



Book of Posters

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Abstract

Heavy metal exposures from food and water are common in industrial cities as well as in agro economies resulting in multiple health issues. Ex vivo imaging studies on three model tissues (Apple, banana and sweet potatoes with 3 different bulk pH and different proportions of biomaterials) are undertaken in our X-ray laboratory to understand x-ray absorption and scattering by various minerals at micromolar concentration range. The results should be applicable to build X-ray absorption models for nanomaterials as well as to understand the role of endogenous (native) biomaterials to maintain metallo-protein and carbohydrate structures in live biological systems. In addition the functional role of biological water that are intercalated within the macromolecules in the presence of exogenous heavy metal contaminants from environment are explored by low energy (soft) x rays. We have discovered that sample noise (sample standard deviation) is more sensitive to even minute structural change from heat shock or mechanical damage and can be used to develop biomarkers for trauma or burn patients. Analyzing small changes in sample standard deviation requires reproducibility and standardization. Hence the mammography system was calibrated at various mAs ranges at 29kVp with 16 mAs being the best with reproducibility of intensity fluctuations at 1% across the imaging field compared to 1.7% at 4 mAs that increased to 2 and 2.3% for 16 and 4 mAs respectively at 20kVp.

Method

We first calculated air R.O.I. to measure the accuracy of the machine using different focal spots and technical factors. This experiment was conducted by prepping the samples; a red delicious apple, granny smith and sweet potato. We then cut as uniformly as possible 1" thick slices in each sample. Using a toothpick 16 points were made down the middle and 2 diagonally. Immediately after, the samples were covered with saran wrap to limit air exposure. An X-ray was taken at 20 Kv and 16 and 65 mAs to observe mechanical trauma. Samples were rotated and exposure repeated.

Background

Used one Granny Smith, Red Delicious, and Sweet potato that was cut into 1-inch slices. The slices were skewered equally using a toothpick to create mechanical damage. The slices were imaged by Hologic Mammography system.

Metal (in µg) & Iodine (in mg)	pH at 25C	Na (Z=11)	K (Z=19)	Mg (Z=12)	Ca (Z=20)	Mn (Z=25)	Cu (Z=29)	Fe (Z=26)
Model System								
Red Delicious Apple	3.9	2	208	10	12	0.06	0.06	0.22
Sweet potato (Beanegard, USA)	5.3-5.6	110	498	42	98	0.6	0.4	1.6
K-edges (keV)		1	3.3	1.3	3.7	5.9	8.0	6.4

Results-1



Figure 3:Skewering the samples



Figure 4: Exposure of samples

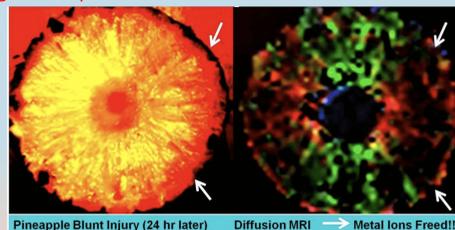


Figure 5: MRI diffusion results of pineapple

Discussion/ Conclusion

- The differentials show that larger quantities of photons do not saturate the absorbers, rather get absorbed better. Does it mean photons in a crowded carbohydrate/mineral structure bounce around and when there are more photons present? Photons cannot escape the sample but get absorbed more.
- This is a very important result as it shows the effect of electron clouds on photon flux. Are those electrons that obstruct photon escape are from carbohydrate molecules or are they the electron clouds from minerals.
- Based on our findings it can be concluded that the portions in the middle absorbed more radiation due to the scatter via it's positioning to other samples. This is in comparison to the outer segments which only had air directly next to them.
- Possible explanation is that there are abnormal metal ion accumulation at the trauma site in the pineapple, similar to the abnormal metal accumulation near the center of fruit samples that has caused greater X-ray absorption per the absorption table. The center of all 4 fruits have greater density of cuts compared to distal regions and have absorbed more photon flux.
- MRI signal also is abnormal when there is a greater metal ion accumulation
- Hence the X-ray and MRI together indicates that trauma can cause metal ion release from biomolecules and have direct implications in TBI treatment in acute care hospitals.

Acknowledgment

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Results-2

	EXPOSURE 1	EXPOSURE 2	EXPOSURE 3	EXPOSURE 4
20 KVP/65 MAS A	226	247	246	276
20 KVP/65 MAS B	200	197	260	269
20 KVP/16 MAS C	216	236	236	236
20 KVP/16 MAS D	192	188	256	264
DIFFERENCE IN ABSORPTION A-C	10	11	10	40
DIFFERENCE IN ABSORPTION B-D	8	9	4	5

Figure 6: Results of Exposures taken at 20 kv , 65 & 16 mAs. Calculated the difference in absorption.



Figure 1
Upper: Granny Smith, Sweet potato
Bottom: Sweet potato, Red Delicious

Figure 2:
X-ray image showing points for R.O.I.



The Energy Challenge: Moving From Fossil Fuels To Biofuels, Hydrogen, and Green Energy Sources

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ABSTRACT

The aim of this literature research is to evaluate and identify alternative sources of energy instead of fossil fuels. Fossil fuels like natural gas, oil, and coal are known as nonrenewable resources because they are finite resources that cannot be readily replenished at the same pace as their consumption. The alternatives that will be searched for in this literature review are specifically, biofuels, hydrogen, and green energy sources which are all known as renewable. The review will then focus on hydrogen as true potential replacement of fossil fuels. In some countries, alternative renewable sources include geothermal energy, nuclear energy, solar energy, wind energy, and hydroelectric technologies. Hydroelectricity is the only renewable energy that is reliable. Generally, renewable energy sources generate most of their energy at certain times of the day, and their electricity generation does not match the peak demand hours. The intermittency of sunshine and wind cannot provide an on-demand power source 24 hours a week. Solar energy and wind are unpredictable. Unlike fossil fuel, green/renewable energy does not appear to be a one size fits all solution. The use of multiple sources is generally required to meet energy needs. Identifying those sources and evaluating their viability is the adjusted purpose of this research project.

MATERIALS AND METHODS

- Extensive Literature Research Conducted on Energy sources
- Google Scholars was used to search related articles
- Critical Understanding of Inorganic Chemistry and Biochemistry
- Keywords: alternatives, energy, renewable, hydrogen, electrolysis
- Selected 7 articles out of 32 that were read for this research
- Research Experts Consulted: Professor Alberto Martinez

INTRODUCTION

Fossil fuels used today as main source of energy have a limited lifespan and a high environmental cost. Concerns on climate change and global warming are progressively raising in developed societies, which are trying to reduce their dependence on fossil fuels to generate energy. Renewable energy sources are being explored as a true alternative. These sources (biomass, hydropower, geothermal, wind, solar, etc) are naturally replenishing but flow-limited.

As wind, solar, and lithium-ion each have their own shortcomings and are not enough to meet the demands of the future, science has proven that hydrogen is the best and the cleanest option for renewable energy. Hydrogen has the potential to play a vital role in meeting the energy storage needs required to slash CO₂ emissions. It is the most plentiful element in the universe and its capability as an effective energy carrier has been well-understood for decades. Because hydrogen does not exist freely in nature and is only produced from other sources of energy, it is known as an energy carrier. It is a clean-burning fuel, and when combined with oxygen in a fuel cell, hydrogen produces heat and electricity with only water vapor as a by-product. [1]

Hydrogen can be made directly from fossil fuels or biomass, or it can be produced by passing electricity through water, breaking the water into its constituent components of hydrogen and oxygen. Some envision a future "hydrogen economy," where hydrogen is produced from a variety of energy sources, stored for later use, piped to where it is needed, and then converted cleanly into heat and electricity. [2]

Most hydrogen production today is by steam reforming natural gas. But natural gas is already a good fuel and one that is rapidly becoming scarcer and more expensive. It is also a fossil fuel, so the carbon dioxide released in the reforming process adds to the greenhouse effect. Hydrogen has very high energy for its weight, but very low energy for its volume, so new technology is needed to store and transport it. And fuel cell technology is still in early development, needing improvements in efficiency and durability. [3]

RESULTS

A simple element like hydrogen has unique properties such as, it's highly combustible and very cold as a liquid, but it also has its challenges like it's the smallest molecule to contain. Processing and storing hydrogen requires expertise. Hydrogen can be produced in different ways, typically from fossil fuels, nuclear and renewable sources. Water electrolysis is a commonly used method. During this process an electric current is used to split hydrogen from oxygen. If the electricity comes from renewable sources, the hydrogen fuel is considered to be renewable or "green" because it is produced without CO₂ emissions. Electrolysis is energy-intensive and has only recently been considered feasible as the cost of renewable power has declined and electrolysis technology has improved. Nuclear power can also provide the energy for electrolysis to split water without CO₂ emissions. U.S. utilities Exelon, FirstEnergy, Xcel Energy, and Arizona Public Service have all committed to commencing small-scale hydrogen production at nuclear plants. [4]

Hydrogen is almost always found as part of another compound, such as water (H₂O) or methane (CH₄), and it must be separated into pure hydrogen (H₂) for use in fuel cell electric vehicles. Hydrogen fuel combines with oxygen from the air through a fuel cell, creating electricity and water through an electrochemical process. Electrolysis is an electric current that splits water into hydrogen and oxygen. If the electricity is produced by renewable sources, such as solar or wind, the resulting hydrogen will be considered renewable as well and has numerous emissions benefits. [5]

Hydrogen energy storage and transportation issues are present and inspiring. Storage and transportation operations are important as production processes. Those processes play a very essential role in the hydrogen energy economy. The common strategy for the storage of hydrogen are compressed gas, cryogenic liquid hydrogen, and solid hydrogen. Also, the density of the hydrogen stored as a liquid is greater than the density of its stored as compressed gas, and it stores more energy per unit volume. In the liquid hydrogen storage method, hydrogen is stored for a short time due to its low boiling point. On the other hand, in the solid state storage method, a large amount of hydrogen can be stored in a small volume. It is more efficient than the other two methods because it needs less volume. There are two ways of storage for the solid storage method. One is nanostructured materials that can store more hydrogen with nanotechnology. The solid storage method also uses complex hydrides, such as lithium borohydride (LiBH₄), sodium borohydride (NaBH₄), magnesium borohydride (Mg(BH₄)₂), and calcium borohydride (Ca(BH₄)₂). [6]

In a polymer electrolyte membrane (PEM) electrolyzer, the electrolyte is a solid specialty plastic material. Water reacts at the anode to form oxygen and positively charged hydrogen ions (protons). The electrons flow through an external circuit and the hydrogen ions selectively move across the PEM to the cathode. At the cathode, hydrogen ions combine with electrons from the external circuit to form hydrogen gas. (as shown in figure 1) [7]

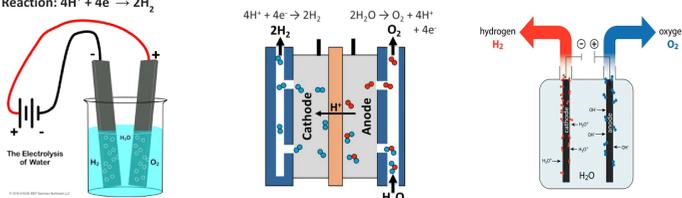
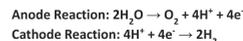


Figure 1. Left: Schematic representation of a simple water electrolysis. Center and right: Schematic representation of a fuel cell

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DISCUSSION

Hydrogen can be produced and used without toxic pollution or CO₂ emissions. It burns clean when mixed with oxygen from the atmosphere and can be used as a source of heat or to power an internal combustion engine. Hydrogen can also be fed into a fuel-cell device that converts hydrogen's chemical energy into electricity. In either case, the only emission produced is water vapor. When hydrogen fuel cells are used to power an electric motor, the system is more than twice as efficient as conventional internal combustion engines.

Hydrogen rarely exists in isolation but is amassed in enormous quantities in water, hydrocarbons, and biomass. Efficient extraction of hydrogen from these compounds is critical for wide-scale deployment. Currently, about 95% of hydrogen is produced by splitting it from natural gas through a process called "steam-reforming." Hydrogen produced in this manufactured as "gray" and is generally not considered an effective climate solution because it gives off CO₂ as a byproduct. However, it is possible to capture and sequester the CO₂ to produce "blue" hydrogen at an additional cost of about 30%. The oil and gas sector, in particular Shell, BP, and Repsol, are interested in the blue hydrogen approach because it could help preserve the value of their natural gas assets. Commonly used methods of storage as compressed gas and liquid hydrogen. Compressed gas transport by steel, aluminum, and carbon fiber reinforced plastic composite materials.

Hydrogen production via electrolysis may offer opportunities for synergy with dynamic and intermittent power generation, which is characteristic of some renewable energy technologies. For example, though the cost of wind power has continued to drop, the inherent variability of wind is an impediment to the effective use of wind power. Hydrogen fuel and electric power generation could be integrated at a wind farm, allowing flexibility to shift production to best match resource availability with system operational needs and market factors.

