2016 High School Research Program Projects

Department of Computer Science

1) Mariofanna Milanova

a. Model of Facial Parameter Extraction and Animation

Recent advances in multimedia-related technologies and new applications such as virtual agents, video conferencing, visual effects in movies, and virtual players in computer games are motivating much research in digital character and face animation. In this project we will develop a system for the implementation of photo realistic avatar using video captured from the user. This is achieved by constructing a dynamic video map of facial expressions and mapping them to a 2D/3D models. The dynamic video map reflects user's facial expressions with constant updates directly from the input video. The goal of this project is to provide a vivid representation of participants with the use of dynamic video map in perceptually important facial regions, notably eyes and mouth as compared to all of the facial parameters defined by MPEG4. We implemented an automated system that performs face detection, face tracking and facial feature extraction.

b. Step by Step introducing Scratch Programming

The students will create interactive stories, games and animations with Scratch. The student will have experience implementing Scratch for

- Interactive games
- Storytelling
- Interactive projects
- Music projects
- Animations
- Programming concepts
- Basic introduction to Electronics and Techniques

2) Mengjun Xie

Research on Mobile Apps

Smart mobile devices (e.g., iPhone, iPad, smartphones/tablets powered by Android, etc) have become so popular and powerful that they are not just a phone or an e-book reader nowadays, but a camera, a GPS device, a game console, a barcode scanner, and many more. Essentially, it is the software applications that make a phone/tablet become so smart. If you have a novel idea of mobile app, really want to make your phone smarter or bring more fun to you, your friends, and others, you should apply for this project.

With this summer project, you will learn how to develop a real-world Android application without coding (using App Inventor) if you never touched any code before. If you are ambitious enough, rest assured you will get your hands dirty with Java programming. Creativity is a must for this summer project.

2016 High School Research Program Projects

Department of Systems Engineering

3) Jing Zhang

Rechargeable-Battery for Smart Loads

Smart loads are referred to those which can automatically adjust the power consumption based on the operating state of the electrical power system. They are helpful to improve the system stability and power quality of electrical power grids as well as to reduce the peak load. Equipped with a rechargeable battery, a smart load should be able to adjust the power consumption from power grid in much wider range without a negative impact at the customer end. In the proposed project, an investigation in theory and experiments will be performed about rechargeable batteries, their efficiency and life time related to discharging windows, and control strategies for smart loads. A test platform developed for rechargeable batteries will be available for the experiments.

Department of Construction Management and Civil and Construction Engineering

4) Amin Akhnoukh

a) Fabrication of Highway Bridge Girders using High Strength Concrete

The Construction Industry in the United States of America accounts for almost 10% of the national gross domestic product (GDP). Due to the large increase in traffic volume and truck weights, 25% of the bridges included in the national inventory are classified as structurally deficient or functionally obsolete. New generation of structural concrete is being developed to produce high strength girders for building bridges with longer life spans. The research at the material lab of the University of Arkansas at Little Rock participates in concrete mix development projects for the Arkansas Highway and Transportation Department to produce better concrete mixes to be used in future construction projects within the State of Arkansas.

Researchers working at UALR lab have the advantage of investigating the quality of different construction materials, select the high quality ingredients for concrete mix development, use concrete mixers to do practical mixes and test produced specimens to investigate their performance. This research is of significant importance for students who will pursue a career in construction, civil, and/or architecture engineering.

2016 High School Research Program Projects

Department of Construction Management and Civil and Construction Engineering (cont.)

