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MECHANICAL ENGINEERING GRADUATE STUDENT ORGANISATION

Characterizing the Mechanical Behavior of Soft Materials

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2004 Black Engineering

Abstract:
The ability to determine the mechanical behavior of soft materials is invaluable to biomedical applications, such as the design of biocompatible implants and tissue simulants. Other applications include the development of critical tools for objectively assessing the performance of protective equipment (e.g. helmets). This seminar will highlight research projects that consider the quasistatic and dynamic behavior of soft materials. In the first project, finite element (FE) simulations were performed to investigate the benefit of coating silicon-substrate microelectrode arrays with hydrogel material. The brain and hydrogel coating were described using the fractional Zener (FZ) constitutive model. The FZ coefficients were optimized using quasistatic data from pig brain experiments. The second project focuses on the development of an eye simulant for assessing the effectiveness of ocular protective systems. Polydimethylsiloxane (PDMS, Dow Corning's Sylgard-184) is a silicone elastomer that was considered as a candidate material for this synthetic eye. PDMS samples were subjected to shock tube inflation experiments to determine the dynamic elastic properties. Dynamic pressure history was recorded and digital image correlation (DIC) was applied to capture the displacement field. The dynamic Young's modulus of PDMS was extracted given the phase velocity of a traveling wave on the sample surface and out-of-plane displacement frequency of the sample. Future research projects will merge the pig brain and shock tube experiments to investigate traumatic brain injury mechanisms due to blast overpressure.

Biography:
Sarah A. Bentil is a new Assistant Professor in the Mechanical Engineering Department. In 2015, she completed her one year postdoctoral appointment with the Hopkins Extreme Materials Institute (HEMI), located at Johns Hopkins University. Her research interests are in the field of soft tissue biomechanics and biomaterials. Her current work involves validating a methodology, developed while a postdoctoral fellow, to extract the dynamic material properties of soft materials subjected to high rate loading. She received her Ph.D. from The Ohio State University in Mechanical Engineering in 2013. Prior to her studies at The Ohio State University, she worked as an Engineer at the National Highway Traffic Safety Administration (NHTSA), which is an agency associated with the United States Department of Transportation. She received her M.S. degree in Mechanical Engineering from the University of Hawai'i at Mānoa. Her undergraduate degrees (B.S.) in both Mechanical Engineering and Mathematics were obtained from the University of Vermont.

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This seminar counts towards the ME 600 seminar requirements.

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