CONCLUSION

Electrolysis is a leading hydrogen production pathway to achieve Hydrogen Energy. Hydrogen produced via electrolysis can result in zero greenhouse gas emissions, depending on the source of the electricity used. The source of the required electricity including its cost and efficiency, as well as emissions resulting from electricity generation must be considered when evaluating the benefits and economic viability of hydrogen production via electrolysis. In many regions of the country, today's power grid is not ideal for providing the electricity required for electrolysis because of the greenhouse gases released and the amount of fuel required due to the low efficiency of the electricity generation process. Hydrogen production via electrolysis is being pursued for renewable (wind, solar, hydro, geothermal) and nuclear energy options. These hydrogen production pathways result in virtually zero greenhouse gas and criteria pollutant emissions; however, the production cost needs to be decreased significantly to be competitive with more mature carbon-based pathways such as natural gas reforming. [5] [6] Although the compressed gas method and liquid state storage method are widely used in hydrogen storage, the method to be used for the future is the solid state storage method. The solid-state storage method also consists of complex hydrides, chemical hydrides, magnesium-based alloys, and intermetallic compounds. Complex hydrides have high hydrogen storage capacity.

Today's grid electricity is not the ideal source of electricity for electrolysis because most of the electricity is generated using technologies that result in greenhouse gas emissions and are energy-intensive. Electricity generation using renewable or nuclear energy technologies, either separate from the grid or as a growing portion of the grid mix, is a possible option to overcome these limitations for hydrogen production via electrolysis. The U.S. Department of Energy and others continue efforts to bring down the cost of renewable-based electricity production and develop more efficient fossil-fuel-based electricity production with carbon capture, utilization, and storage. Wind-based electricity production, for example, is growing rapidly in the United States and globally. [7]



Modeling of Infiltration Through Large Openings in Buildings

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ABSTRACT

Infiltration through entrance doors significantly affect the calculation of building loads. It affects indoor thermal environment and building energy consumption by causing a significant temperature difference. It is particularly important in that the performance of building energy systems and building envelop has been significantly improved. To that end, unwanted airflow through large openings has a greater impact on building energy consumption. This project is intended to learn the existing methodologies that are being used in modeling infiltration rates in buildings. Several methods have been developed to accurately predict infiltration rates. Each model has certain degree of similarity and differences. These models can be effectively used to predict the infiltration rates. Future research is needed to account for the impact of the infiltration on building energy consumptions since the impact of infiltration rates on building energy analysis has been increased.

METHODS

Empirical Analysis

Many studies conducted field measurements to estimate infiltration rates through different types of doors and windows in buildings. The measurements have also been done in various building types since each building has its own thermal behavior and operational strategies. Some studies introduced tracer gas method that uses trace gases such as SF₆ and CO₂. This method requires sophisticated instruments to monitor the concentration of the trace gases with time. Some studies performed direct measurements of main factors affecting the magnitude of infiltration rates. The results of these measurements have been utilized to validate computational models.

Numerical Analysis

EnergyPlus is a whole building energy simulation program developed by the Department of Energy (DOE). It is a core simulation engine for many applications such as OpenStudio.

In EnergyPlus, Airflow Network model calculates infiltration rates as follows:

Infiltration

$$= I_{design} \cdot F_{schedule} [A + B|\Delta T| + C \cdot W_s + D \cdot W_s^2]$$

I_{design} is design infiltration rate in m³/s

$F_{schedule}$ is factor between 0 and 1

ΔT is temperature difference in °C

W_s is wind speed in m/s

A, B, C, and D are constants.

Gowri et al. (2009) proposed a method that only accounts for wind effects. It suggested a factor of 0.25 to employ the effect of differential pressure when the HVAC systems are operated. The main limitation of this PNNL method is the assumption of a fixed differential pressure of 4 Pa since the pressure over the building surfaces varies with time. It simplifies the calculation of infiltration rates in buildings and enhances the useability.

Ng et al. (2014) proposed a method that accounts for main components of building load calculations while other models partially account for such components. It simulated the proposed model in eight different types of buildings. It suggested factors for constants of A, B, and D in the Airflow Network model to adjust local air temperature and wind speed.

DISCUSSION

Continuous research is needed to adequately account for all physical phenomena. Both wind and temperature effects should be coupled with the computational models. Internal heating sources, system operations, and facility operation must be part of the model. Efforts should be made to develop a model that can sufficiently characterize thermal behavior of buildings.

RESULTS

CONTAM vs. EnergyPlus

Considerable differences in mean infiltration rates between the proposed method (CONTAM) and the Airflow Network in EnergyPlus was found. The standard errors were greater when the HVAC systems were turned on in the simulations (System on case). The variation in the standard error of the simulation results was fairly constant in both "System on" and "System off" cases.

Table 1. Comparison of CONTAM and EnergyPlus infiltration results (high I_{design})
(Adapted from 6)

	Restaurant	Hospital	Large Office	Medium Office	Small Office	School	Hotel	Retail
System on								
CONTAM mean infiltration rate (h ⁻¹)	2.05	0.51	0.36	0.77	1.38	1.14	1.21	1.04
EnergyPlus mean infiltration rate (h ⁻¹)	1.82	0.04	0.30	0.43	0.10	1.35	0.77	0.82
Standard error of EnergyPlus rates (h ⁻¹) (% of CONTAM mean)	0.35 (17%)	0.19 (37%)	0.08 (23%)	0.17 (22%)	0.26 (19%)	0.27 (24%)	0.27 (23%)	0.20 (19%)
Coefficient of determination, R ²	0.81	-2.18	0.78	0.26	-3.51	0.60	0.27	0.70
System off								
CONTAM mean infiltration rate (h ⁻¹)	1.95	NA	0.53	1.01	1.39	1.16	NA	1.04
EnergyPlus mean infiltration rate (h ⁻¹)	0.54	NA	0.47	0.80	0.49	1.45	NA	1.00
Standard error of EnergyPlus rates (h ⁻¹) (% of CONTAM mean)	0.29 (15%)	NA	0.09 (17%)	0.25 (25%)	0.24 (17%)	0.22 (19%)	NA	0.16 (15%)
Coefficient of determination, R ²	-1.59	NA	0.77	0.45	-1.45	0.26	NA	0.86

Note: The Hospital and Small Hotel HVAC systems are always scheduled to be on. The standard error of EnergyPlus rates and R² values were based on the comparison between EnergyPlus and CONTAM results.

CONTAM vs. PNNL

The differences in mean infiltration rates between the proposed method (CONTAM) and the Airflow Network in EnergyPlus using PNNL approach were significant. The standard errors fluctuated with types of buildings while fairly constant in the "System off" case. The differences in standard error of the predictions of infiltration were relatively greater when PNNL approach is employed.

Table 2. Comparison of CONTAM and EnergyPlus infiltration results using PNNL approach (low I_{design})
(Adapted from 6)

	Restaurant	Hospital	Large Office	Medium Office	Small Office	School	Hotel	Retail
System on								
CONTAM mean infiltration rate (h ⁻¹)	0.12	0.0001	0.00003	0.002	0.05	0.02	0.03	0.03
EnergyPlus mean infiltration rate (h ⁻¹)	0.01	0.0467	0.01	0.02	0.01	0.02	0.04	0.02
Standard error of EnergyPlus rates (h ⁻¹) (% of CONTAM mean)	0.04 (33%)	0.0007 (799%)	0.0003 (936%)	0.01 (293%)	0.02 (41%)	0.01 (58%)	0.01 (34%)	0.01 (49%)
Coefficient of determination, R ²	-3	-4880	-3260	-7	-0.77	0.49	0.66	0.37
System off								
CONTAM mean infiltration rate (h ⁻¹)	0.11	NA	0.03	0.06	0.08	0.07	NA	0.06
EnergyPlus mean infiltration rate (h ⁻¹)	0.03	NA	0.05	0.07	0.04	0.08	NA	0.06
Standard error of EnergyPlus rates (h ⁻¹) (% of CONTAM mean)	0.04 (33%)	NA	0.011 (33%)	0.02 (36%)	0.03 (36%)	0.02 (31%)	NA	0.02 (35%)
Coefficient of determination, R ²	-1.51	NA	-2.81	-0.45	-1.06	0.19	NA	0.34

Note: The Hospital and Small Hotel HVAC systems are always scheduled to be on. The standard error of EnergyPlus rates and R² values were based on the comparison between EnergyPlus and CONTAM results.

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The Effects and Consequences of Chemical Weapons

A CRSP Theoretical and Physical Analysis

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Professor Jose L. Martinez, MS, RT(R)(CT)(MR)



Abstract

Our research has the aim to uncover both the consequences and effects of Chemical Warfare on a biological and moral scale. We will be investigating the usage of several common chemical weapons throughout history. The categories of these weapons will be limited to lung toxicants, tear inducing irritants, and vesicating agents. We seek to understand the impact that these weapons have on living organisms, especially on the human body. Experiments will include synthesizing a non-lethal aerosolized compound and examining its impact on a human, and then compare it to other chemical weapons that are regularly used in combat and in civilian settings.



Introduction

Throughout the history of mankind, humans have slowly but surely advanced and progressed the methods and ways harm can be inflicted on other humans. One of the most barbaric developments of the aforementioned advancement was the advent of chemical weaponry and their use in war and combat. Chemical weapons have been used throughout human history. One of the earliest sightings of chemical weapons being deployed can be found in the Syrian desert. Estimated to have been used around 256 A.D, the Sasanians used Sulfur Dioxide gas to render the enemies unconscious. Other examples of simple chemical weapons can be seen all throughout antiquity. The true advent of modern chemical weaponry came during World War One. Chlorine, Mustard, and Tear gases were all used heavily, in order to dissuade the long and brutal stalemates that trench warfare brought about. The toxic gases brought about in the First World War set the stage for thousands of peoples death and suffering, leading chemical warfare to be one of the most barbaric and cruel developments of military technology.

To test the true levels of inhumanity and the levels of damage that chemical weapons can cause to humans, we will be synthesizing a mild non-lethal inflammatory agent using habanero peppers. We will test the effects of the gas onto ourselves. We will record our findings, and use said findings to make a conclusion on the possible level of damage that chemical warfare can cause. Throughout our experimentation, we will follow every scholarly research guideline taught to us from the CITI Certification course, in order to ensure the integrity of our experiment.



Methodology

Safety was our number one priority when performing our experiments. Precautions and protections such as eyewear, masks, gloves, lab coats, open environments, and a standby helper were all utilized.

Ingredients and Tools

1. Dried Habanero Peppers
2. Rubber Gloves
3. Non-Metallic Mixing Bowl
4. Whisk
5. Funnel
6. 1/2 Cup White Vinegar
7. 1/2 Cup Water
8. Mortar & Pestle
9. Knife
10. Cutting Board

Step 1.

Utilizing all safety equipment, slice peppers into centimeter sized pieces, and throw out all stems.

Step 2.

As the peppers are dried, grind them into a fine powder using the mortar and pestle, be sure to grind everything from the pepper flesh to the seeds.

Step 3.

Mix newly formed pepper powder into 1/2 cups of white vinegar and whisk well, cover bowl with saran wrap and allow to sit in the fridge for at least 1 night. The longer the better

Step 4.

Add 1/2 cups of water to the mixture, and whisk until consistency is even

Step 5.

Decant into a bottle, and seal tightly. Gas will begin to rise in the bottle.

After gas began to form, student researcher Ryan Donnelly elected to be exposed to this mild capsicum gas. The following effects were immediately noticed

1. Eyes began to water and red
2. Mucous began to form in excess from his nasal passages
3. Mild temporary coughing

Effects wore off within minutes



Results

Tear-inducing irritants were first employed on the battlefield during World War I by the French Army against the German Empire. Accounts from troops serving in France during WWI describe the irritating sensation that tears gas brought, and they also go on to describe the horrors that chlorine, mustard, and phosphorous gas induced onto them.

The accounts of irritation from WWI tear gas line up very well with the sensations experienced by Researcher Ryan Donnelly when he was briefly exposed to our mild capsicum solution. Contrary to popular belief, tear gas is usually an aerosolized solid and not gas.

Capsicum tear gas works when capsaicin (the chemical component in peppers) latches onto tissue such as mucous membranes and pain receptors in the body and kicks them into overdrive. This same principle also applies when we eat peppers, as the capsaicin binds to pain receptors in our mouths. In most cases, coughing and choking can also occur when exposed to tear gas, such as in our case. Researcher Ryan Donnelly experienced mild coughing the moment he was exposed to the aerosolized mixture, and that can be attributed to high amounts of capsaicin entering the lungs, which irritate the upper respiratory tract, causing the lungs or respiratory tracts to become inflamed, causing choking and coughing.

Not only this, but a novel study suggests that among women impacted by tear gas, menstrual changes and abnormalities can occur. In many cases, tear gas can prove to be lethal in close quarters or poorly ventilated areas. In fact, just last year, demonstrators in Tunisia were killed after inhaling copious amounts of tear gas fired from police. The cause of death was asphyxiation. Other long-lasting effects can include cataracts, eye scarring, and possibly even asthma. Tear gas is still actively used by militaries and police forces around the world. Despite its consistent and extensive use against civilian populations, it is banned by various international treaties.

