UK = \rho U\Gamma \qquad (8)$$

Thus for the unit length of cylinder lift force would be FL = Y = ρUΓ which is known as Magnus effect and does not depend on the size of cylinder and can be shown that this is not a function of cylinder shape. Meaning that any object that circulation around it is Γ,lift force above is applied.

Of course in actual flow of fluid the amount of circulation generated is a function of shape, size and body condition. Drag force is along the air flow and enters from the flow to object. Pressure drag force for a cylinder with circulation in ideal or Non-viscous fluid is calculated by equation (9).

$$F_{Drag} = X = -\int_0^{2\pi} pa\cos\theta d\theta = 0 \qquad (9)$$

But in actual fluid flow it is not used and is generated by the effects of viscosity. This difference between actual flow and ideal flow is called D'Alembert's paradox in actual fluid with rotating cylinder a

circular flow around the cylinder can be generated. As a result the flow around the cylinder is with vortex and the lift force is created. This issue is even seen in other objects motion such as a ball rotating and is used to navigate ships by wind. In this research the equation used for calculating the drag force is given by equation (10).

$$F_D = \frac{1}{2}\rho v^2 C_D A \qquad (10)$$

Where
F_D is the drag force,
ρ is the density of the fluid
v is the speed of the object relative to the fluid,
A is the cross sectional area, and
C_D is the drag coefficient – a dimensionless number

Kutta-Joukowski theorem for a cylinder

$$L = \rho G V \qquad (11)$$

where
ρ is gas density
G is vortex strength, $G = 2\pi b v_r(*)$
V is velocity(m/s)
(*)v_r is the rotational speed ,$v_r = 2\pi bs$
s is spin (rad/ second)
b is radius of cylinder

As you see Bernoulli and Kutta-Joukowski reach the same lift formula.

Equations of Motion

The equation of motion is written based on the formulas mentioned before. Cylinder has a projectile motion and starts it motion with an initial velocity makes an angle with the horizon line. Like the figure (5) velocity and every action and reaction forces has been decomposed into its horizontal and vertical components. Then by writing equation of forces in each axis and solving , motion equations have been obtained and lift and drag forces are calculated from Kutta-Joukowski theorem and drag in actual flow.

Theoretical diagrams

In this stage motion equation are used to get a predicted diagram of the glider motion which is simply close to a motion (Fig. 6).

$$\sum Fx = -L_y - D_X$$

$$\sum Fy = L_x - (D_y + W)$$

$$F_{net} = ma \quad \Rightarrow \quad a = \frac{F_{net}}{m}$$

$$a_x = \frac{-L_y - D_X}{m} \qquad a_y = \frac{L_x - (D_y + W)}{m}$$

$$v_x = a_x t + v_{x\,n-1} \qquad v_y = a_y + v_{y\,n-1}$$

$$x = v_x t + x_{0\,n-1} \qquad y = v_y t + x_{0\,n-1}$$

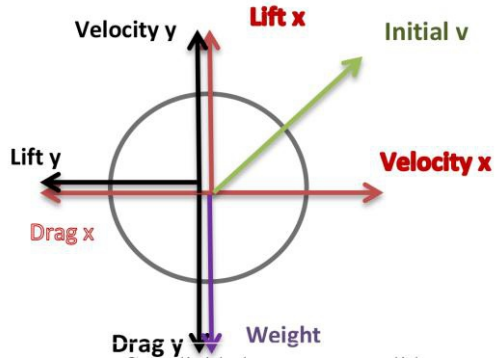

Fig. 5: action and reaction forces

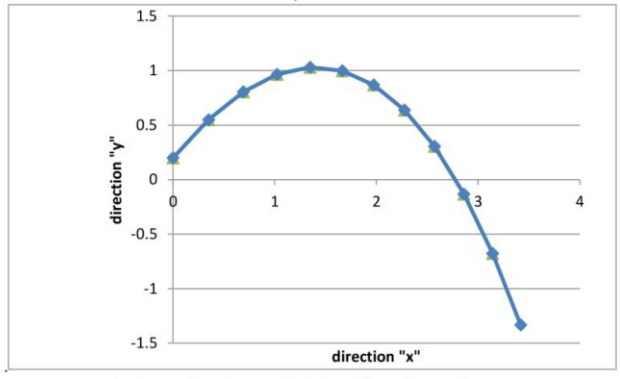

Fig. 6: graph derived from theory data

In this predicted graph the origin of coordinates was considered 1.7 m above the ground with the initial velocity of 5 meters per second. The object will start moving with a minus acceleration(retarding motion) and in peak point it reach velocity approximately equal to zero and then continue with a positive acceleration(quicken motion) till it reach the ground and stop moving, so it won't reach zero velocity (stop moving) before collision with ground .

Experiments

Using 2 light cups and a power adhesive tape, glider was made and rubber bands that give the initial force for navigating the glider were made by knotting them to each other. Like the figure (7) rubber bands are twisted around the glider and by

releasing the free end glider starts its movement.

FIG.7: process of making a simple Magnus glider.

By tracking a video of experiments with "tracker" program, the location was drawn (Fig. 8).

