SECTION IV. ENGINEERING AND COMPUTER SCIENCE

Paper Session
Thursday Morning, 10:00 – 11:00 am
Arthur J. Bond Engineering Building, Room 103
Ravi Gollapalli, Presiding

1. 10:00 **u AN INTRODUCTION TO OBJECT-RELATIONAL MAPPERS. *Michael Porter*, Alabama A&M University.

   In an effort to write better code, software developers have created tools called object-relational mappers (ORMs). These ORMs utilize object-oriented programming (OOP) concepts, such as data encapsulation and inheritance, to directly integrate the data tier into the application tier, which produces software that is overall more secure, less prone to bugs, and easier to maintain and further develop. Whereas developers used to have to write their data and application tiers using two different programming languages (usually SQL and another language), ORMs allow them to write both tiers using the same language, therefore reducing the amount of complexity and knowledge that is required by developers. ORMs allow developers to define their data structure and perform all the fundamental data operations using object-oriented styles. In this paper, we provide an introduction to ORMs in order to show how they can be used to filter, insert, update, and delete data, as well as compare them to the equivalent SQL code for each operation.

2. 10:20 SURFACE ENGINEERING OF BIOMATERIALS USING COLD PLASMA PROCESSING. *Vinoy Thomas*, University of Alabama at Birmingham.

   Low, temperature cold plasma can initiate chemical reactions that produce different reactive radicals, charged particles, ions, and UV light. Active species can be used for biomedical and soft-biomaterials surface engineering/modification for biointerface applications. Accordingly, nanofibrous tubular tissue-scaffolds (4-mm diameter), for potential use as vascular-graft, were spun from both biodegradable and biostable graft polymers. Both biodegradable and biostable graft polymers, such as polycaprolactone (PCL) or Dacron (PET), were allowed to interact with LTP Plasma under various gas conditions. Electrospun into thin nano/microfibers to form seamless 3D-conduits of 4-mm intimal diameter, the tubes were exposed to dielectric barrier discharge using controlled gas flow into ambient atmosphere. For the optimization of the plasma process required for surface modification of intimal surface of tubes, the system parameters, such as feed gas compositionand electric power, were varied. The variation of the feed gas from Ar, He, air, air/He, and air/ammonia was studied. Surface characterizations were done using x-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), and glycerol contact angle (GCA) measurements for surface chemistry, morphology and wettability. The overall results indicated a facile method for intimal surface modification for blood/tissue interactions.

***u or **g* Denotes presentation entered in student competition as an undergraduate or graduate student, respectively.

SECTION IV. ENGINEERING AND COMPUTER SCIENCE

Poster Session
Thursday Morning/Afternoon
Arthur J. Bond Engineering Building, Auditorium
Authors Set-up: Begins at 11:00 am
Authors Present: 11:30 am –1:00 pm
Ravi Gollapalli, Presiding

3. **u RAMAN SPECTROSCOPIC STUDY OF BUILDING FIRE-BARRIERS. *Tyra Harris*, Aschalew Kassu, Anup Sharma, Alabama A&M University.

   The use of Raman spectroscopy for the characterization of construction materials and forensic analysis of ancient building materials is becoming an area of interest in construction and civil engineering research. Portable and standoff Raman spectroscopy is a promising technique for characterizing construction materials in a laboratory setting and for non-destructive evaluation. Portable and standoff Raman spectroscopy also includes forensic analysis of defects and deterioration of civil engineering structures in an outdoor environment. This step eliminates the need to collect a sample from the building part and eliminates structural damage. Fire-barrier sealants are construction materials used to stop the spread of fire and smoke through openings created by electrical and mechanical system pipes and other openings in walls, floors, and ceilings for up to four hours. Several brands of fire-barriers are commercially available with distinct differences in the composition of the constituent materials. In this research, Raman spectroscopic technique was used to characterize fire-barriers obtained from local suppliers without further processing. The paper reports the characteristics of the different Raman bands used in the research. The paper also reports and discussesthe elemental composition of the construction material.

4. **u QUALITY ASSURANCE AND RELIABILITY ANALYSIS IN ADDICTIVE MANUFACTURING. *Adedotun Ayokanmbi*, Alabama A&M University.

   This work summarizes the experimental results and the analysis of 3D printed parts using Fused Deposition Modeling (FDM). The testing procedures have been performed according to the ASTM D3846–02 method for defining the in-plane shear strength while the ASTM D5379 method has been used for determining the out-of-plane shear properties. Hence, specimen dimensions, testing methods, procedures, loading jig, tightening torque, and other recommendations have been used during this investigation. Reliability analysis has been performed for determining the Probability density function, the survival function, and the hazard function. A comparison between parts manufactured using the 3D printer and the commercial manufacturing process have been performed using a two-sample Kolmogorov-Smirnov normality test of the underlying distributions which wassupported by Mann-Whitney test.

5. **u RELIABILITY ANALYSIS BASED APPROACH TO IDENTIFY VEHICULAR CRASH POTENTIALS OF STATE HIGHWAYS AND COUNTRY ROADS IN MISSOURI USING THE EQUIVALENT PROPERTY DAMAGE ONLY CRASH INDICATOR. *Fermin Ruiz Crespo*, Sudip Bhattacharjee, Alabama A&M University.

   Vehicular crashes are common on state highways and county roads which carry three fourths the United States' total traffic. These crashes frequently result in fatality and/or severe injuries and property damages which cost millions of dollars in public litigations and compensations.