Despite this, there exist some chemical weapons that remain internationally legal despite their effects being far more disastrous than tear gas.

White Phosphorous, for example, is employed and used by the United States, and first began using it in 1917 during the First World War. The US has used this chemical weapon as recently as the War in Afghanistan, where it reportedly caused massive casualties among Afghan civilians, including 3rd degree burns, asphyxiation, blindness, and other debilitating injuries.

White Phosphorous is a waxy solid that is shot high into the air, and rains down in mesmerizing streaks. Exposure to it causes a wide array of injuries, and many times results in death. It burns at over 2,700 degrees Fahrenheit and is described as an indiscriminate weapon of war. Despite this, it is not banned, and its usage is encouraged in warfare. It causes unnecessary pain and suffering not only to soldiers but to innocent civilian lives, such as an 8-year-old child in 2009, who sustained excruciatingly painful 2nd and 3rd degree burns to nearly half of her body, including her face. Her father reports that today, over 11 years later, she is still embarrassed to leave her house and show her face, and suffers from debilitating pain every day of her life.

Conclusion

To conclude, it is more than evident to us what various chemical weapons can do to the human body. Many chemical weapons, such as tear gas and white phosphorous are legal under international law, despite their apparent indiscriminate nature.

The creation of a mild capsicum gas helped us understand the process and science behind how chemical weapons such as tear gas impact the human body. It is clear to us that chemical compounds which induce inflammation and pain are deliberately chosen for scientific reasons to be used in chemical weapons, such as capsaicin in tear gas. This is because capsaicin immediately binds to pain receptors and mucous membranes to cause a wide array of complications, such as crying, asphyxiation, pain, and even death. We also became aware to the lasting impacts they can have on humans, such as eye complications and menstrual issues.

The difference between chemical weapons such as tear gas/white phosphorous when compared to other chemical weapons such as sarin gas is that tear gas and white phosphorous are completely legal to use, despite being very similar in nature to other banned weapons.

It is our firm conclusion these chemical weapons, despite their legality, should be, without a shadow of a doubt, illegal internationally. These weapons, such as white phosphorous, are not weapons that can be controlled once deployed. White phosphorous attacks soldiers and children alike as if they were the same targets, and causes unnecessary pain and suffering to the victim. Similar to Napalm, white phosphorous is extremely difficult to wash off, and continues to burn on human flesh even when water is applied.

Acknowledgements and References

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- We would like to extend our gratitude to the Undergraduate Research team for the opportunity to research in a scientific and professional manner. We would also like to thank our great mentor, Jose Luis Martinez!



Soft X- Ray Imaging of Possible Transmetallation among Endogenous Fe(II)/Fe(III) and Mn(I-IV) States due to Thermo-mechanical Stress in Model Carbohvdrates



Sonia Orellana (Rad

Me

Departments of (1) Radiologic Tech

ABSTRACT: We have been working to test micro contaminants affecting carbohydrates or protein matrix for this project. Our laboratory has designed experiments to demonstrate chelation and transmetallation of native bio metals (endogenous Fe, Mn, Ca, Mg, P for example) in the presence of radiological contrast media added to the carbohydrate matrix. Routine imaging modalities (x-ray, MR and CT) do not have adequate resolution or sensitivity for nanomolar bio metal reactions with such exogenous media. However, soft x-rays from Mammographic systems at low keV energies seem to show additional x-ray scatter sources in the bulk matrix away from infused radiological media that could originate from endogenous metals.

METHOD: This project analyzes background standard deviation (x-ray noise) in bulk matrix adjacent to heavy atom infusion sites in biologically active matrix as a function of time, and is compared with reference carbohydrate phantoms without heavy atom infusion. The changes in these systems with time seem to favor transmetallation of added Gadolinium/chelation by added iodine complexes to such mineral rich carbohydrates. Our work includes observation of these phenomena with heat/mechanical shocks applied to multiple apple & sweet potato species.

We are also working with our MRI team to compare the x-ray results with the paramagnetics distribution obtainable by MRI (see figure) and details in an MRI poster (Basilicata et al.)



RED DELICIOUS APPLE used pre/post shock mammography testing.

RESULTS-1: The mineral content I apples are shown below:

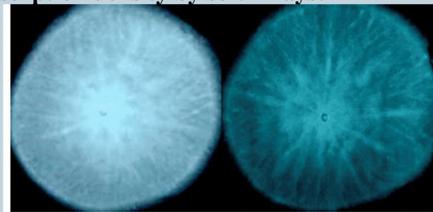
Metal (in µg) & Iodine (in mg)	Na (Z=11)	K (Z=19)	Mg (Z=12)	Ca (Z=20)	Mn (Z=25)	Cu (Z=29)	Fe (Z=26)
Model System							
Red Delicious Apple	2	208	10	12	0.06	0.06	0.22

ACKNOWLEDGEMENTS:

We would like to acknowledge valuable help from Jodi-Ann, also New York City College of Technology for access to mammography equipment for our undergraduate research students. This work was made possible with student stipends from City Tech to above student researchers under CRSP.

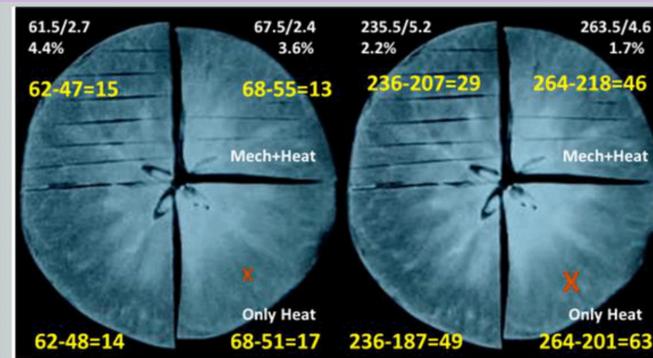
BACKGROUND: This project involves study of micro contaminants from environmental pollutants that affect plants and animal species, including humans. If external stressors (heat or mechanical shock) cause tissue changes and mineral redistribution then using soft x-rays from Mammographic systems at low keV energies one may be able to target native metal ions and demonstrate higher absorbed density. Excess absorbed photon flux from mammographic x-rays requires presence of additional metal centers and that may prove biometal (Fe for apple) release from native pools, an important predictor of heat induced climate change consequences we may need to be prepared for. MRI can also detect free paramagnetic metals and in this project, we have compared X ray results with MRI to verify if indeed excess metal accumulation happens after heat or mechanical shocks.

RESULTS-2: The mineral content seems to be seen below as high absorption density by soft x-rays:

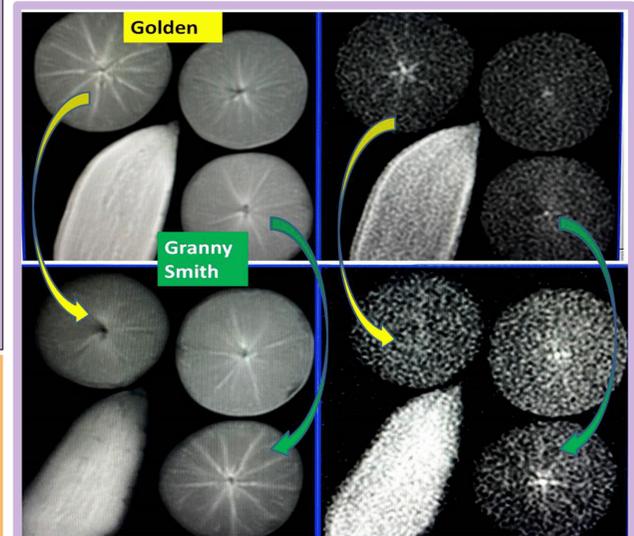


1 hr no stress(left) 20/40 70 hr no stress(right) 20/40
Some general clumping of minerals happen with time, as the metal ions go toward center even with no additional stress.

RESULTS-3 Excess absorbed photon flux from mammographic soft x-rays (shown by subtracted values in yellow) due to mechanical and/or heat shocks in red apple perhaps due to biometal (Fe for apple) release from native pool.



1 hr post mechanical stress using sharp cuts on cold apple piece (Left half) and on heat shock apple piece (Right half) for each slice shown. Imaged by 20kV/10mAs (Left panel) & 20kV/40mAs (Right panel) The excess radiation absorbed (shown by X, particularly when 40 mAs given)



MR image of 3 apple varieties & sweet potato show mineral redistribution pre/post heat shock (20 sec microwave). Only Fe & Mn can alter MR signal. The apple only has Fe and other non-magnetic metals (K, Ca, Mg etc). Bright streaks are Fe are rich regions. MRI signal increases when small amounts (ppm) of Fe is present.

Top 2 panels show T1-weighted images before heat shock
The left shows full carbohydrate matrix that can be magnetized fast as well as slowly.
The right shows only those regions that can be magnetized fast.
Bottom 2 panels show 10 hr post heat shock

The golden apple seems to have lost its Fe, and redistributed it after heat shock (bright streaks are gone)
The Granny Smith has accumulated more Fe from bulk & has organized in streak regions due to heat.

The right (fast magnetized species) show the fast species redistributed in Golden, while the fast species also accumulated in the Granny Smith after heat.

Comparing the X-ray and MRI results one may conclude that:

- 1) Soft mammographic x-rays can indeed show the redistribution of minerals due to heat or mechanical shock since MRI can verify that with greater certainty.
- 2) Mineral redistribution can happen in biological tissue i.e. biometals can come out of biochemical pool and vice versa due to stressors.
- 3) This could have significant implication in human health during the extreme heat waves predicted in next several decades (approx 1+ B population will go through 50C temperature climate for at least one 15 day cycle by the end of the century). Biometal redistribution can lead to significant disease and death.



Open Lab Vs. Radiologic Students Final Practical Grades

By-Navdeep Kaur, Katie Tam, Robert O'Brien, Safraz Harun

Mentor- Zoya Vinokur



Abstract

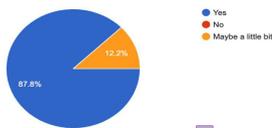
Open Lab provides the students of the Radiologic Technology & Medical Imaging Department the opportunity outside regular class time to practice communicating effectively in a health care setting, and grants the students the freedom to craft critical thinking skills in a radiologic environment. Our research aims to analyze the correlation between hourly time spent in Open Lab, and its contributing factor to a student's overall Radiographic Procedures grade. The amount of time spent in Open Lab can additionally contribute to a student's grasp of didactic concepts, and their integration into the clinical setting. Additional time spent in the laboratory can demonstrate a student's ability to visualize structures radiographically as well as demonstrate a student's positioning plan to acquire a diagnostic image. Analysis of data collected will show how Open Lab has helped imaging students to understand the didactic component of positioning and integrate it into their lab practical performance progressively. A gradual improvement can be shown as students' positioning and imaging will reflect during lab practical examinations. Data accumulated is essential in showing how Open Lab truly aids in the development of that student into an ARRT Registered Radiologic Technologist. It is of utmost importance as newly accepted students have minimal exposure to unfamiliar radiologic content and equipment knowledge that results from the span of Two years spent in the Radiologic Technology & Medical Imaging program at New York City College of Technology.

Introduction

Radiographic imaging student's ability to conceptualize positioning as well as apply them to real life patient care, and diagnostic imaging is essential for their critical thinking development. Open Lab has provided progressive, and gradual improvement of students' overall final performance. Time spent in Open Lab can aid in a student's performance for practical examinations as it allows that student to visualize anatomical structures discussed in class. Open Lab enables a student to develop in-room patient rapport as well as critical thinking for patient positioning to acquire diagnostic film. Time spent in Open Lab can help a student visualize and differentiate between similar radiographic views. Longitudinal study of previous radiographic alumni's performance can also display the significance of Open Lab and its real world application as a Radiologic Technologist. We believe that there will in fact be a correlation. We believe the more hours the students spend, the better their grades will be.

Senior Results

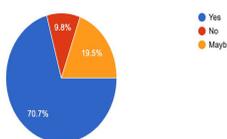
Do you believe open lab helped improve your practical grade?
41 responses



Based on the surveys responses that we received from the senior students of the Radiology Department, 88 percent of the entire senior student body said "Yes" to Open Lab's improvement on their practical grades. This suggests that Open Lab has significantly helped improve their practical grade. While the last remaining 12 percent stated "maybe" which shows that remaining of the student did not improve or their grades state the same as before. The results show that out of the 41 students, no one answered "no" to that question.