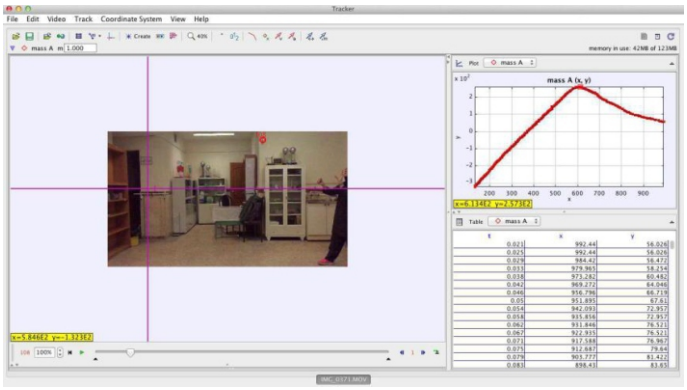

Fig. 8: screenshot of "tracker" program

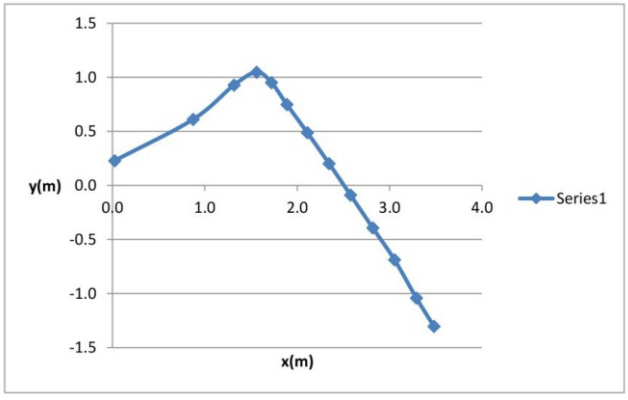

Fig. 9: graph derived from an experiment video (13 points are used from 445 data)

As shown on the figure (9), glider travels an upward path with a decrease in velocity (which is because of the predominance of drag force and other surface frictions) until it reaches the top part where linear velocity approaches zero but still acceleration exist. After that continue its path with an increase in the velocity (in this state weight force overcome the lift force) till it collide with the ground and stop moving.

Relative parameters are:
a) if the glider weight is higher then it will decreases the lift force
b) low initial velocity causes lower acceleration
c) high density of fluid causes to decrease velocity and angular velocity
d) the shape of objects changes the motion

Some of the errors are:
a)Possibility of wind blowing or turbulence in air flow around the glider which causes errors in the gliders motion and deviation from the path
b)Holding the glider and the rubber band around it in a wrong way (too up or too low,..) that cause the wrong motion in glider
c)Existence possibility of inequality and roughness on the glider surface that increase the friction and change the path of motion
And other environmental errors

Comparison between theory and video processing has been shown in figure (10). The general form of two diagrams are the same even the peak points are very close to each other and simply the same but in some points such as the distance between starting point and the peak ,theoretical diagram act a bit more smooth and parabola shape but in experimental diagram data are more factual .

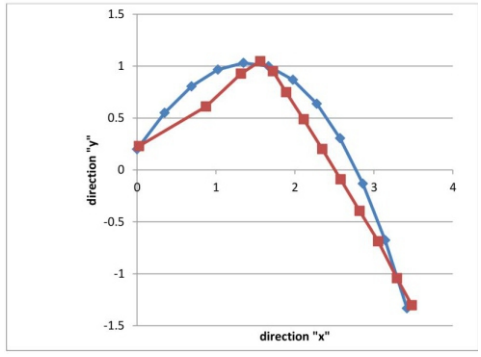

Fig. 10: comparison between theoretical and experimental data

Conclusion

- Magnus effect changes the motion behavior of a thrown object in a projectile motion and creates more lift like forces that make the glider to fly higher.
- The glider will fly with a decreasing velocity caused by drag force and frictions and reaches a point where the glider has the velocity approximately equal to zero and

then continue the path with approximately constant velocity and won't stop before colliding with the ground.

- Lower weight cups can make the glider to fly much higher than heavier ones.
- By considering the flow around the glider semi laminar, a path can be drawn for the glider movement.
- Three forces are applied on the glider: drag, lift and weight, and also because the glider starts moving with velocity and not a force then glider has no thrust.

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Crazy Suitcase

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Supervisor: Mahmood Reza Amini

Abstract:

When two wheel's suitcase is pulled along, under certain circumstances it can wobble side to side so strongly to the limit that it may turn over. Study this phenomenon. Can it be suppressed or intensified by changing of the luggage packing? By hypothesis such as balance condition and several experiments, important parameters have been investigated.

Inroduction

Hypothesis1: The suitcase is in balance condition

As illustrated in figure (1) when the suitcase is in balance condition by proper packing, accordingly the center of mass is on on *Z* axis, which leads to torque of the suitcase around *X* axis.

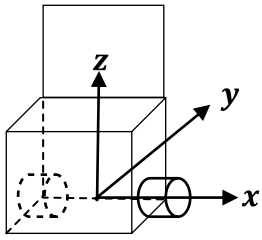


Fig. 1: suitcase is in balance condition

First, we solve a simple problem and then generalize it to the original question.

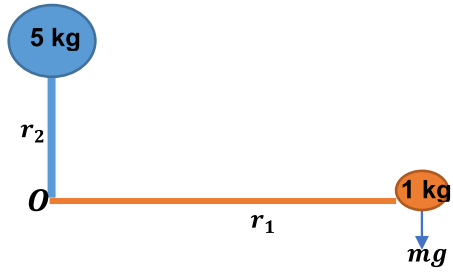
Theory

The physicists have always been using simplification methods and skills to solve complex issues and problems; so a simple question is initially examined which will be extended to the complicated question in next step and we want to do it.

Question Simplification

Step 1:

It is presumed that two spheres like cannonball as shown in figure (2) are interconnected by means of two light rods and whole system is fixed to the wall in the point of O.



$$\tau_t = r\, m_1\ sin\theta$$

Fig. 2: The illustrated system in suitcase

Firstly, we study the illustrated system as shown in figure (2), under this condition, developed torque is on the ball with weight of 2 kg which causes the mentioned ball to turn to the right side; however, when the below illustrated system (Fig. 3) is considered, in that case, the torque is existed on the both weight and consequently there would be probability of load dropping to the both side.

