The American Society of Mechanical Engineers
Delaware & UD Student Section

The ASME Delaware Section and University of Delaware Student Section invite you to a presentation on the

The Effects of Battlefield Blasts on Human Brain

Wednesday – November 7, 2018

Dr. Rohan Banton, US Army Research Laboratory, will present research on:

Investigation of Blast Overpressure Impact on Surrogate Head Forms: An Experimental and Numerical Study

Agenda:

- **5:30 to 6:00 – Networking & Light Dinner**
- **6:00 to 8:00 – Presentation by Dr. Banton**
- **8:00 - Closing Remarks**

Cost: $10 (no cost for students to attend)

Potential Professional Development Hours (PDHs)

Location: University of Delaware, Room 106 in Composites Manufacturing Science Lab (Delaware Ave & Academy St.)

Reservations:
Please RSVP to Tom Langley at langleyt2@asme.org or call 302-383-8994, no later than end of day Monday November 5, 2018. Please leave your full name, contact information, email address; and if you seek a PDH certificate. If you find you cannot attend, please call in a cancellation by end of day November 5.

Dr. Rohan Banton Bio:

Rohan Banton received his B.S. degree (1987) in Physics from Lincoln University, a M.Sc. degree (1991) in Mechanical Engineering from Drexel University, and his Ph.D. degree (2003) in Mechanical Engineering from The University of Maryland Baltimore County (UMBC).
Dr. Banton joined the Weapons and Material Research Directorate of the Army Research Lab (ARL) in Aberdeen, MD in June 2003. He has served as the principal investigator and lead in numerical modeling in the areas of Explosive Reactive Armor, Insensitive Munitions, Shock and Detonation of Explosives and Propellant Beds.
He has authored several publications and made significant impact in these areas. Dr. Banton is also named associate editor to the JANNAF journal. His work has also earned him invited talks to Los Alamos National Laboratories, The Pennsylvania State University, and The US Military Academy at West Point. He has also served as an adjunct faculty at UMBC in the Department of Mechanical Engineering where he was the thesis advisor to two master's students.
Dr. Banton has also expanded his research area to include investigating the mechanism involved in mild traumatic brain injury (mTBI) related to blast (shock wave) impact.
Currently Dr. Banton is working as a visiting professor at the Uniformed Services University in the neurology department. Membership in professional organization include ASME and APS and Fellow African Scientific Institute and Meyerhoff Alumni. Dr. Banton's email address is rohan.j.banton.civ@mail.mil.

Abstract of: Investigation of Blast Overpressure Impact on Surrogate Head Forms: An Experimental and Numerical Study

There is an urgent need to unravel the mechanisms leading to mild traumatic brain injuries experienced by warfighters exposed to blast overpressures. More specifically, blast exposure in theatre and in military training operations have led to new concerns in sub-concussive and mild traumatic brain injuries to military personnel. To that end, the current research is conducting a systematic approach (experimentally and numerically) to investigate the effects of blast overpressure impact on surrogate head forms. In this research, high speed imaging experimental techniques are employed to capture the blast overpressure generated from the initiation of a laboratory scale explosive charge. This approach provides information on the evolution of the blast/shock wave propagation, the pressure flow field conditions, shock velocities, and the time of impact to the surrogate head form. Additionally, the pressure time histories, magnitude, and impulse energy in this blast overpressure environment are also captured using strategically placed pencil gauges.

Since implantation of intracranial pressure sensors in the brain of warfighters is not feasible, the surrogate head model is outfitted with pressure sensors. These pressure sensors are strategically placed at 5 mm depth inside the anterior, posterior and kocher points of the surrogate brain. The intracranial pressure loadings are recorded at these locations and the response behavior of the surrogate brain to the blast overpressure from the explosive charge is assessed for areas of elevated stress.

In addition to the experiments, a numerical approach is also adopted to investigate the biomechanical response of the surrogate brain model subject to the blast overpressure. A finite element (FE) model of a human head form filled with bio-fidelic gel representative of brain tissue is placed in an eulerian air domain and subjected to simulated blast waves. These simulated results compared well with the high speed images obtained from the experiments. The simulated shock wave impact to the surrogate head was in agreement with the experiment in terms of time of arrival and compressive pressure loading to the skull at 140 microsec and 300 kPa respectively.

The simulated results revealed strong compressive loading in the anterior and posterior regions of the surrogate brain with pressures of 198 and 205 kPa respectively. Taken together, the experimental and numerical results revealed high compressive and tensile loading as well as deviatoric stress distribution at the skull/surrogate brain interface. These results indicate the potential for shearing/tearing of brain tissue due to blast overpressures.

Directions and Parking:

Directions to Composites Manufacturing Science Lab at Delaware Ave & Academy Street and Parking:

For directions to CCM, please visit the **College of Engineering Map and Directions to UD Engineering Buildings** web page and click on the Center for Composites link at the top of the page. CCM is located at the southeast corner of the intersection of Delaware Avenue and Academy Street. The main entrance is on Academy Street and the reception area is on the second floor. If you have difficulty finding CCM, please call (302) 831-8149.

Parking:

- **Lot #1 is located between Main Street and Delaware Avenue, behind the Galleria**
- **Lot #2 is located at the intersection of Main and Academy Street**
- **Lot #3 is located off of Main Street, between the Center and Choate Street.**