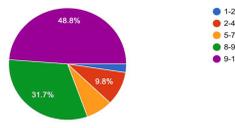
One of the main goals of this research project was to keep all of the questions answered without being biased. Since the radiology department required the students to attend lab in order to gain their mandatory lab hours for them to progress to progress to the higher level Radiographic Procedure courses. One of the questions we deemed unbiased would be "would they attend Open Lab if it wasn't required?". Based on the survey results Seniors have answered "maybe", which translated to 9.8 percent. While 71 percent of the results of the seniors answered "YES". We concluded that mandatory open labs are helpful to the senior student of the radiology

Would you do open lab if it wasn't required?
41 responses



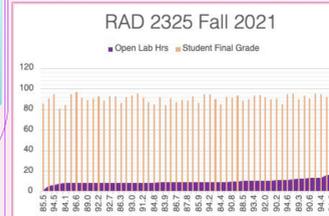
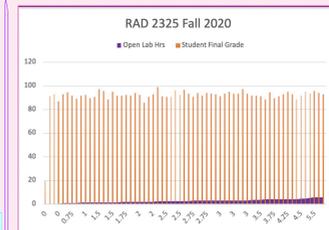
Based on the data that we collected from the seniors of the Radiology Department, 48.8 percent of the whole student body answered the survey by stating "9-10", showing the "Open Lab is helpful to them". The data consisted of a scale range of 1 to 10; with one being the lowest and ten being the highest which would translate to their performance. While the remaining students are divided into different scales. For example, only 31.7 percent reported a scale of "8-9" which is the second majority of the student body. While the few remaining percent are slotted in the middle of the scale. Where 9.8 percent only stated out of 10, 9.7 scale is what they felt based on their performance.

On a scale of 1-10 (10 being most helpful) how helpful was open lab?
41 responses



Longitudinal Alumni Study

A longitudinal study of student's hourly time spent in Open Lab shows that additional time outside of scheduled class time has had a significant impact on the students final Radiographic Procedures grade. Data suggest that students who spent additional lab time outside of mandatory laboratory hours were more inclined to gradually improve in the course. RAD 2325 given during Fall 2020 was facilitated via distance learning. Availability of Open Lab varied due to social distancing guidelines. Mandatory required hours for that semester was set to 4 hours, however students that spent additional time outside the mandatory hours, had a significant overall improvement in their final course grade. Data of Fall 2021 supports this claim as mandatory lab times had been doubled as in-person classes began to resume. Those students who spent additional lab time outside the mandatory 8 hours of laboratory time, displayed progressive improvement in the overall understanding of the course subject and diagnostic image evaluation criteria.

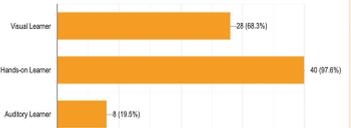


Methodology

Distribution of surveys will assist in gauging how diagnostic imaging students find the beneficial use case of Open Lab to their conceptualization of radiographic imaging along with its associated positioning. Students would fill out questionnaires in relation to utilization of open lab based on didactic information, and its relation to lab in order to prepare for practical examinations. Data accumulated is diagnostically crucial as newly accepted students in the Radiologic Technology and Medical Imaging program at New York City College of Technology have the least amount of exposure to Radiography, and the scope of diagnostic imaging. Therefore, Open Lab was developed to give each, and every student additional lab practice as well as the necessary exposure outside class time to practice radiographic positioning. This is important for the clinical component of the Radiologic Imaging Program in order for that student to conceptualize diagnostic image evaluation. Open Lab serves as an environment for that student to not only develop effective equipment manipulation, but rhythmic flow that will systematically work for all patient body habitus. The ability to practice positioning outside the limited scheduled class time is crucial for clinical component of the Radiologic Technology and Medical Imaging program. Ability to conceptualize various positions will thus contribute to that students overall final radiologic procedures grade. In order to maximize our target audience, we distributed anonymous Google surveys to all radiologic imaging students in order to keep the surveys unbiased. Similarities amongst responses displays the significance of dedicated Open Lab time for both junior and senior students. The survey responses were designed to target specific topics such as age, how Open Lab has helped that student the most, and what radiologic positioning content Open Lab has helped that student perfect.

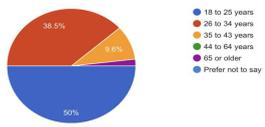
Student Correlating Data

What type of learner are you?
41 responses



While analyzing data collected, we found correlations between both groups of students in their ability to conceptualize radiologic positioning. Open Lab enables visualization of anatomic structures, and positioning that corresponds with the image evaluation criteria required for diagnostic film. Many of the radiologic imaging students are hands-on learners followed by visual learning. Using associative learning, students can utilize classical conditioning to aid in their visualization of radiographic criteria. Learning through association was discovered by Russian physiologist Ivan Pavlov. In Pavlov's experiment on classical conditioning, "the sound of the tone served as the conditioned stimulus that, after learning, produced the conditioned response (CR), which is the acquired response to the formerly neutral stimulus" (Walinga, J., & Stangor, 2014). By dedicating time to Open Lab, students can utilize visualization techniques as a conditioned stimulus to evaluate diagnostic criteria for medical imaging. Open Lab serves as a stimulus to facilitate adaptive learning, and critical thinking analysis. Therefore, through adaptive learning facilitated by the Radiologic Technology and Medical Imaging Department, students can sharpen their visualization of imaging criteria outside of required laboratory hours to improve their overall radiologic performance and reproducibility.

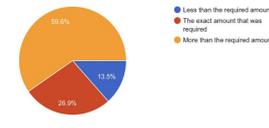
What is your age?
52 responses



This chart separates the students of the junior class by age group. Out of the 52 total remaining junior radiography students, exactly half of said students (50%) are between the ages of 18-25. The second majority of students (38.5%) range from age 26-34. The next group of students (9.6%) are between the ages of 44-54. And the remaining students (0.9%) are 65 or older. This data provides insight on the age demographic because age may have a contributing factor to the student's performance in this rigorous program.

The data in this chart represents the amount of junior students who have met, exceeded, or fell below the Open Lab attendance goal for this current semester: Spring 2022. The goal is to meet 8 hours or more of Open Lab hours to earn credit for this portion of their final grade in the RAD 1225 course. About 59.6% of junior students stated that they exceeded the 8-hour goal, while about 13.5% of junior students have less than the required 8 hours. Approximately 26.9% of students met the goal exactly at 8 hours. This information gives us insight into how much work the students are putting into their program performance outside of lecture, lab and clinical hours.

How often did you attend open lab?
52 responses



This chart represents the survey answers to how helpful students feel Open Lab has been toward their overall performance in the program. A rating of 1-2 being the least helpful and 9-10 being the most helpful. About 48.1% of the junior students answered that they found Open Lab to be very helpful by responding with a 9-10. On the other hand, 18% of students answered that Open Lab has not been helpful to them at all by submitting a score of 1-2. The rest of the students fell in the middle of these two extremes. This data is useful in understanding the junior students' feelings about the Open Lab requirement and its personal impact on their conceptualization of the information being taught in class.

Junior Results

Conclusion

Student's within the Radiologic Technology & Diagnostic Imaging fall in the age groups of 18-25. The remainder of the students ranges from 26 and older. Most students (59.6%) attend more than the required Open Lab hours for additional preparation and practice. 48.1% of first-year junior class found Open Lab to be helpful in their academic experience. It can be inferred from the data collected that Open Lab is truly beneficial for radiologic imaging students. Many students find the beneficial aspect of Open Lab to be influential on their clinical experience. The time dedicated to Open Lab can demonstrate tremendous improvement on a students final radiologic procedures gradelt enables the student to perform routine radiological projections more efficiently to develop a systemic flow. About 13.5% of Junior students have not met the Open Lab hour requirement. However, altogether 86.5% have either met or exceeded the Open Lab hour goal and more than half the class found it to be beneficial. Therefore, a correlation can be made with the outcome of the data that Open Lab is beneficial to Junior and Seniors students' performance in this current semester.

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Compare how students performed and attendance before, during and after pandemic waves

Prof. Zoya Vinokur, Dept of Radiology Technology

Student Researchers: Peber DeJesus, Rohini Mattan, and Ralph Lauren Ocampo

Abstract

Covid-19 is a global pandemic that affected many people that includes students from all different parts of the world. In this case, the research would focus on the Radiologic Technology and Medical Imaging program students at New York City College of Technology, who must do hands-on learning in order to accomplish the experience required for the degree.

One of the hardest obstacles that radiologic students must go through are the ones that are unable to be online. One example of those required classes would be the Clinical Rotation. It is mandatory for the radiologic student to go to a required hospital site and complete the necessary hours and competency to get passing grades. The Radiologic Technology and Medical Imaging Radiology is a degree where students must deal with patients and have in-person contact in order to take the best diagnostic medical images. The covid-19 virus was spread to the whole United States and was announced a pandemic beginning in March of 2020.

It got to the top peak level of exposure in hospitals within that time. In order to gather the data that would be used in this research, surveys would be sent out to both Juniors and Seniors in the program, which would represent the answers to how the pandemic affected students. Comparisons are going to be made on how students did and attended through the pandemic and after the pandemic between juniors and seniors. Analysis of how Radiology tech students attended school before, throughout, and after the pandemic (when vaccines were out), are going to be further critiqued and explained.

Once the Surveys have been answered the research would create a data and graph that would be analyzed in order to compare the Attendance and Performance in the Year 2020 to the Year 2022 to see if there were any changes that affected the student during those pandemic years. This is continuous research as the Covid-19 Pandemic is still active as of this day.

Introduction

Many people around the world were affected in a variety of ways due to the COVID-19 pandemic. The pandemic forced many people to have to make changes or new adjustments in their lives that they wouldn't think would ever happen. Many workers had to switch from being in person to working online, which is an adjustment for people who didn't have a workstation at home or may not have a proper environment necessary to focus on what they need to get done. This also goes for students, many students had to switch to virtual learning, and some are still virtual. This was an adjustment for many especially people who are visual learners. On the other hand, many students still had to function through the pandemic in person. This goes for the students in the Radiologic Technology program at New York City College of Technology. Surveys were done to analyze the different experiences each student in the program had before, during, and after the pandemic. After being in person and virtual during the pandemic every student had a different learning experience and preference.

Methodology

In order to compare differentiate the performance of the Junior Student and Senior Student in Radiology. The used of surveys is the most ideal scenario for this research study due to the facts that surveys have a high reliability, as it produce a similar results under the consistent conditions that we apply for both, Juniors and Seniors. Google Survey is the form that have been chosen to be used in this research. Since Google Surveys are known for their flexibility of creating a data that would be used for this research.

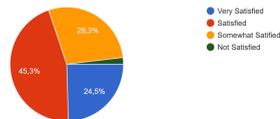
For us to acquired the results we need for both, Seniors and Juniors, we asked the professor of the Radiologic and Imaging department to send the surveys during class time. Having a professors sending the surveys during class time allows us to gain the response and data we need in more efficient way since many would answer it. Due to the facts, it may be part of the curriculum or can be graded by the professor. Which give the for both Juniors and Seniors surveys validity and reliability as the whole class answered it .

The moment the data have been collected for both Junior and Senior. Google Survey have a built-in tool to create a Graph, or a chart based on the response we received. In this research we would use the pie chart as it is more accurate to use the percentage since we can see the amount of student answers in percentage which would allows us to divide and review it. Once the pie graph is done, we would then compare the results to both Juniors and Seniors to see which of the two made a difference in terms of different environment.

Results Junior Year

Surveys were successfully submitted and responded to, by the juniors from class 2023. The juniors from class 2023 are 69.8% females and 30.2% male which makes a total of participants of 53 people. After a whole pandemic, students this year had an opportunity of coming back to school with vaccination mandates. The class of 2023 responded with a total of 69.8% being satisfied including both votes of satisfied(45.3%) and very satisfied (24.5%) this year coming back to an in-person class, leaving only a total of 30.2% of the class being somewhat satisfied (28.3%) and not satisfied (1.9%). One of the factors of being satisfied with coming back to school is what type of learner students are. Therefore, 64.2% of respondents were visual learners leaving 35.8% being Auditory learners with 13.2% and Physical learners with 22.6% of respondents.

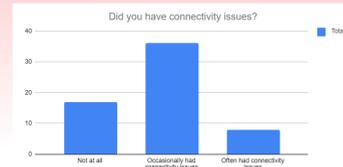
How do you feel coming back to in-person class?
53 responses



One of the main effects of attendance can be transportation and vaccination mandates. One of the first effects of school can be transportation. A 100% of the class of 2023 takes Public transportation to get to school. Only 39.6 was in the last two scales of difficulty (very difficult 17% and 22.6% difficult) in getting to school. Leaving an intermediate difficulty in getting to school only a 49.7%. The first two scales of easiest getting to school are only calculated at 37.7% (very easy (11.3%), and easy (26.4%).

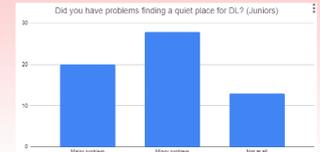
Results Senior Year

Seniors are students that have already gone through the three stages of pandemic; before, through and after. Class of 2022 when they started as juniors, they had to go to clinical even though in hospitals there was already a high rate of covid. Also, despite all their concerns about the pandemic, they made it through, they also continue forward by studying through the challenging exams that professors give in order to prepare them for the board exam. After the pandemic it was all getting better, but what was their comparison between the pandemic times when there were juniors compared to now when the pandemic is already over.



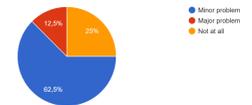
Class of 2022, Connectivity issues graph throughout the pandemic; survey done in the midsemester of 2020.