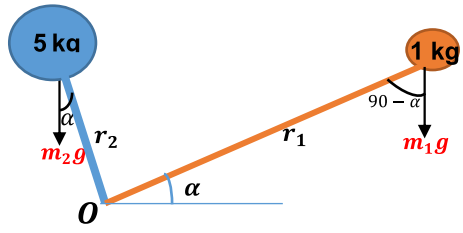


Fig. 3: Connected wheels with different condition in suitcase

5 kg → $\tau_2 = r_2 F_2 sin\theta_2 = r_2 \times m_2 g \times \sin(180-\alpha) = r_2 m_2 g \sin(\alpha)$

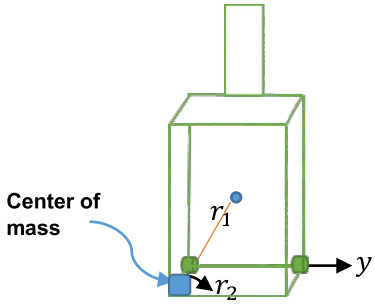
1 kg → $\tau_1 = r_1 F_1 sin\theta_1 = r_1 m_1 g \sin(90-\alpha) = r_1 m_1 g \cos(\alpha)$

$$\tau_1 + \tau_2 = r_2 m_2 \cancel{g} sin\alpha - r_1 m_1 \cancel{g} cos\alpha = 0$$

$$r_2 m_2 sin\alpha = r_1 m_1 cos\alpha$$

$$tan\alpha = \frac{r_1 m_1}{r_2 m_2} \quad (1)$$

Based on the calculation it is concluded that the magnitude of developed torque on the balls depends on two quantities:



1.The forced applied by the weight

2. The Length of the lever arm.

Now, by solving this problem, we get back to the previous question.

Step 2:

In this system, two following parameters are important in torque:

1- The centre of mass of baggage

2- Centre of gravity of the load

And suitcase can have two rotations:

1- Rotation around y (θ)

2- Rotating which is caused by the disruptions (Φ) (orbit the suitcases category)

-Before turning to luggage:

$$\vec{r_2} = \frac{1}{2}\begin{Bmatrix} a \\ b \\ c \end{Bmatrix} \qquad \vec{r_1} = \begin{Bmatrix} a \\ 0 \\ 0 \end{Bmatrix}$$

After rotation: matri x r_1 and $r_2$must be multiplied as follows:

$$\vec{r_2'} = \begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix} \vec{r}_2 \qquad \vec{r_1'} = \begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix} \vec{r}_1$$

If this formula is inserted into the formula (1), we have:

α angle between r_2' and g

β angle between r_1' and g

($\vec{g}$ vector to the centre of the Earth)

By putting these two equations :

$$\tau_{r_2'} = r_2'(m_2\vec{g}) \sin\alpha$$

$$\tau_{r_1'} = r_1'(m_1\vec{g}) \sin\beta$$

in the **Mathematica** app for baggage with dimensions of 10, 20 and 30 cm and a mass of one kilogram for baggage (M) and weighs 4 kg for luggage once inside (m) and the carrying angle is θ = 30 , accordingly, the critical angle for staggering baggage in this particular case is 18.4349. If luggage reaches to this critical angle, it will begin to wobble.

Important Parameters in suitcase wobbling

Parameters which are affecting on the wobbling in suitcases are as follows:

-wheel dimensions
- material of wheels
- shape of wheels
- distance of wheels between each other
- concurrent moving of wheels
- speed of suitcase
- angle of person's hand
- category of suitcases
- location of wheels
- ruggedness surface/ obstacle
- surface material (friction)
- handle adjoined body or wheels
- material of load (liquid or solid)
- dimensions of suitcase
- place of center of mass

wheels and baggage is considered as a single object.

Here, we have extended the simplifying assumptions to the original problem. Also assume that the suitcase as a rigid object and cuboid, and it is symmetric (simple premise: 2). (In fact it is not). We had to get the **best** parameters.

-Surface roughness: unevenness of the surface also causes suitcase stumbling.

Type of collision: When a suitcase is pulled over the stony ground, it hits the stones; therefore, it begins to move unsteadily and sways as it is being stricken by stones. Under this condition, the suitcase hits the obstacles continuously and loses part of its energy with each stroke. Partially energy losses in the suitcase is inevitable and therefore, the wobbling period is shortened and consequently it falls down faster as being stricken by more obstacles. With respect to the mentioned conducted experiments, it is observed that the magnitude of developed torque on the suitcase (when it is pulled over uneven surface) is larger and time taking to fall down is less comparing with the time it is pulled over even surface.

-Suitcase's speed: Assume that the suitcase is

moving on a flat surface, but suddenly bops to an obstacle and wobbles and finally falls. If the movement's speed is increases, the suitcase wobbles more. Because in this case, suitcase has traveled the same distance of the obstacle at the less period, so the impact intensity of the obstacle will increase and this force will be transferred to suitcase that was causing more torque (Fig.4) .

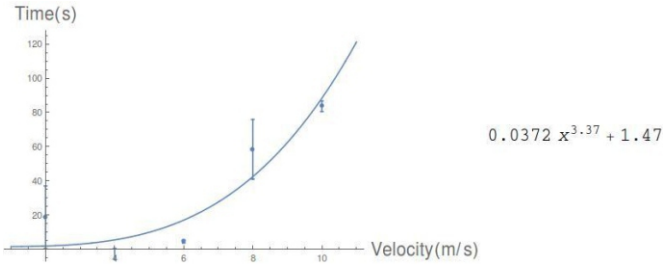


Fig. 4: velocity versus time

-Material of load: We presume that the baggage is liquid. So, when the suitcase moves, the centre of mass will change and then, the torque will increase. But if the load is solid, the centre of mass remains constantly and does not change the location.

-The length of handle: If the length of handle increases, the torque lever around X axis. increases. As a result, the torque around the X axis will increase and wobble of suitcase occurs in less time and the baggage falls sooner. (if it is short-the angle changes)

-The distance of wheels: if the wheels become closer to the Z axis the torque lever of COM around Z axis becomes less and the existing torque will lessen. But in this case the centre of mass of the object B will be farther from the wheel. The wobble of suitcase will increase by approaching two wheels to each other around Z axis ; (symmetrically) the torque will increase.

