Interdisciplinary Presentation:

: "Engineering Applications in Biosystems, Bioengineering and Biomechanics"

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Dr. Ehab Tamimi is a recent graduate from the University of Pittsburgh in Pittsburgh, Pennsylvania where he received a PhD in Bioengineering. He also holds a Masters degree in Agriculture and Biosystems Engineering and a Bachelors of Science degree from the University of Arizona. In this presentation, he will be discussing his interdisciplinary engineering work in computational fluid dynamics modelling, tissue engineering, ocular biomechanics and vascular graft optimization.

Short Abstract:

Briefly, we will discuss a developed three-dimensional computational fluid dynamics (CFD) model to study the internal climate of naturally ventilated greenhouses equipped with high-pressure fogging system. Drawing from the composition of native human arteries, we will discuss an experimental/computational approach to fabricate an acellular biomimetic hybrid tissue engineered vascular graft composed of layers of electrospun porcine gelatin/polycaprolactone (PCL) and human tropoelastin/PCL. Finally, we will discuss the results of an ocular biomechanics study where the biomechanical properties of the posterior human eyes were determined as a function of racioethnicity. These methods may provide a unique opportunity for the development of novel diagnosis and treatment opportunities in the future.

Extended Abstract:

Briefly, we will discuss a developed three-dimensional computational fluid dynamics (CFD) model to study the aerodynamic behavior of a naturally ventilated greenhouse equipped with high-pressure fogging system. High pressure fogging systems and control strategies in naturally ventilated greenhouses has recently been investigated as an alternative cooling mechanism to mechanical fan and pad systems. Required instrumentation, number of scenarios, time allocations, and cost of experimental analysis are among limiting factors for detailed analysis of greenhouse aerodynamics. CFD has been shown to be an effective tool in studying the environmental uniformity of controlled environments.

Drawing from the composition of native arteries, we will discuss an experimental/computational approach to fabricate an acellular biomimetic hybrid tissue engineered vascular graft composed of alternating layers of electrospun porcine gelatin/polycaprolactone (PCL) and human tropoelastin/PCL blends with the goal of compliance-matching to rat abdominal aorta, while maintaining specific geometrical constraints. Cardiovascular disease (CVD) continues to be the largest cause of death in the United States with the highest percentage of CVD-related deaths attributed to coronary artery disease. In the following work, we fabricated and mechanically characterized small-diameter acellular electrospun gelatin/fibrinogen cylindrical tissue engineered vascular grafts. We have shown that we can tune the mechanical properties of our hybrid synthetic/protein grafts by varying the ratio of protein to synthetic polymer. The
methods presented are part of efforts towards the design of a functional and clinically translatable tissue engineered vascular graft.

Finally, we will discuss the results of an ocular biomechanics study where the biomechanical properties of the

posterior sclera were determined as a function of racioethnicity. This was done to explain the disparity in glaucoma between racioethnic groups (African descent, European descent and Hispanic ethnicity). The mechanical theory of glaucoma rests on the assumption that mechanical damage forces acting on the optic nerve cause a loss of retinal ganglion cell function. Sequential digital image correlation was used to recreate the scleral geometry and determine surface deformations as a function of intraocular pressure. Statistical analysis revealed differences between the three racioethnic group in tensile and compressive principal strains. This may provide a unique opportunity for the development of novel diagnosis and treatment opportunities.