In their junior's year of the class of 2022, students had some attendance effect when there was attending online. One of them was internet connectivity. In a survey that was spread in Fall 2020 to juniors, in the mid-semester, 59% of students had occasionally had connectivity issues, 13% of students had often a connectivity issue. In total that makes 72% of students that had connectivity issues of some type leaving almost 28% of the class that didn't have all issues. The most important thing in doing online class is not having issues with connectivity at all so it doesn't interfere with your assignment submission, quizzes, or even exams.



Class of 2022, finding a quiet place graph throughout the pandemic; survey done in the midsemester of 2020.

Did you have problems finding a quiet place to do coursework online during Spring 2022, now that school are open?
24 responses

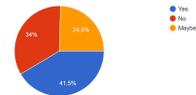


Class of 2022, finding a quiet place graph throughout the pandemic; survey done in the midsemester of 2022.

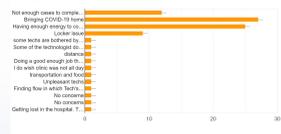
Another effect of attendance is being able to concentrate in classes by having a quiet place and a home. Students have had struggles with having more loud noise at home than in a school where you can find a quiet place. Survey of a class of 2022 in their junior year, 32% of them responded to having major problems finding a quiet place at home in pandemic times, 45% of them consider it a minor problem. Nowadays, the same question was spread again when being back on campus, a major problem of finding a quiet place was reduced; only 12.5% of students voted. A 62.5% of students now have a minor problem finding a quiet place. This percentage increased now when they are back on campus.

Another effect of attendance is the lack of concentration, compare to pandemic times, students could not concentrate as much. Now that people are back to school is better, in school you can even find a quiet place to study, etc. A 41.5% of the class of 2023 replied with a yes in concentrating more than in pandemic times. A 75.5% find a quiet place in school. A 54.7% person find that place to study which is located in the hallway chairs available for students. Even though great things can be obtained by being on campus, unfortunately, a 43.4% voted that they want to go back to online classes

Do you focus/concentrate more now than in pandemic times?
53 responses



What are some concerns that you have regarding your clinical site? (Select ALL that APPLY)
53 responses



Lastly, students in the class of 2023, 100% of them attending clinical. On a two-scale, the rate of 5 of liking attending clinical (56.6%) and a rate of 4 of liking (24.5%), which is an 81.1% that likes attending clinical. One of the most concerns in attending clinical is bringing covid-19 home which is 52.9% of respondents voted; this is more than half of the juniors. Another concern is the lack of energy to come to didactic classes which were voted second with a 49% rate. The rest of the concerns were minimum as the following: not enough cases to complete comps, locker issues, Unpleasant techs, transportation & food, etc.

Conclusion

Concluding all the surveys and comparing through previous years, Radiology students were having more struggles and times were harder through pandemic. Radiology students were committed professionally because they had to proceed in clinical despite difficulties but even in the middle of a pandemic, they made it through. In the surveys that were spread now in 2022, the rate of in-campus concentration, and studying was higher. Also, majority of students that were back on campus stands more satisfactory. All of this, as a result, reflects the improvement in attendance that radiology students made after the pandemic.

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Fabrication of a Thin Flexible Film Coating Made of Pristine Graphene for Lightning Strike Protection

CRSP Program- New York City College of Technology, CUNY- Department of Mechanical Engineering Technology
Student: Aaryan Nair Mentor: Prof. Dr. Akm Rahman

Abstract

Lightning strike protection (LSP) have recently been a newly developing field particularly with the emergence of graphene thin film integration into carbon fiber composite structures. This technology has a widespread application in airplanes, wind turbines, and other instruments which are susceptible to frequent lightning strikes. Electrical discharge of the instrument in a safe manner is vital for the safety of the passengers (in the case of flights) as well as the integrity of the aircraft structures because of their specific mechanical and structural properties, which are essential for their functioning. The purpose of the study is to fabricate graphene thin film coated carbon fiber composite structures for assessment with simulated lightning strikes. This study will look at different methods for incorporating GTF (graphene thin film) into Carbon Fiber Reinforced Plastic and assess the electrical conductivity through methods such as compressive molding, Resin Transfer molding fabrication to achieve highly conductive functionalized nanosized GTFs, integrated with carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs). The method developed must reduce the resistivity of the CFRP and provide a safe discharge outlet for the lightning strikes. In the current study we will develop GTF using GNP impregnated polymers. Electrospinning process will be one of the processes implemented to develop the GTF. The purpose would develop viable methods for the fabrication of graphene thin film material, and simulated testing of lightning strikes.

Introduction

Lightning strike protection (LSP's) have recently been a newly developing field particularly with the emergence of graphene thin film integration into carbon fiber composite structures, particularly in airplanes, wind turbines, and other instruments susceptible to frequent lightning strikes. This study will look at different methods for incorporating GTF (graphene thin film) into Carbon Fiber Reinforced Plastic, and assess the electrical conductivity, through methods such as fabrication of a highly conductive functionalized nanosized GTFs, and combined use of carbon nanotubes (CNTs) and graphene nanoplatelets (GNPs).

Methods Adopted and Data Collection

Three different methods were analyzed during the study. According to Zhang et al. (2017), flexible GTF's made of pristine Graphene were made using a process involving sonication. An input power of 50 W was applied on the test side and the energy was measured using open hole measurement of the reception side with a test panel. The difference between the open hole reference and the test-panel was considered as the shielding effectiveness of the material. On the other hand, the GTF fabricated by M Rahman et al. (2019) devised a method involving 3-D stitching of carbon fiber and GTF for the composite layups. The samples were neutralized and filtered. The third paper, Li et al. (2017) attempted to create synergistic effects by spray coating hybrid carbon nanoparticles on CFRP Laminates. Nanoparticles were sprayed using an airbrush system, and encapsulated with resin film, allowing much lower resistivity and increased electrical pathways.

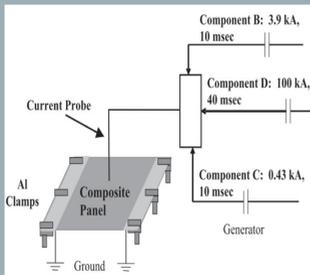


Figure 1- Displays the impulse test applied by Zhang et al. (2017). High current was applied over very short

Test Data & Results

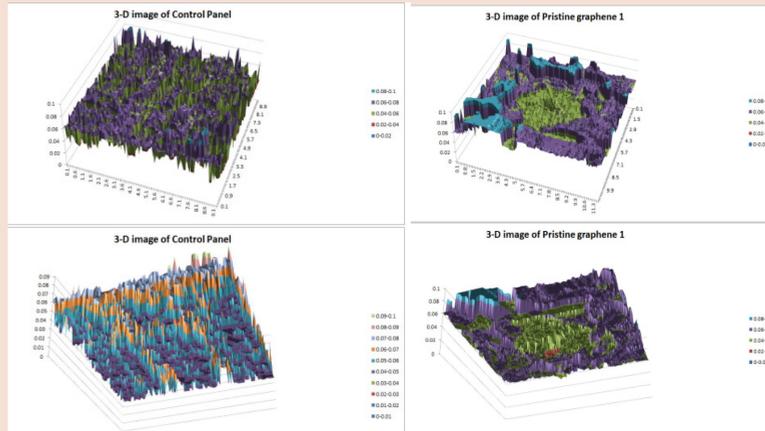


Figure 3- Demonstrates relative damage to the panel after impulse strike. The second diagram shows the area damaged by the impulse strikes. Zhang et al. (2017)

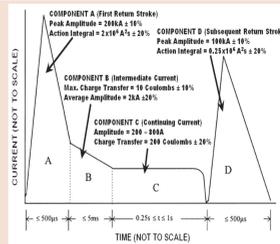


Figure 2- Displays the region-wise current test applied by Li et al. (2019).

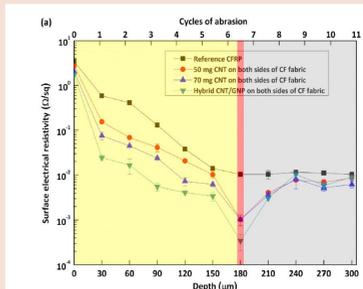


Figure 4- Displays Surface electrical resistivity of different nanocarbon modified CFRPs in relation to surface depth by Li et

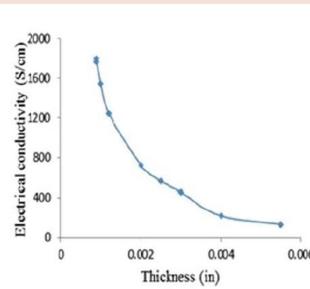


Figure 5- Illustrates how the 3-D stitched samples of varying thicknesses played with it's electrical conductivity. M Rahman et al. (2019)

Evaluation and Adaptation

From the data, we can clearly see that graphene in any form reduces the resistivity of the medium. Likewise, a larger depth of graphene also showed reduced resistivity, though, there was an optimum region. Readings higher than that resulted in higher resistivity meaning that the conductive pathways seemed to be hindered in some form. Another evaluation which could be drawn was that pristine graphene clearly created conductive pathways and reduced the volumetric damage to the material underneath the film. These properties examined would mean vital progress could be made to the aviation industry, and in large-scale wind turbines.

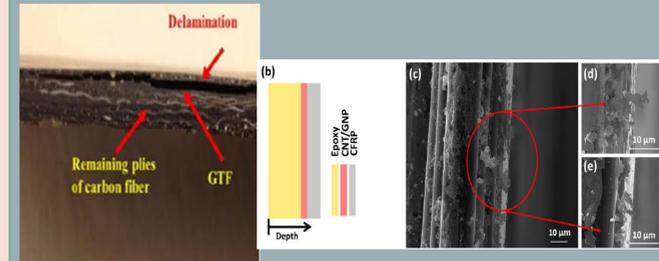


Figure 6 (Left) Demonstrates delamination without 3-D Stitching, while Figure 6 (Right) shows the synergistic GNP/CNT integration by Li et al. (2019)

A future extension of this would be understanding the synergistic relations between the CNT/GNP's, and its conductivity with relation to temperature. In practice, there are a lot of factors which determine materials for aircrafts/turbines. Another aspect is the risk of delamination of the panel after repeated strikes. A future extension could be an enhanced understanding of the large area shear crack and warpage of the film.

Conclusion

The purpose of the study and the subsequent experiment was to understand the impact of Graphene nanoparticles on CFRPs. This assessment should help us reduce the risks of Lightning Risks. In the case of wind turbines, this would hopefully encourage more people to take up wind-energy, since now there would be a reduced risk of lightning strikes.

Acknowledgements

I would like to acknowledge Prof. Dr. Akm S Rahman for supporting me throughout, and the CBML Lab for its facilities.



Harvesting of Animal Populations

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Abstract

The three main biological processes are birth, death and aging. The objective of this project is to investigate how these processes impact the distribution of the female population overtime. We employ the Leslie Matrix Model, which was developed by demographers in the 1940s, to study the growth of the female portion of a human or animal population. In this model the females are divided into n age classes (intervals) of equal duration. In order to perform matrix calculations, we use SageMath in the CoCalc platform. We consider several initial age distribution vectors and observe how they influence the future female population.

Introduction

The **Leslie Matrix Model** is a discrete, age-structured model of population growth that was developed by Patrick H. Leslie. This model is one of the most well known ways to describe the growth of populations along with their projected age distribution in population ecology. In this project we focus on the development of the female portion of a human or animal population.

The procedure starts by splitting the females into age classes of equal duration. For example, let's say that the maximum age attained by any female in the population is L years, and we distribute the females into n age classes. Then each class is L/n years in duration as the following table shows.

Age Class	Age Interval
1	$[0, L/n)$
2	$[L/n, 2L/n)$
3	$[2L/n, 3L/n)$
\vdots	\vdots
$n-1$	$[(n-2)L/n, (n-1)L/n)$
n	$[(n-1)L/n, L]$

We denote the birth and death processes between two consecutive observation times by:

$$\left\{ \begin{array}{l} a_i : \text{The average number of daughters born to each female} \\ \quad (i = 1, 2, \dots, n) \text{ during the time she is in the } i\text{th age class.} \\ \\ b_i : \text{The fraction of females in the } i\text{th age class that can be} \\ \quad (i = 1, 2, \dots, n-1) \text{ expected to survive and pass into the } (i+1)\text{-st age class.} \end{array} \right.$$

It is vital to see that any b_i cannot be equal to zero, because then no females would survive beyond the i th age class. Another factor to note is that at least one a_i must be positive so that some births can occur.

The Leslie Matrix Model

We define the age distribution vector $\mathbf{x}^{(k)}$ at time t_k by

$$\mathbf{x}^{(k)} = \begin{bmatrix} x_1^{(k)} \\ x_2^{(k)} \\ \vdots \\ x_n^{(k)} \end{bmatrix},$$

where $x_i^{(k)}$ is the number of females in the i th class at the time t_k . When $k = 0$, we call $\mathbf{x}^{(0)}$ the **initial age distribution vector**.