-simultaneously movement of the wheels: When the suitcase moves on a straight path, the wheels mete the equal distance. But when the suitcase rounds, one of the wheels will stay constant on the ground and the other one will traverse the distance. When the wheels are connected to each other, the existing torque becomes less but in this case the suitcase can't rotate and will be in trouble.

-Mass of load: Sometimes, the suitcase isn't in balanced condition by improper packing thus the center of mass of the suitcase is placed asymmetrically with three axes and if the weight of load increases, the torque force increases more and finally suitcase rampages more. .

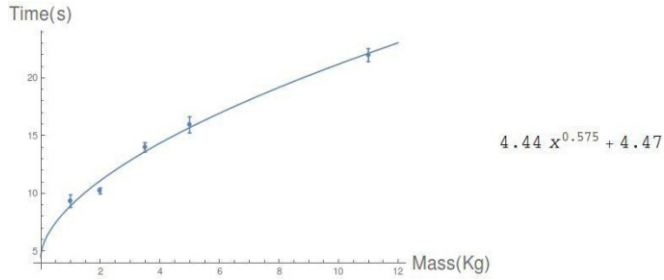


Fig. 5: Mass versus time

Results

-Obstacle: sometimes, when we are carrying the suitcase, suddenly it hits an obstacle and the obstacle enters the angular momentum to the luggage in opposite direction. If the force can overcome the resistant force, the suitcase will wobble.

-The effects of butterflies: The butterfly effect is one of the reasons of wobbling the suitcase. These chaotic dynamical systems study the chaos theory. Chaotic systems are nonlinear dynamic systems and very sensitive to their original condition. Small changes in initial conditions will become the big changes in the future. This phenomenon is well known in chaos theory butterfly effect. The behaviour of chaotic systems is seemingly accidental. Sometimes, the cause of wobbling of the suitcase is a tiny rock. In this state if conditions are favourable, suitcase may start to severe wobble and a very small force in the opposite direction enter the suitcase and in good condition, has become a cause for its craziness.

Centre of Mass: at most times the centre of mass is placed outside the centre of suitcase, therefor the force of the centre of mass of the luggage for torque will reach to its lowest level. Also, if place of the centre of mass be closer to the bottom of the suitcase (on axis Z)), it will wobble less.

Because in this case, if the bags do start to wobble, the center of mass to the opposite side and the luggage back to the original state is balance. Because when suitcase starts to wobble, the force of the centre of mass enters into the opposite direction, then it will return to balance condition. In fact, the place of the center of mass led to the centre of mass as a function resistant. But if load packing is unbalanced and the centre of mass be placed at a minimum distance of three axis coordinates and a fixed distance from the axis, the torque force becomes less. because the torque arm around three axes become shorter.

Conclusion

- The first part, proved staggering suitcases and bags in certain circumstances, have gained critical mass angle equal to 18.4349
- Factors affecting the intensity of the wobble baggage and then went to check some of them.

So if the ground is rocky, Increases movement speed, its mass is very high and if is picking unbalanced load, Wheel distance is less and length increases in these cases is staggering possibility of increasing luggage.

Recommendations

1. We can make this phenomenon optimized by changing the load packaging. If the centre of mass of load be placed at a minimum distance of three axis coordinates and a fixed distance from the axis, the torque force becomes less. it can reduce the effects of insanity. Also, if the objects within the suitcase are placed on both two sides of it, a relative balance created that prevent from wobbling.

2. Also, due to the great influence of the centre of mass in the torque of suitcase, we can use a variable mass centre.

3.We can also use an intelligent system to calculate the Critical Angle. In this system, a special program is used to calculate the critical angle in different situations.

-Description: In this method, an electronic system be installed on the bottom of the suitcase. This electronic system measures the critical angle in current conditions. If when moving suitcase is reached the specific angle, the system warns and this causes the variable centre of mass becomes activated and prevents the wobbling suitcase then suitcase will balance. In this method, we use a fluid for the variable center of mass to move it sooner.

4. We can build the bottom of suitcase like an arc and half of the wheels are inside of it. by this method, we can reduce the torque of wheels.

*** After extensive review, we decided to instal a gyroscopic on the axis of rotation of suitcase to equipoise it. The force of the spinning gyroscope's rings acted as resistance force that is making it harder to move the suitcase around the rotation axis, thus suitcase becomes balance. With increase in mass of rings and the rotation speed of them, more resistant force is created. In this case, using a digital sensor can control output force of gyroscope to give the needed force (at any circumstances) to suitcase for balance.

- In this way we can use electronic gyroscope because it is accurately and more efficiently.

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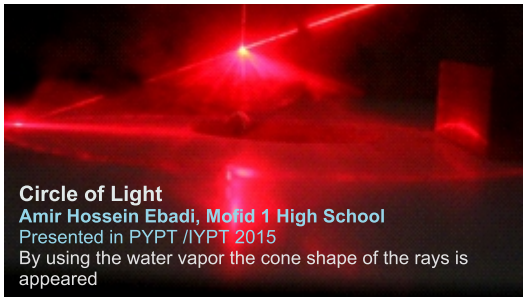
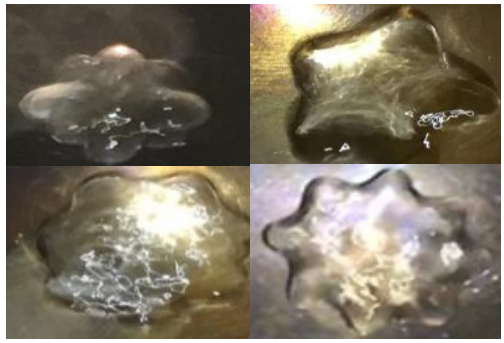
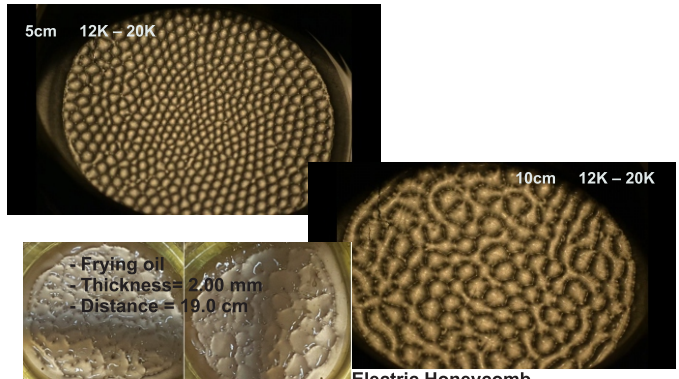