4) Amin Akhnoukh

b) Improving Air Quality by Using Smog Eating Concrete in Highway Projects

The level of principal air pollutants as carbon monoxide, sulfur dioxide, lead, and volatile organic compounds has exceeded the EPA permissible limits in multiple locations at West Memphis and within Little Rock due to the increased number of vehicles at the Interstates and State highways. The increased levels of air pollutants result in severe health issues, loss of vegetation, acidic rain, and elevated temperature due to the greenhouse effect. Recent research results showed the possibility of decomposing air pollutants using specific types of cementitious materials as Titanium Oxides and nanosilica through photocatalysis process in the presence of direct sunlight. An Italian company by the name Italcementi developed the first proprietary smog-eating concrete. However, the high cost of the patented product made it impossible to use the product on a large scale in various highway applications. This proposed research investigates the possibility of producing economic smog-eating concrete mixes to be used in highway applications within the State of Arkansas. The efficiency of the developed mixes in improving the air quality in highly polluted areas will be studied to quantify the advantages of using the smog-eating concrete on a large-scale within the State of Arkansas. The success of this research will result in a significant improvement in air quality and to the wide spread of smog-eating concrete, which could be of a possible new generation of concrete for highway projects.

Center for Integrative Nanotechnology Sciences

5) Dr. Fumiya Watanabe

Material characterization for nanotechnology and biomimetics

Biomimetics or biomimicry applies solutions learned from nature to real human problems. In nanotechnology, we often find the solutions to our very complex problems being solved by nature. Lotus leaves utilize nano-structure to float on water, butterfly wings repel rain water, and geckos' feet can grip to seemingly flat smooth surfaces, all because they have developed their own "nanotechnologies." Gore-Tex® fabric used in artificial stents (blood vessels) has structure very similar to butterfly wings. In the microscopy labs at UALR's Center for Integrative Nanotechnology Sciences, we will examine and characterize nano-structures existing in nature with our state of the art instruments, such as transmission electron microscope, scanning electron microscope, atomic force microscope, X-ray diffractometer, X-ray photoelectron spectrometer, etc. The purpose of the analysis is to understand how nature achieves its goal and to consider new applications of such bio-nano-structures in human engineering problems.

6) Dr. Ganesh Kannarpady

Development of nanotechnology-based coatings for anti-icing applications

Nanotechnology is the study and application of extremely small things; it spans all science disciplines, including chemistry, biology, physics, materials science, and engineering. In the Advanced Deposition Lab at UALR's Center for Integrative Nanotechnology Sciences, researchers are working to develop coatings composed of tungsten nanorods that do not allow water droplets to form on a surface. As a result, the surface does not ice. These coatings can be applied in different industries like the aerospace industry and HVAC industry.

2016 High School Research Program Projects

Center for Integrative Nanotechnology Sciences (cont.)

7) Dr. Viney Saini
Nanotechnology-based solar cells (photovoltaics)
Nanotechnology is the study and application of extremely small things; it spans all science disciplines, including chemistry, biology, physics, materials science, and engineering. In the Photovoltaic (PV) Lab at UALR's Center for Integrative Nanotechnology Sciences, researchers synthesize, characterize, and process materials for use in photovoltaic devices (solar cells). We use several characterization techniques to better understand the relationship between material and device properties, in order to optimize the conversion of light energy into electrical energy. The ability to process materials into solutions for use in solar cell (photovoltaic) applications has the potential to lower costs associated with this emerging technology. Our focus is to completely dissolve or highly disperse nanomaterials within polymer matrices so that they can be produced as a thin film on various substrates (silicon, indium-tin-oxide coated glass, etc.) by using simple methods, such as spin-coating, ink-jet printing, etc.

Students interested in chemistry, engineering, nanotechnology, environment, and alternative energy generation will find this project fascinating and challenging. They will learn how to synthesize, analyze, and test the efficiency of a solar cell.

8) Dr. Shawn Bourdo
Mechanical testing of biomaterial scaffolds
In the nanomaterials synthesis lab, growth, purification, and functionalization of nanomaterials, including carbon nanotubes and graphene, is performed. These nanostructures are the "building blocks" for other projects, and are later incorporated into various materials, such as polymers, in order to evaluate mechanical and/or electrical properties among others. In addition to carbon nanomaterials, several other nanoparticles are utilized in projects related to bioengineered scaffolds.

Students interested in materials science, engineering, or chemistry and how they can be applied to biological systems will be challenged by this project. The student will learn basic polymer-nanoparticle formulation techniques, process them into films or rods, and learn about and test the mechanical properties of the final product. The student will not perform any work directly with biological components.