At the time t_k , the females in the first age class are just those daughters born between t_{k-1} and t_k . In other words, we have

$$\left\{ \begin{array}{l} \text{number of} \\ \text{females} \\ \text{in class 1} \\ \text{at time } t_k \end{array} \right\} = \sum_{i=1}^n \left\{ \begin{array}{l} \text{number of} \\ \text{daughters} \\ \text{born to} \\ \text{females in} \\ \text{class } i \\ \text{between times} \\ t_{k-1} \text{ and } t_k \end{array} \right\}.$$

We can use our parameters to describe this as:

$$x_1^{(k)} = a_1 x_1^{(k-1)} + a_2 x_2^{(k-1)} + \dots + a_n x_n^{(k-1)}. \quad (1)$$

In addition, we need to take into account that the females in the $(i+1)$ -st age class at time t_k are those females in the i th class at time t_{k-1} who are still alive at the time t_k . This means that

$$\left\{ \begin{array}{l} \text{number of} \\ \text{females in} \\ \text{class } i+1 \\ \text{at time } t_k \end{array} \right\} = \left\{ \begin{array}{l} \text{fraction of} \\ \text{females in class } i \\ \text{who survive} \\ \text{and pass into} \\ \text{class } i+1 \end{array} \right\} \cdot \left\{ \begin{array}{l} \text{number of} \\ \text{females in} \\ \text{class } i \\ \text{at time } t_{k-1} \end{array} \right\}.$$

or, equivalently,

$$x_{i+1}^{(k)} = b_i x_i^{(k-1)} \quad (2)$$

for $i = 1, 2, \dots, n-1$. We can combine (1) and (2) by writing

$$\begin{bmatrix} x_1^{(k)} \\ x_2^{(k)} \\ \vdots \\ x_n^{(k)} \end{bmatrix} = \begin{bmatrix} a_1 & a_2 & a_3 & \dots & a_{n-1} & a_n \\ b_1 & 0 & 0 & \dots & 0 & 0 \\ 0 & b_2 & 0 & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & b_{n-1} & 0 \end{bmatrix} \cdot \begin{bmatrix} x_1^{(k-1)} \\ x_2^{(k-1)} \\ \vdots \\ x_n^{(k-1)} \end{bmatrix},$$

that is,

$$\mathbf{x}^{(k)} = L\mathbf{x}^{(k-1)}$$

for $k = 1, 2, \dots$, where

$$L = \begin{bmatrix} a_1 & a_2 & a_3 & \dots & a_{n-1} & a_n \\ b_1 & 0 & 0 & \dots & 0 & 0 \\ 0 & b_2 & 0 & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & b_{n-1} & 0 \end{bmatrix}$$

is the **Leslie Matrix**.

The Female Age Distribution Problem

Suppose that the oldest age attained by the females in a certain animal population is 15 years. We divide the female population into three age classes with equal duration of five years. Let the Leslie matrix for this population be

$$L = \begin{bmatrix} 0 & 4 & 3 \\ 1/2 & 0 & 0 \\ 0 & 1/4 & 0 \end{bmatrix}.$$

Our goal is to demonstrate how choosing different values for the initial age distribution vector will affect the total number of female population after 15 years. The control variable is the total number of females in the initial age distribution vector, which we set to be 3,000.

In Table 1 we display the vectors as row vectors to make the values more accessible to observe the relationships.

$\mathbf{x}^{(0)}$	$\mathbf{x}^{(1)}$	$\mathbf{x}^{(2)}$	$\mathbf{x}^{(3)}$
[1,000 1,000 1,000]	[7,000 500 2500]	[2,750 3,500 125]	[14,375 1,375 875]
[500 1,500 1,000]	[9,000 250 375]	[2,125 4,500 125/2]	[36,375/2 2,125/2 1,125]
[1,000 500 1,500]	[6,500 500 125]	[2,375 3,250 125]	[13,375 11875.5 812]
[500 2,000 500]	[9,500 250 500]	[2,500 4,750 125/2]	[38,375/2 1,250 2,375/2]
[2,000 500 500]	[3,500 1,000 125]	[4,375 1,750 250]	[7,750 4375/2 875/2]
[500 500 2,000]	[8,000 250 125]	[1,375 4,000 125/2]	[32,375/2 1,375/2 1,000]
[750 750 1500]	[4,125/2 3,750 375/4]	[4,125/2 3750 375/4]	[61,125/4 4,125/4 1,875/4]

Table 1. Female Population of Animals.

We want to compare all values in $\mathbf{x}^{(0)}$ amongst each other and all values in $\mathbf{x}^{(3)}$ with $\mathbf{x}^{(0)}$, in order to see how they affect each other.

Conclusion

We want to compare some initial age distribution vectors to Row 1 on Table 1. After experimenting with different initial values using SageMath, we make the following observations.

- In Row 3, the population of the first class is kept constant, the second class is decreased by 500, and third class is increased by 500. So we have [1,000 500 1,500].
- After 15 years, the population of the three classes would be [13,375 11,875.5 812]. However, if we use the initial age distribution vector from Row 1, after 15 years, the population would result in [14,375 1,375 875].
- Therefore, if we compare the final population of the initial age distribution vector to our fixed values, we can see that the population decreases in the first class, increases in the second class and decreases in the third class. We predict there exists an indirect relationship.

In addition, we analyzed the following situation. Whenever we fix two consecutive classes with the same fixed initial age distribution vector, the second class would hold a direct relationship with the resulting female population compared to our initial age distribution vector.

- For instance, we take [500 500 2,000] and [750 750 1,500]. Note how we have two identical initial values.
- The first class would hold an indirect relationship, however the second class would hold a direct relationship despite the conditions. Refer to Rows 6 and 7 in Table 1 for the resulting values.

Further Work

Another study we would like to conduct is experimenting fixed values while not having a controlled variable. More specifically, we would be allowed to change the total number of initial females in the population while maintaining the same Leslie Matrix. We would also like to explore how the number of age classes can affect the study, and other demographic problems that make use of this model.

References

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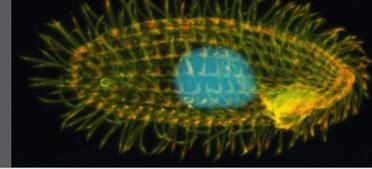


Computational Characterization Of Calpains In *T. thermophila*

Anjalee Rabbani, Mentor: Professor Ralph Alcendor

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Abstract

Calpains are a set of calcium-dependent cysteine proteases that are found in almost every type of living organism, except archaeobacteria. Calpains share a set of common domains that help with their function as proteases. These domains are also used to classify the various Calpains. For example, in humans have 15 different calpains which are divided into two classes; classical and nonclassical calpain. Classical calpains contain C2L, PEF and CysPc domains, while the non-classical calpains do not have C2L and or PEF domains. Calpains have been shown to play important roles in cell death, diabetes and neurological diseases such as Alzheimer's disease.

T. thermophila is a ciliated protozoan which lives in lakes, ponds, and streams. These eukaryotic cells have two nuclei, a macronucleus and a micronucleus. The macronucleus is involved in vegetative growth while the micronucleus contains germline information. As a eukaryotic model, *T. thermophila* has been used to study many cellular structures and functions, including histones, cell cycle and cell motility. Although these cells have been studied extensively, they are yet to be exploited to examine the role of calpains. The genome of *T. thermophila* has been sequenced, but information on the thousands of genes in these cells is yet to be assigned.

The goal of this project was to use computational tools to begin examining the structure and function of THERM_00287920, one of *T. thermophila* calpain family members. This gene was selected from about 27 different calpain family members. Multiple alignment was done using tools like Multiple Sequence Comparison by Log-Expectation (MUSCLE), Tree-based consistency objective function for alignment evaluation (T-Coffee) and Multiple Alignment using Fast Fourier Transform (MAFFT). Phylogenetic analysis was done using Phylogeny.Fr and Molecular Evolutionary Genetics Analysis (MEGA).

Objective & Hypothesis

The purpose of this research was to characterize using bioinformatics tools. It can be predicted that THERM_00287920 shares similarity in structure with one or more of human calpains.

Methodology

Identification of Protein of Interest

Ciliate.org database was used to identify *T. thermophila* calpain of interest by performing a BLAST (Basic Local Alignment Search Tool) using human calpain 1 amino acid sequence. NCBI BLAST was also used to verify the sequence information and to identify any conserved domains.

Multiple Sequence Alignment

Sequence alignments to identify similarities between human calpains and THERM_00287920 were done using MUSCLE, MAFFT, T-COFFEE. All human calpains and THERM_00287920 were used as input sequences in these software.

Phylogenetic Tree Analysis

Phylogenetic trees were drawn using phylogeny.fr and MEGA using the same sequences mentioned above. Maximum evolutionary method was used to draw for tree drawing.

Protein Structure Modeling

SWISS-MODEL was used to model the protein structure of THERM_00287920. These online tools use templates from RCSB Protein Data Bank to predict the possible three-dimensional structure of the THERM_00287920. % templates from both SWISS and PHYRE were taken and were uploaded on VMD for a better visualization of the structure of the protein.

Results

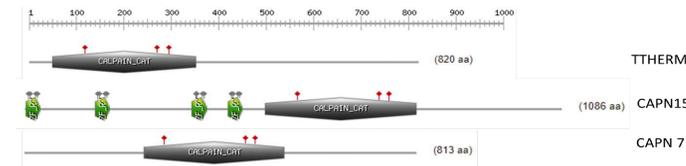


Figure 1. Conserved domains of TT_00287920 (THERM), CAPN7 and CAPN15. All three have a conserved CysPc. The three red symbols indicate the active sites.



Figure 2: CLUSTAL Multiple sequence alignment results from MUSCLE. Conserved regions or amino acids are indicated. Left brace highlights regions with many conserved amino acids. "*" indicates conservation between of weakly similar properties, "." shows conservation between highly similar property groups, and "**" indicates positions with a single, totally conserved property.

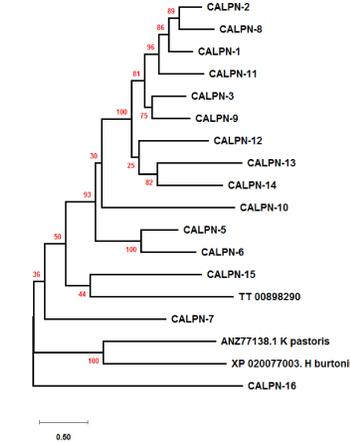


Figure 3: Phylogeny tree from MEGA using Maximum Likelihood method. Result shows THERM_00287920 may be more closely related to Calpain-15. *K. pastoris*, *H. burtonii* were used as outgroups.

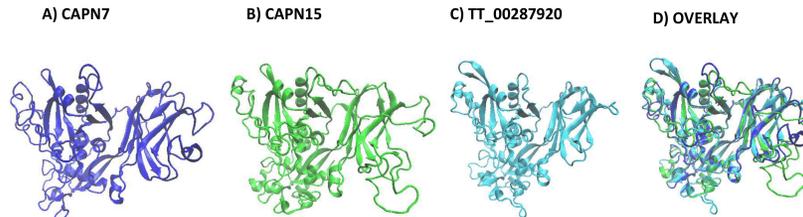


Figure 4: SWISS-MODEL and VMD results of TT_00287920. VMD analysis supported TT_00287920 being more similar to CAPN7 (A) compared to CAPN15 (C). (D) overlay of A – C.

Discussion

- THERM_00287920 is one of the Calpain family of *T. thermophila*.
- Like other calpains, it has a cysteine protease domain with three active sites
- Different areas of the protein are conserved in both human calpains and THERM_00287920.
- Based on Phylogenetic analysis and Multiple Sequence Alignments, THERM_00287920 seems to be more closely related to Human Calpain_15
- In addition to Calpain-15, THERM_00287920 is more similar to Calpain-10 and Calpain-15 when being compared to the other calpains.
- VMD analysis of protein models from SWISS-MODEL supported THERM_00287920 being more similar to calpain-15.

Conclusion

THERM_00287920 seems to be more closely related to human calpain-15, suggesting these two proteins may have some cellular functions in common.

Future Directions

This is an ongoing research, and more analysis can be done to explain why THERM_00287920 may be more similar to CAPN15 compared to the other human calpains. human Calpain-7 is more Calpain-15 are so similar to THERM_00287920. Furthermore, functions of CAPN7 and CAPN15 can be examined and related to possible functions of THERM_00287920 in *T. thermophila*.

Acknowledgements

- I would like to thank Professor Ralph Alcendor for being my mentor for CUNY Research Scholars Program. I really appreciate all of his help.
- I would also like to thank the Undergraduate Research for giving me the opportunity to be a part of the CRSP Program.