Circle of Light
Amir Hossein Ebadi, Mofid 1 High School
Presented in PYPT /IYPT 2015
By using the water vapor the cone shape of the rays is appeared

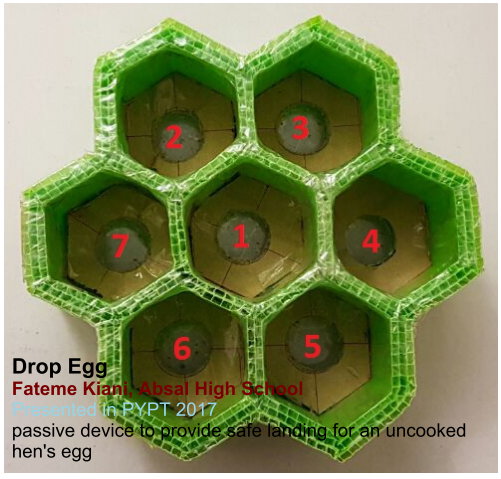


Leidenfrost Star
Banafsheh Gholinejad and Paniz Mollaghadimi
Farzanegan 3 High School
Presented in PYPT 2017
Leidenfrost effect is a phenomena that happen if the temperature is higher than the boiling point of the drop liquid .

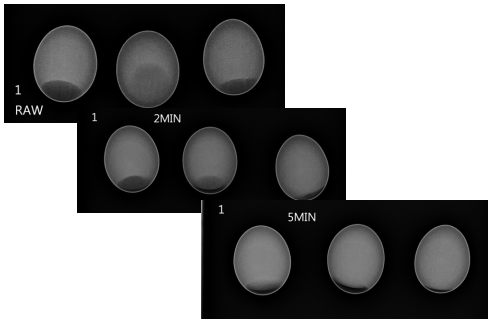
Magnetic Hills
Mohaddeseh Masoumi, Absal High School
Presented in PYPT 2017
Ferrofluids are liquid in normal states but solid when approaching a magnet



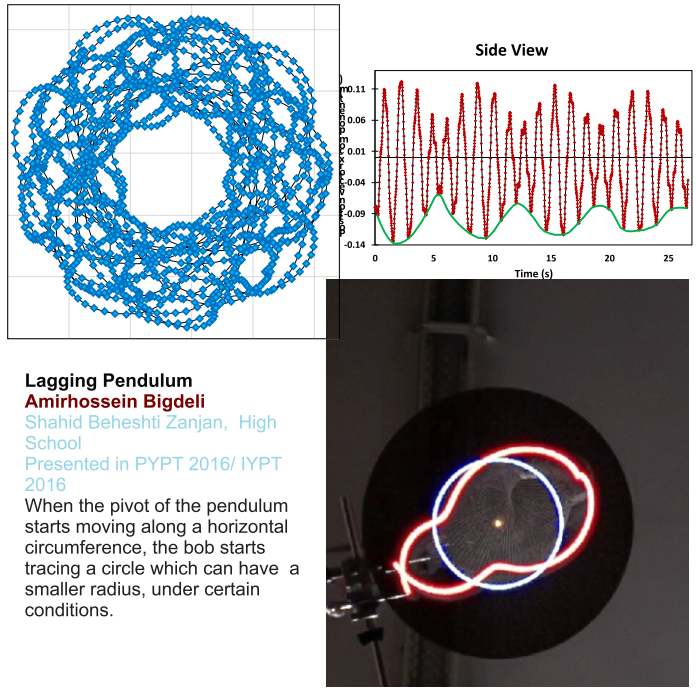
Electric Honeycomb
Nazila Sharifi
Farzanegan 1 High School
Presented in PYPT 2016/ IYPT 2016
A vertically oriented steel needle over a horizontal metallic plate with some oil and constant high voltage between the needle and the plate will make a cell structure on the surface of the liquid.



Drop Egg
Fateme Kiani- Absal High School
Presented in PYPT 2017
passive device to provide safe landing for an uncooked hen's egg



Boiled Egg
Dayana Movassaghi. Rahe Roshd High School
Presented in PYPT 2017
Non-invasive methods to detect the degree to which a hen's egg is cooked by boiling



Lagging Pendulum
Amirhossein Bigdeli
Shahid Beheshti Zanjan, High School
Presented in PYPT 2016/ IYPT 2016
When the pivot of the pendulum starts moving along a horizontal circumference, the bob starts tracing a circle which can have a smaller radius, under certain conditions.

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انجام دهد. به علت نبود زمان کافی برای نگهداری طولانی مدت پپتری‌دیش در یخچال و بررسی میزان تبخیر آب داخل آن، برای اثبات این ادعا دو پلیت آزمایش و شاهد پنج شبانه روز در دمای ۵۰ درجه سانتی‌گراد گرمادهی شدند، نتایج حاکی از آن بود که آب داخل پلیت طراحی شده حداقل تبخیر را نشان داد. در حالی که در پلیت شاهد، محیط کشت مانند ورقه‌ایی خشک شده از سطح پلیت جدا شده بود. که این نشان دهنده کاهش امکان ورود خروج هوا به داخل پلیت طراحی شده نسبت به نمونه شاهد و در نتیجه کاهش ورود آلودگی به آن و یا کاهش سطح تبخیر آب محیط کشت بود. ناگفته نماند که این پتری دیش علاوه بر مزایای موجود نسبت به پتری دیش‌های سابق، هزینه‌های اضافی استفاده از پارافیلم، ورق آلومینیومی و ... را حذف نموده و قیمت تمام شده خود نیز، در تولید انبوه، برای مصرف کتنده تفاوت چندانی با پلیت‌های موجود در بازار نخواهد داشت.