One of the major problems faced by traffic engineers is that there is a high level of uncertainty in predicting the number of crashes. The goal of this research is to determine a methodology based on reliability analysis of crash data which incorporates the uncertainty in crash prediction and identifies the locations for future potential crashes. This research is expected to save lives and property by reducing the number of crashes. The reliability is defined as the probability that number of crashes will be less than or equal to a given threshold level.The results showed that three out of the ten sections of roadways indicated very low reliability levels with high crash potential needing immediate attention. The sections were ranked from lowest to the highest reliability. The model accurately predicted crashes 95% of the time. The 95th percentile ranking also matched with the reliability ranking. The reliability and 95th percentile values for the sites correlated with the corresponding high number of crashes observed for the sections, thus validating the approach. The results showed that the reliability-based crash prediction approach can successfully identify the roadway sections that need further improvements even with including the effect of uncertainties in the predicted crash numbers.

6. **u ANGEL SCAN: A NOVEL APPROACH OF USING MACHINE LEARNING TO DETECT ABNORMALITIES IN MEDICAL IMAGING. *Georgiana Wright*, Marius Schamschula, Alabama A&M University.

   Approximately 41,000 women in the US were expected to die from breast cancer in 2018. Mammograms are needed to find breast cancer, yet the cost for a mammogram from a radiologist can be over $1,000. This cost exceeds the $50 Medicare reimbursement, which can cause financial burden for patients. High mammogram costs cause patients to turn down proper treatment to protect their finances. To decrease this problem, we created a machine learning tool with image recognition features that reads mammograms and classifies them. This machine acts as a trained radiologist by identifying normal shapes or irregular abnormalities. PyCharm was used as the developing environment to use during this experiment. The data was collected from the MIAS Mini-Mammographic Database, which was created by organizations of UK research groups. The database contains 322 mammograms. It also includes radiologists' markings on the locations of abnormalities within the images. The images were downloaded and stored in PyCharm. Then the program associates the classifications to mammograms and inputs them into the ML algorithm for each of the mammograms. The images in the database are used to train the model to learn abnormalities. In 7 hours, the computer ran 345 of the 30,000 iterations. The results o iterations were outputted in the Google Kubernetes system. The results were limited by time and Kubernetes capabilities. I will be using results for future research by limiting iteration time and switching to the MURA imaging database to train a new model.

7. **u SPECTRAL CHARACTERIZATION OF SEALANTS USED IN CONSTRUCTION INDUSTRY. *Kwaneitra Powers*, William Petway, Aschalew Kassu, Anup Sharma, Alabama A&M University.

   This paper presents the results of the Raman and FTIR (Fourier-Transform Infrared) spectroscopy study of ten different commercially available silicone-based sealant materials widely used in commercial and residential buildings. Both Raman and FTIR techniques have been widely used in the characterization of pharmaceutical products, mineralogical compositions, petroleum industry, forensic research, food sciences, semiconductor, and agro-industries. This work demonstrates the application of Raman and FTIR analysis in the study of construction materials and reports the spectral signatures of the selected building sealants

commonly used in the construction industry. This study found that there are several vibrational bands that are common to some of the samples. This suggests that there was a reasonable similarity in the molecular composition of the samples drawn from three different manufacturer brands: DAP, GE, and HDX. Despite the degree of similarities in the spectral bands of the samples studied, Raman spectroscopy and FTIR techniques provided enough evidence to distinguish the samples and suggest that the molecular structure of most of the silicone brands possess unique signatures.

8. **u ANALYSIS OF CONSTRUCTION WORK ZONE CRASHES IN ALABAMA. *Hiram Davis*, Virgil Studdard, Aschalew Kassu, Mahbub Hasan, Anup Sharma, Alabama A&M University.

   According to the National Work Zone Safety Information Clearinghouse (www.workzonesafety.org) report, nationally, the 2018 work zone fatal crashes & fatalities were 671 and 754 respectively. In the state of Alabama, there were 23 work zone related fatal crashes resulting in 27 fatalities. As compared with the fatal and non-fatal injury crashes that occurred on non-work zone segments of the highways, the number of crashes that happened in construction work zones is relatively small. However, the growing prevalence of crashes is a concern for construction workers, the roadway users, and state and federal transportation stakeholders. This paper presents the safety effects of several variables including posted speed limit, time of the day, day of the week, lighting condition, weather condition, the functional classification of the roadway, the driver's gender, driver's age and condition on the likelihood of occurrences of highway construction work zone related traffic accidents in Alabama. The study analyzes the severity and the frequencies of the crashes observed in several individual work zone locations on freeways, rural and urban designation of the highway segments. The factors contributing to the traffic accidents within the highway work zones are identified and presented.

9. **u PROTYPING A SPATIAL ATOMIC LAYER DEPOSITION SYSTEM FOR FASTER NANOMANUFACTURING. *John Lucius*, Tingyi Wei, Griffin Tull, Dongqing Pan, University of North Alabama.

   Atomic Layer Deposition (ALD) is a technique used to create thin film layers for micro components and microstructures such as transistors, processors, and memory drives that are crucial components extensively used in everyday electronic devices such as smartphones, computers, and gaming systems. ALD is a proven effective nano-manufacturing technique used to deposit nano-scale thin films with remarkable uniformity and conformity in surface geometry. However, confined by the fashion of alternately injecting chemicals to enable the surface reactions, ALD is very slow process. For instance, a conventional single wafer ALD system can only achieve a few nanometers of layer thickness per minute of deposition. Therefore, this project is dedicated to designing and developing a spatial ALD system, which adopts the spatial concept to deposit materials much faster than the traditional way of ALD by eliminating the significant amount of waiting time. Three different system designs were proposed, designed, and developed. Then, the flow in spatial ALD was simulated using the computational fluid dynamics method. Three different prototypes based on the designs were created and developed, and flow tests were carried out. The effectiveness of separating gases in the spatial ALD system were tested and verified.