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You Are Prepared: A Browser-Based Performance Using AI and ML

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Abstract

In today's age of rapidly expanding technology, people around the globe have resorted to extreme measures to "hack" their bodies through technological implants, ranging from NFC chips in fingers to entire hard drives in thighs. Led by Professor Allison Berkoy, You Are Prepared is an interactive browser-based experience, exploring the similarities and intersections between human and machine self-optimization. In the first phase of my contributions, I researched examples of experimental biohacking and human augmentation projects from recent years. Humans are looking to self-augmentation as a method of seamlessly integrating technology into their bodies. I also worked with Playform.io, a machine-learning platform. We trained AI models using Playform's machine-learning software, inputting specially prepped image assets to generate new AI-produced images. Recently, I continued research on human optimization, focusing more narrowly on topics like transhumanism and cyborgism. I dove deeper into learning about the ML programs used in many projects I researched in the fall: namely ml5.js, p5.js, Posenet, and Tensorflow. My second phase of work for this semester was preparing for pitching to and recruiting volunteers for a playtest of the current You Are Prepared prototype. Having a wide range of volunteers to test the experience and provide feedback is crucial as it will give insight to how well the project functions across various computing platforms, its technical usability, and its experience design.

Video Research

The first phase of video research was focused on examples of extreme body modification with the goal of self-optimization. There are two main subsections to this work: wearables (Fig. 1) and implantation (Fig. 2). Users are looking to expand their senses and cognitive function with the use of new and emerging technology. I was careful not to include medical projects in my research, as our project is focused on the voluntary choice to augment the body in recreational ways. This research will be utilized in the final culmination of You Are Prepared as an informative piece of the performance, giving participants a taste of the ways humans have been developing ways to physically integrate technology into their bodies. This semester, my research included more research on human optimization, while also shifting my focus to examples of projects which utilized emerging ML programs, primarily ml5.js, Posenet, and Tensorflow. After observing several hours of projects which used these programs as their structure, I was able to identify common trends throughout the projects: mainly the use of the body to perform functions as input, as opposed to using the mouse and keyboard. In Figure 3, Cristina Maillo is displaying the YogAI program she developed using Tensorflow.js. In Figure 4, a participant is testing keypoint accuracy with the Posenet model.



Fig. 5: Original asset



Fig. 6: Image generated by Playform



Fig. 7: Asset with BG removed



Fig. 8: Image generated by Playform

Playform.io Testing and Results

Playform.io is a machine-learning (ML) software that "utilizes a particular class of ML systems called Generative Adversarial Networks (GANs), in which two artificial neural networks play a turn-based game with each other that teaches them the statistical attributes of the training data."¹ Specifically, we are utilizing Playform's Freeform process, which "interprets the [assets] and tries its best attempt to replicate its subject matter...all the shapes inputted will affect the shape of the amalgamated result."² For the purpose of our research, we are experimenting with different assets and how to prepare those assets for training the AI model in order to achieve optimal results. In our initial test, we ran images of flowers without any editing into Playform (Figure 5). The resulting set were images which often lacked distinction between the subject (flower) and the background of the image, as seen in Figure 6. We had the idea to remove the background of the images to include just the flower (Figure 7), hoping to assist the ML software in identifying only patterns and forms from the flower itself. As a result, the second image set showed much improvement in the AI's interpretation of the shape of a flower, as well as the most common colors and petal structures (Figure 8). Another test was conducted on vector images of existing logos and icons based around "wellness." The goal of this test was to not only see how Playform works with black and white line-based images, but also to see how it interprets and understands the motifs in the very human idea of health and wellness.



Fig. 1: "AlterEgo is a wearable system that allows a user to silently converse with a computing device without any voice or discernible movements."



Fig. 2: Youtuber Amie DD shows the RFID chip that will be implanted into her hand. The chip will allow her to unlock her Tesla without using the vehicle's key card.



Fig. 3: Cristina Maillo's YogAI guides you through yoga poses and counts down as you hold them. She created the program to allow users to do guided yoga at home.



Fig. 4: A debugging test created by Berkoy and her students, testing the accuracy of PoseNet's real-time skeleton tracking in the browser.



Figs. 9 & 10: Original assets



Figs. 11 & 12: Images generated by Playform

Playtesting & Recruitment

Playtesting is an essential part of the process for the browser-based experience, as many of the technologies included are new and emerging, and tests on various computing platforms will allow for better troubleshooting. We are looking to recruit as many students in the MTEC program as possible, before branching out to the public in further iterations.

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- Fig. 10: Wellness icons. GraphicRiver (2016, January 19). Retrieved April 28, 2022, from <https://graphicriver.net/item/wellness-icons/14493965>.

¹: Getting started... Playform. (n.d.). Retrieved November 24, 2021, from <https://playform.github.io/playform/>.

²: AI processes. Playform. (n.d.). Retrieved November 24, 2021, from <https://playform.github.io/playform/#ai-processes>.



I am listening!

Screenshots from the browser experience, which is made in p5.js. The second image illustrates that the program is waiting for a response of "yes" or "no."



Force-feedback Design for Robotics Hand: Bio-based Design and Simulation

Student: Husnain Khan, Mentor: Zhou Zhang, Ph.D.

New York City College of Technology
Department of Mechanical Engineering Technology

Abstract:

The great challenge for the Virtual Assembly Platform is how to make the users have the in-person feeling with the augmented tools. Hands are the most important organs that are used to provide touch feeling. In a real assembly scenario, the force from the components and tools will be feedback to the brain via the hands. Unfortunately, the virtual assembly failed to mimic the in-person scenarios since it will not provide such kind of feedback. As a result, the users' real identities are lost. Then, the users' slower-progressing wrong habits will prevent them from success in the future. Therefore, it is necessary to design a robotics hand that can provide force feedback. The proposed robotics hand will combine the motion synthesis of the human body, kinematic, dynamics, and computer graphics to reproduce the movement of a hand. Besides, spring, damper, and servo motors are integrated into the hand design. All the components will contribute to the force-feedback. After that, this project will be integrated into the project of "Procedure-Oriented for Engineering Education" to improve users' immersive feeling when they implement the virtual assembly.

Advantage:

Among the products and research, two methods are employed to provide the force feedback: passive and active actuation. Passive ones generate resistance with the dampers, springs, or electromagnetic clutches, and they are inherently safe since the resistance is one kind of reactions of the inertia system, and only effect when the motions detected. The active ones usually use motors and pneumatic systems to realize force-feedback. Its advantage is the force can adapt the changes of the motion to provide a more realistic feeling. The disadvantage will be the potential risk due to the malfunctional motions. Therefore, the specific design to safety is critical for the active haptic gloves: limit the maximum output loading, and design the emergency stop equipment. The proposed design can solve the conflict and provide an optimized trade-off between safety and force-feedback.

Disadvantages

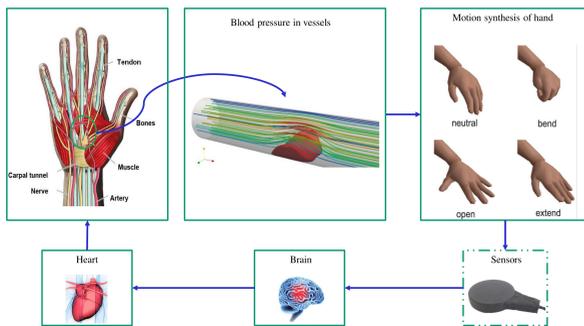
Bio-inspired design needs to employ the motion synthesis to figure out the relation between the hand motion and force generated according to the motion. It means that the complicated non-linear problems are involved. As a result, the complexity and the cost of computation will be a great burden for the research.

Applications:

The success of this project will benefit a diverse application as virtual rehabilitation, virtual training, virtual assembly, gaming, prosthesis, dynamics analysis of fluid etc.

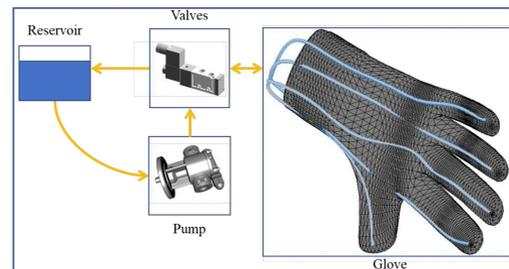
Conclusion:

In this project, a force-feedback hand is designed. It is inspired by the real hand, and simulated with Autodesk CFD. This project has the potential to provide the users with an immersive feeling when they use the virtual reality systems. After the simulation and design, the hand will be fabricated with additive manufacturing. To mimic the real hand, the filament of the 3D printer will use thermoplastic elastomers (TPE) that is flexible enough to make the hand.



Bio-inspired Design of Hand

The procedures that the hand generates the force feedback are demontated: the hand is motivated, the sensors (nerves) detect the actions, the brain will process the data, and control the heart to power the vessels of the hand.



Hydraulic Control for Force-feedback

The pipes inside of the glove mimicking the vessels of the hand are powered by the hydraulic control system and used to generate the appropriate force based on the operations to the machines. It can spontaneously invoke the feeling of real operations to the various machines, and provide the users with an immersive virtual environment.

Modified Prototype



Robotic Hand



Effectiveness of Collimation in Radiation Protection

Student Researcher: Ollana John, Mentor: Professor Eric Lobel
Department of Radiologic Tech and Medical Imaging



Abstract:

Radiation protection is used to reduce the amount of ionizing radiation exposure that the patient and/or radiographer are exposed to. Collimation is a method of radiation protection that reduces the exposure field to radiate only the area of interest. The purpose of this investigation is to compare the amount of dose absorbed using a Phillips digital radiography x-ray machine VS a Pascal dosimeter and if the collimation on a larger body part reduces dose at a higher percentage than a smaller body part. In this investigation, the two body parts of interest were the hand and lumbar spine. All technical factors remained the same (40" SID, OID kept at a minimum, AEC used, 80 KVP set for lumbar spine exposures and 52 KVP set for PA hand exposures). Collimation was increased by 1-inch length and width for each exposure. The expected result is that dose will decrease as collimation is increased. It is important to note that with the pascal dosimeter, dose will increase since the dosimeter was placed in the collimated field and once collimation increased and the dosimeter was not in the collimated field dose, decreased as expected, for the most part. This research is useful in radiation protection practices and confirms that collimating does decrease dose.

Introduction:

Collimation is reducing the exposure field to radiate only the body part of interest. The purpose of increasing collimation close to the body part is to reduce the radiation dose. The purpose of this investigation is to compare the amount of dose absorbed using a Phillips digital radiography x-ray machine VS a Pascal dosimeter as collimation increases and if the collimation on a larger body part reduces dose at a higher percentage than a smaller body part.

Methods:

- An adult hand and adult lumbar spine was used
- Technical factors were set on the Philips direct radiography x-ray tube and on the computer.
- The lumbar spine was placed in AP position. CR set at 3rd lumbar vertebrae
- The hand was placed in PA position. CR set on the 3rd metacarpophalangeal joint
- Multiple exposures of the lumbar spine and of the hand were taken. Collimation starting at 11x15 for the lumbar spine and 11x14 for the hand. Collimation increased 1-inch Length x width
- Exposure readings were recorded on the DR machine and Pascal dosimeter; Absorbed Dose (D) μ gym

Technical factors used:

- Kvp set at 80 for all lumbar spine exposures
- Kvp set at 52 for all hand exposures
- SID set at 40" for all exposures; OID kept at a minimum
- Small focal spot used for the hand
- Large focal spot used for the lumbar spine
- A grid was used for the lumbar spine
- AEC used



Figure 1: Hand in PA position. First image shows collimation fully open, as well as the dosimeter by third digit. Second image shows an increase in collimation (the field size reduced).

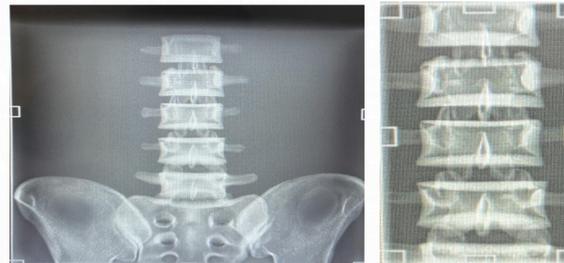


Figure 2: Lumbar spine in AP position. First image shows collimation fully open. Dosimeter was placed at the top by the first lumbar vertebrae. Second image shows an increase in collimation (the field size reduced).



Figure 3: 1st image shows Lumbar spine positioning with the x-ray tube. Second image shows right hand in PA position with the Pascal dosimeter. Third image shows a close-up of Pascal dosimeter by lumbar spine.

Lumbar Spine					PA Hand				
Collimation	Absorbed Dose (Dosimeter reading)	% of (D) reduction (Dosimeter)	Absorbed Dose (DR dose reading)	% of (D) reduction (DR Machine)	Collimation	Absorbed Dose (Dosimeter reading)	% of (D) reduction (Dosimeter)	Absorbed Dose (DR dose reading)	% of (D) reduction (DR Machine)
11x15	91.07	Overall decrease 6%	68.14	Overall decrease 29%	11x14	24.42	Overall increase 214%	2.56	Overall decrease 14%
10x14	94.41		59.83		10x13	24.19		2.17	
9x13	98.27		53.80		9x12	24.28		1.77	
8x12	103.7		48.84		8x11	24.45		1.51	
7x11	113.7		42.56		7x10	24.48		1.20	
6x10	131.5		39.17		6x9	5.136		0.91	
5x9	82.96		33.96		5x8	405.4		0.73	
4x8	10.48		26.21		4x7	157.8		0.53	
3x7	5.364		19.54		3x6	52.37		0.37	

Figure 4: Dose readings on Dosimeter VS DR machine for Lumbar Spine and PA Hand. Percent of Dose reduction shows and overall decrease in dose for lumbar spine but for PA Hand there was an increase.