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مالچ پاشی برای منسجم نگه داشتن ریزگردها

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راهنمای پروژه : مریم حلوایی

چکیده:

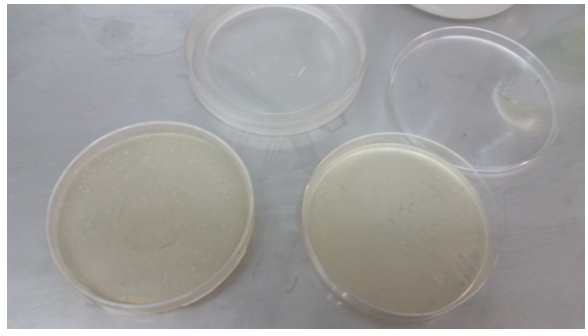
امروزه وجود ریزگردها در هوای کشورمان باعث بروز بیماری های گوناگونی شده ومشکلاتی را با خود به همراه آورده است از جمله مشکلات تفسی، ریوی واختلال سیستم ایمنی و...که قشرهای مهم جامعه از جمله کودکان و سالمندان و بیماران خاص را بیشتر از قشرهای دیگر مورد تهدید قرار داده است.

این طرح طرحی کاملا دانش آموزی و خلاقانه است واز مزیت های دیگر این طرح می‌توان به مقرون به صرفه بودن آن و استفاده از مواد دورریختنی و غیرکاربردی گیاهی اشاره کرد که باعث غنی شدن خاک می‌شود. می‌توان با استفاده از این مواد شن های بیابان را که توسط بادکه تا هزاران کیلومتر را طی می‌کنند و باعث به وجود آمدن ریزگرد در هوا می‌شوند را منسجم کرد.برای اجرای این طرح روی خاک بیابان با مقدار یکسان، تولوئن همراه با ظرف یکبار مصرف فیبری، تخم شربتی، عصاره تخم شربتی و پکتین را ریختیم و بعد از مدت یک هفته مشاهده کردیم خاک دارای پکتین به علت مناسب بودن و سازگاربودن با محیط زیست مناسب ترین گزینه برای منسجم نگه داشتن خاک است.

نازک موجود بر سطح داخلی کفه بزرگتر، برای آب‌بند کردن محیط داخلی پلیت، پس از پیچش کامل درب، طراحی گردید. به علت گرانی ساخت قالب از صفحات پلکسی برای تراش دستی طرح استفاده شد. در نتیجه ضخامت لایه استفاده شده مقداری بیشتر از پتری‌دیش معمول گردید.

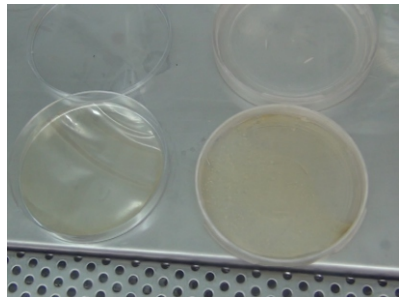
شکل(۱): پتری دیش طراحی شده. بالا: کفه کوچکتر، پایین: درب با حلقه آب‌بند

۲۴ ساعت بعد از کشت باکتری و گرما گذاری در دمای ۳۷ درجه، رشد باکتری در هر دو پلیت آزمایش و شاهد به یک میزان مشاهده گردید



شکل(۲): مشاهده میزان رشد باکتری در هر دو پلیت شاهد و آزمایش

سپس درب پلیت طراحی شده را بر کفه زیزین کاملا پیچانده و با پلیت شاهد تحت شرایط ذکر شده نگهداری شد. محیط کشت داخل پلیت شاهد کاملا خشک شده و به صورت ورقه‌ایی نازک از سطح پلیت جدا شده بود. درحالی که محیط کشت داخل پلیت آزمایش کاملا آب‌دار بوده بر سطح پلیت متصل باقی ماند.



شکل (۳) : مشاهده قابلیت پلیت آزمایش و شاهد در حفظ آب محیط کشت

شیب کم رزوه‌ها در مدل آزمایش باعث شد که از قسمت‌های خاصی بتوان درب را بر روی کفه زیرین سوار نمود و پیچ داد. در نتیجه طراحی پیشرفته‌تر از پلیت موردنظر با شیبی مناسب‌تر (با الهام از درب قوطی-های آب معدنی) انجام گرفت اما وجود این شیب قابلیت تراش دستی آن را محدود نمود و حتما نیازمند ساخت قالب بود. در نتیجه، در این پژوهش، تنها به ساخت آن توسط پرینتر سه بعدی، به عنوان مدل بسنده شد.

شکل ۴: مدل پیشنهادی ساخته شده با پرینتر سه بعدی

بحث:

بررسی سوابق موجود در جهان با توجه به سوابق آن دراداره ثبت اختراعات و علائم تجارتی آمریکا که کامل ترین مرجع برای اختراعات ثبت شده در جهان، با بیش از ۷ میلیون ثبت اختراع می باشد و همچنین بررسی سایت های معتبر علمی عدم وجود هیچ گونه طرح مشابهی برای پلیت طراحی شده را به تایید رسانید.

به علت آزاد بودن نسبی درب بر روی کفه زیرین (برای آنکه در صورت نیاز بتوان هوادهی به داخل پلیت انجام گیرد) پتری‌دیش‌های معمول در آزمایشگاه، از زمان باز نمودن بسته‌های حاوی پلیت استریل تا اتمام زمان مصرف باید نهایت دقت را نمود تا در هنگام حمل، نگهداری و کار با هر یک، درب در شرایط غیر استریل باز نشده و باعث ورود آلودگی به داخل پلیت نگردد. از طرف دیگر، پس از انجام آزمایش، اگر نیاز به نگهداری طولانی مدت پتری دیش وجود داشته باشد باید اطراف محل اتصال دو کفه کاملا مسدود گردد تا آب داخل محیط کشت تبخیر نشده و آلودگی وارد آن نشود. برای رفع مشکلات موجود، امروزه از پارافیلم، نوارچسب، ورق آلومینیومی و... برای بسته نگه داشتن درب استفاده می-کنند که تمام روش‌های مذکور هزینه و زحمت اضافی را بر آزمایشگر تحمیل می‌نماید.

در این پژوهش، با ایجاد چند رزوه مورب در دیواره خارجی کفه کوچکتر و چند رزوه مورب در دیواره داخلی کفه بزرگتر سعی شد با قرار دادن درب بر روی کفه دیگر و چرخاندن یک نیم پیچ علاوه بر جدا نشدن این دو جز حین حمل و جابجایی امکان هوادهی به داخل آن در شرایط نیاز(در کشت میکروارگانیسم هوازی) را حفظ شود. رشد باکتری‌ها موجود در سطح پوست در هر دو پلیت شاهد و کنترل مطلب فوق را تایید نمود از طرفی دیگر، سطح داخلی کفه بزرگتر دارای یک حلقه برآمده بود که هنگام پیچاندن کامل دو کفه بر روی یکدیگر، کاملا با لبه دیواره کفه کوچکتر مماس شده و در اصطلاح آن را آب بند می نمود. این طراحی به آزمایشگر این امکان را می‌دهد که در صورت نیاز به کاهش هوادهی به داخل پلیت (مانند نگهداری طولانی مدت پلیت حاوی محیط کشت)، بدون هیچ ابزار و وسیله دیگر بتواند این کار را

ساخت پتری‌دیش با قابلیت بسته نگه داشتن درب و تنظیم هوادهی به داخل آن

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چکیده:
پتری دیش ها ظروفی بشـــــقاب مانند و درب دار بوده که عموما از آن برای کشـــت میکروارگانیســـم ها استفاده می شود. بین دو کفه این ظروف هیچ اتصالی موجود نیست و به راحتی از هم جدا می شوند به همین دلیل هنگام باز کردن بســـــته های استریل پتری دیش ، باید نهایت دقت در حمل آن ها و نگهداری کلیه پتری دیش های مصرفی و باقی مانده در بسته، انجام شود تا با باز شـــدن درب آن آلوده نگردد. به همین منظور امروزه از ابزارهای متفاوتی مانند نوارهای مخصـــوصی برای بســـته نگه داشتن درب استفاده می شود. از طرف دیگر گاهی برای خشک نشـدن محیط یا عدم ورود آلودگی به درون آن، در نگهداری طولانی مدت، اطراف پتری دیش را با این ابزار مسـدود می کنند، که علاوه بر تحمیل هزینه اضافی، سـختی کار را بالا می برند. در این پژوهش، ایجاد رزوه هایی مورب در دیواره کفه ها باعث شـد تا با یک نیم پیچ، چرخش درب بر کفه زیرین، بتوان علاوه بر بسـته نگهداشتن آن، هوادهی را برای رشد میکروارگانیسم های هوازی به داخل پلیت انجام داد نتایج رشد باکتری در هر دو پلیت آزمایش و شـاهد مطلب فوق را تایید نمود. و از طرف دیگر، وجود یک حلقه آب بند در سـطح داخلی درب منجر به کاهش عبور هوا به داخل ظرف، هنگام پیچش کامل دو کفه بر روی یکدیگر شد. و از خشـــک شدن محیط کشت و ورودآلودگی احتمالی در نگهداری طولانی مدت ممانعت نمود.
کلمات کلیدی: پتری دیش ، درب پیچی، هوادهی

مقدمه:
پلیت‌های کشـــت میکروارگانیســـم در زمینه‌های بالینی و تحقیقاتی و آموزشـــی کاربرد دارند. این پلیت‌ها دارای دو کفه می‌باشـــند. کفه‌ی کوچک تـــر محل اعمال آزمایش و کفه‌ی بـــزرگ تـــر به عنوان درب و پوشش روی کفه دیگر قرار می‌گیرد. بین این دو کفه هیچ اتصـــــال و بسـتی موجود نیسـت و به راحتی از هم جدا می‌شوند به همین علت در موقع باز نمودن بســـــته‌های حاوی پلیت و برداشتن یکی از آن‌ها باید نهایت دقت را در مورد آن و سایر پلیت‌های باقی‌مانده در بسته انجام داد تا درب آن‌ها باز نشـــــده و از حالت استریل خارج نگردند، در غیر این صـــورت باید برای کار مجددا اســـتریل شـــوند. این دقت در حین کار، جابجایی و نگهداری پلیت نیز باید انجام گیـرد. زیـرا آزاد بودن درب بـر روی کفه زیرین باعث می‌شـــــود که کوچک ترین بی‌احتیاطی باعث انتقال آلودگی به داخل پلیت شده و در نتیجه کار اختلال ایجاد کند. از طرفی دیگر نگهداری طولانی مدت پلیت‌های مصـــرفی موجود، باعث خشـک شدن محیط کشـت داخل آن می‌شود. زیرا با گذشت زمان آب محیط کشت به علت محصور نماندن کامل توسط پلیت تبخیر شده و از محیط کشت حذف می‌گردد و یا حتی این ارتباط با فضـای بیرون می‌تواند موجب انتقال آلودگی به داخل پلیت و کپک زدن محیط کشـــت شود.