Lumbar Spine			PA Hand		
Collimation	Dosimeter % Absorbed (D) inch by inch	DR machine % Absorbed (D) inch by inch	Collimation	Dosimeter % Absorbed (D) inch by inch	DR machine % Absorbed (D) inch by inch
11x15			11x14		
10x14	104% increased	88% reduced	10x13	99% reduced	85% reduced
9x13	104% increased	90% reduced	9x12	100% increased	82% reduced
8x12	106% increased	91% reduced	8x11	101% increased	85% reduced
7x11	110% increased	87% reduced	7x10	100% increased	79% reduced
6x10	116% increased	92% reduced	6x9	21% reduced	76% reduced
5x9	63% reduced	87% reduced	5x8	79% increased	80% reduced
4x8	13% reduced	77% reduced	4x7	38% reduced	73% reduced
3x7	51% reduced	75% reduced	3x6	33% reduced	70% reduced

Figure 5: Shows the percent of dose change inch by inch. Lumbar Spine: DR machine shows dose reduction inch by inch. The dosimeter shows dose increase due to the dosimeter in the collimated light field during radiation from 11x15 until collimation was increased by 6 inches. From 6x10 to 5x9 and increase by 1 inch collimation, the dosimeter was halfway out of the collimated light field and dose decreased drastically by 53%. At 4x8 collimation the dosimeter was out of the light field and dose reduced by 50%. Comparing the readings from the dosimeter as well as the DR machine, as collimation increased from 5x9 to 3x7, overall dose reduced from the dosimeter and the DR machine was 12%.

PA Hand: DR machine shows dose reduction inch by inch. The dosimeter showed a decrease from 11x14 to 10x13 then dose increased due to the dosimeter in the light field. Dose reduced at 6x9 collimation when the dosimeter was out of the light field. Dose increased 58% from 6x9 collimation to 5x8 collimation. Although the dosimeter was out of the light field dose increased. Dose reduced as the collimation increased but the body part was collimated down to just three fingers.

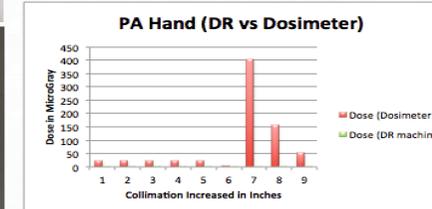


Figure 6: PA Hand: DR Machine: 0.14% reduction in dose VS Dosimeter: 2.14% increase in dose

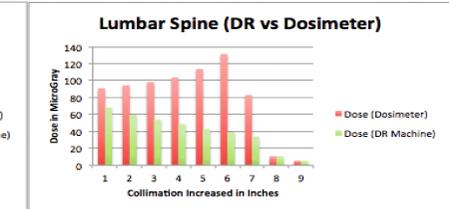


Figure 7: Lumbar Spine: DR Machine: 0.08% reduction in dose VS Dosimeter: 0.06% reduction in dose

Conclusion: Comparing the DR readings overall dose reduction for the lumbar spine is 29% and the overall dose reduction for the hand is 14%. There is a 15% difference and lumbar spine reduced dose 2x more than the hand. I can conclude that there was a higher percentage of dose reduction in a larger body part than in the smaller body part. When looking at the overall dose reduction using the Pascal dosimeter for the lumbar spine, dose was reduced by 6% and for the hand dose increased by 214%. Dose decreased then increased again for the hand. There is still a difference in the amount of dose reduced in the lumbar spine vs the hand. Higher percentage of dose reduced in the lumbar spine and dose increased in the hand.

ABSTRACT

Drawing on a computer using a mouse is quite different than drawing by hand. It can be challenging to use a mouse to even simply trace a line. If the drawing involves several lines and curves, the task becomes more complicated. The goal of this project is to show how to design beautiful artworks using Bézier curves. A Bézier curve is a smooth parametric curve produced by the coordinates of certain points. To draw a specific curve, one needs to select multiple control points positioned in strategic places. By changing these positions, one can draw different curves to produce the desired pattern. We use Krita, which is a professional free and open-source painting program made by artists to create digital art. We demonstrate how the Bézier curve pen tool in Krita can be used to trace over images by selecting the control points. We also explore the mathematics behind Bézier curves.

THE ORIGIN OF BÉZIER CURVES

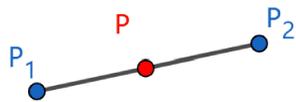
Bézier curves were originally developed in 1912, and used by Paul de Casteljau in 1959 to evaluate polynomials recursively. This procedure is known today as De Casteljau algorithm. Bézier curves started being widely disseminated in 1962 by Pierre Bézier who was a French engineer at Renault. He discovered the Bézier curves independently and used them to design the main body of the cars.

LINEAR BÉZIER CURVES

We start with two vectors P_1 and P_2 in \mathbb{R}^2 . A **Linear Bézier curve** (1) is a linear combination of the form

$$P_t = (1-t)P_1 + tP_2 \quad (1)$$

where $0 \leq t \leq 1$.



REFERENCES

- [1] F. Alayont and S. Schlicker, Linear Algebra and Applications: An Inquiry-Based Approach, Grand Valley State University Libraries, 2019.
- [2] S. Klassen, Bézier Curve Construction. GeoGebra app..
- [3] Mr. Mohammad. How to Use the Bézier Curve Tool in Krita. YouTube.

QUADRATIC BÉZIER CURVES

A **Quadratic Bézier curve** (5) is obtained by considering a Linear Bézier curve based on the vectors Q_1 and Q_2 ,

$$P_t = (1-t)Q_1 + tQ_2, \quad (2)$$

where $1 \leq t \leq 1$, Q_1 is a Linear Bézier curve based on the vectors P_1 and P_2 , and Q_2 is a Linear Bézier curve based on the vectors P_2 and P_3 . We assume that the terminal point of P_3 does not lie on the line passing through the terminal points of P_1 and P_2 .

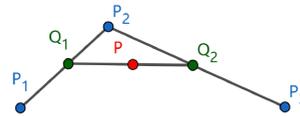
$$Q_1 = (1-t)P_1 + tP_2 \quad (3)$$

$$Q_2 = (1-t)P_2 + tP_3 \quad (4)$$

By substituting (3) and (4) into (2), we obtain:

$$P_t = (1-t)^2P_1 + 2(1-t)tP_2 + t^2P_3 \quad (5)$$

where $0 \leq t \leq 1$.

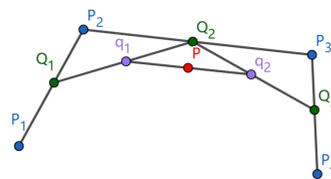


CUBIC BÉZIER CURVES

We can repeat the above process by combining two Quadratic Bézier curves to obtain a **Cubic Bézier curve** (6):

$$P_t = (1-t)^3P_1 + 3(1-t)^2tP_2 + 3(1-t)t^2P_3 + t^3P_4 \quad (6)$$

where $0 \leq t \leq 1$.



GRAPHICAL RESULTS USING KRITA

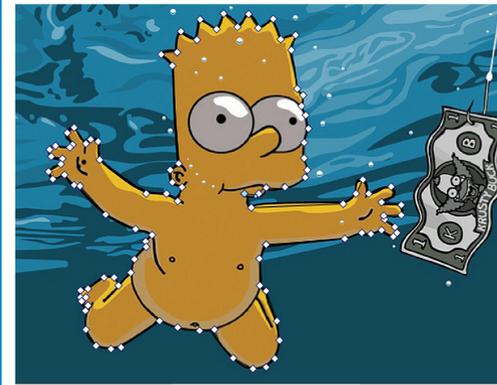


Figure 1: We select a picture to trace and import it to Krita. Before starting to use the Bézier Curve pen tool, we observe the direction of the pattern. Because the start point and the end point of the Bézier Curve pen tool must coincide, we need to use the next control point at the edge of an arc turn. We make three distributions of the picture: the first one is the general outline drawing, the second one is the surrounding objects drawing, and the third one is based on the details.



Figure 2: This artwork was produced using almost 100 control points. The more control points used, the more accurate the shape will be. After we have determined the image selection, we need to open a vector layer on top of the original image layer. At this time, the Bézier Curve pen tool can be individually selected and adjusted. We have to hold the button "Alt" when we switch from the first point to the next one. This keeps our next control point flowing smoothly to the next graphic turning point.

APPLICATION SKILLS ON KRITA

On Krita the Bézier curve pen tool is based on a Cubic Bézier curve. Using the notation in (6), the start point and the end point correspond to P_1 and P_2 , respectively. The control points of the start point and the end point correspond to P_3 and P_4 , respectively.

- The control points are on the outermost or innermost side of the curve as much as possible.
- The handles of the control points should be horizontal or vertical as much as possible, with the exception of the end of the curve.
- Reasonably arrange the density of control points.

DISCUSSION

The use of the Bézier Curve pen tool helps ordinary people, who cannot draw by hand, to draw the patterns they want on Krita. Krita's Bézier Curve pen tool can also move the control points on the vector to change the arc so that one can get a unique pattern. The Bézier Curve pen tool is suitable for every beginner who wants to draw on the computer. Some applications are:

- the design of a logo,
- the design of a pattern,
- the restoration of the lines of a blurred pattern.

FURTHER WORK

There are many interesting brush choices in Krita such as oil brushes and watercolor brushes. We would like to try to use the Bézier Curve pen tool in combination with the color brush tools to paint geometric pictures. We would like to try to replicate the cubism paintings by the famous Spanish painter Pablo Picasso. Cubism was an art movement based on the idea of dealing with nature by means of cylinders, spheres, and cones to try and create structural beauty in the paintings. We expect that the Bézier Curve pen tool may be used to explore the beauty of geometric patterns very well.



Organizing Analog Files:

Los Pirineos the mostly true memoirs of Esperancita Gomez

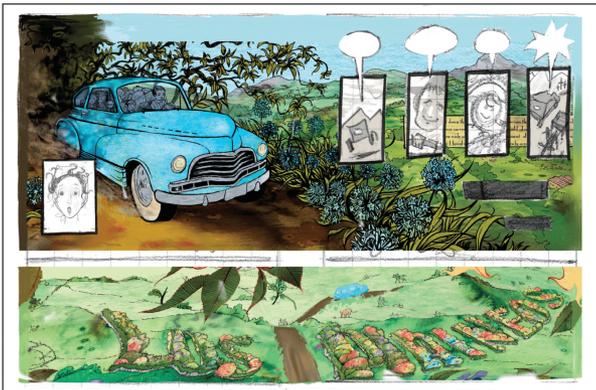
Designed by: Wilna Michel

CUNY Research Scholars Program Fall 2021

New York City College Of Technology - 300 Jay Street, Brooklyn, NY 11201

Introduction

The effective way of capturing the attention of an audience in a book has changed significantly over the years. To reach a new audience some authors have chosen to write their books in the format of a “Graphic Novel”. A Graphic Design novel is a piece of literature that is in the same format like a comic. Meanwhile, some believe that the term only refers to comics others believe that it is a separate medium, due to the difference in its production, publication processes. Unlike comics, a graphic novel has no restriction in genre but can be fictional, non-fictional, historical ,and more.



Page Spread without text

Research Purpose

The Purpose of this Project was to view the process of creating a graphic novel; starting with preparing analog files to the final product , a final piec of fiction. This poster covers the next steps in creating a Graphic novel which consists of organizing the pages for book production; and the use of Adobe InDesign to apply the text within the pages.

Methodology

The Next steps in creating a graphic novel consists of the organization of the digital files. First , You must place all the pages and Spreads within the order of they appear in the book.

- 1.This might take time while deciding which page goes where
- 2.The page order and numbers continually change as the book progresses.

Secondly, Text application within the file.

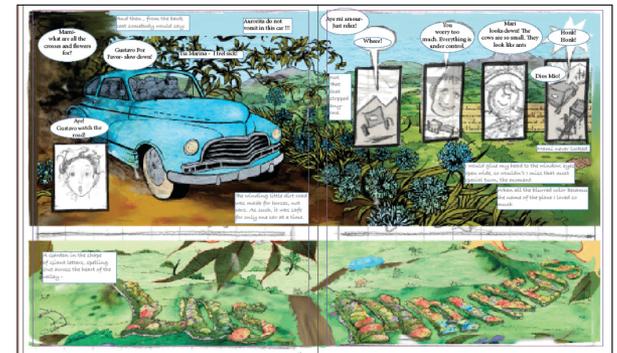
- 1.You have to place text within the text boxes in the page layout.The text diffrenciates depending on what kind of text it is!
 - Captions
 - Narration
 - Sound

Conclusion

Through this entire Process of organizing the Analog files, I viewed the complex role of the book production assistant. Not only do they organize the pages but also they prepare the script for revision by the editor.

Reference

By: Szép, Eszter. European Journal of American Culture. Mar2021, Vol. 40 Issue 1, p93-95. 3p. DOI: 10.1386/ejac_00042_5.



Page Spread with text