امروزه برای رفع مشـــکلات موجود، از چســـب نواری، پارافیلم و یا ورق آلومینیومی و سایر موارد مشـــــابه استفاده می‌کنند. پارافیلم و ورق آلومینیومی به نسبت گران بوده و از نظر اقتصادی به صرفه نمی‌باشد که برای هر بار باز و بسته نمودن پلیت از آنها استفاده نمود و چسـب نواری به سختی از روی پلیت کنده شده و با به جا گذاشتن آثار چســـبندگی خود بر روی پلیت باعث اتصـــال درب به سطوح مختلف مانند دست یا روپوش در حین کار می شود.

هدف از این پژوهش، ساخت پلیتی دارای ساختارهای نر و مادگی پیچ مانند در دیواره کفه‌ها است که بتواند مشـــکلات مذکور را رفع نماید. به نظر می‌رسـد که درب پلیت مذکور بتواند بدون نیاز به وسـیله دیگری با پیچ شدن بر کفه زیرین بسته مانده و مانع ورود آلودگی و خشـک شدن محیط کشت شود.

مواد و روش‌ها:
پلیت اولیه پس از طراحی، توسط تراش بر روی صفحات پلکسی ساخته شد. ۴۰میلی لیتر محیط کشـــــت نوترین آگار درون اتوکلاو و پلیت ساخته شـده، توسـط نور UV هود میکروبی اسـتریل گردید و سـپس داخل آن و یک پلیت موجود در آزمایشـــگاه، به عنوان شاهد،۲۰ میلی لیتر از محیط کشـت استریل ریخته شد. ۱ میلی لیتر از آب دوبار تقطیر استریل برداشته و داخل پلیت حاوی میکروب‌های کشـــت داده شده سطح پوست، ریخته شد. پس از بدست آمدن محلول بر سطح هر یک از پلیت‌ها، درب پتری دیش طراحـی محلولـی یکنواخت با پیپتاژ کـردن، ۳۰۰ میکرولیتر از محلول مذکور داخل هـر یک از پلیت‌ها وارد گـردید. پس از پخش کامل شده نیم پیچ چرخانده شد و سپس گرما گذاری در دمای ۳۷ درجه سانتی گراد، برای هر دو پلیت به مدت ۲۴ ساعت انجام شد. کیفیت رشد باکتری در هر دو پلیت مقایســـــه گردید. درب پتری دیش طراحی شده، با یک چرخش کامل بسـته و با پلیت شاهد به مدت ۵ روز در دمای ۵۰ درجه سـانتی‌گراد، گرما گذاری شـد. برای دریافت پلیتی با رزوه‌های دقیق، طرحی از پتری دیش موردنظر کشـیده و برای طراحی مهندسـی به شـــرکت Tarsh Tarash ارســـال گردید. طرح پیشـــــــــــنهادی با فرمت STL، برای ساخت مدل، به فروشگاه Top3DPrinter فرستاده شد تا با پرینتر سه بعدی پرینت گردد.

نتایج:
طرح اولیه شامل رزوه‌های افقی با شیب بسیار کم در دیواره‌های دو کفه بود که باعث پیچ خوردن دو کفه بر روی یکدیگر می‌شد. حلقه

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Cooling Rack for Keeping Microtubes in Laboratories

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This research is making a suitable equipment to produce appropriate temperature in keeping microtubes in laboratories and doing different tests without using dry ice or other substances that can cause temperature fluctuations.Rack is a metallic or plastic equipment in different sizes has been used to keep microtubes and test tubes.

Coffee Cup

Elahe Ahmadi
School: Farzanegan 2 , 2015
Brain and Cognitive science ,
Massachusetts Institute of Technology (MIT) , 2016-2020
Full Paper : IYPT Magazine, June 2016, Vol.4
Research : PYPT 2015

Abstract

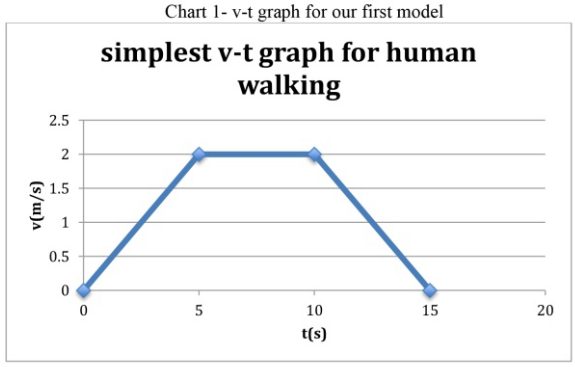
We drink at least four times a day. However, if we fill a glass with a liquid such as coffee or water, and start to walk, it may start splashing. Our purpose is to find a theoretical model for this phenomenon. So we can analyze the problem and find a way to prevent liquid from splashing. First step is to simplify the problem. In order to do that, we will make some assumption for human walking and liquid in the glass, then, based on each of them, we will suggest three different models. After that by calculation we will find out the liquid behavior. At the end, we will design a glass that minimizes the chance of liquid splashing.

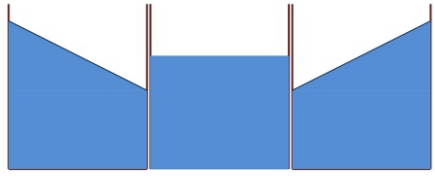
Experiment

Models for human walking

following sentences describe the first suggested model. We assume the person in our problem walks between two points like a block, and the glass is attached to the block. the simplest v-t graph (velocity relative to time) for a block to move from one point to another-with initial velocity equal to zero- is shown in the chart 1. First, the block increases its velocity with a constant acceleration. Then it may keep on moving with a constant velocity for a while.

Chart 1- v-t graph for our first model





Science motivation by discussion and controversy (SMDC) model

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This research explores students' attitudes to science education to establish why many disengage with the subject in class and what can be done to reverse this trend to produce unimaginable scientific and practical benefits to society.