ME Seminar

Dynamic behavior of materials under extreme loading conditions

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ABSTRACT

The development of advanced materials with superior mechanical properties under extreme loading conditions requires a detailed understanding of the physics of deformation and failure behavior of materials. Advancement in diagnostic techniques such as laser interferometry, digital image correlation, high speed imaging, and time-resolved X-ray diffraction provides a unique opportunity to study the material behavior at different length (nm-m) and time scales (ns-s).

In this talk, two research topics focus on developing advanced experimental tools and understanding the material behavior subjected to dynamic loading conditions. The first part of the talk is on the strength of copper at high pressures (approaching 50 GPa) and strain rates (greater than 10^5/s) using a newly developed pressure shear plate impact experimental technique. The results showed that the rate at which the strength increases with pressure is steeper than previously assumed shear modulus scaling. The origins of the pressure dependence of strength are explored using molecular dynamics simulations. In the second part of the talk, the high-rate deformation mechanics of highly filled particulate composites and the origin of accidental detonation in explosives are discussed. A unique experimental technique was developed based on digital image correlation and high speed visible and infrared imaging to understand the in-situ high spatiotemporal resolution strain and temperature measurements. This study revealed that high relative movement between the binder and crystals leads to local temperature rise, which leads to detonation.

ABOUT THE SPEAKER

Dr. Suraj Ravindran is currently a postdoctoral scholar at the Graduate Aerospace Laboratories, California Institute of Technology (GALCIT), working on the high-pressure dynamic behavior of materials. He received his Ph.D. in mechanical engineering from the University of South Carolina in 2018. He worked as an Edison Engineer in General Electric Aviation for two years after completing his masters in mechanical engineering at the Indian Institute of Technology, Mumbai, in 2011. During his Ph.D. research, he developed a unique experimental technique to measure the local strain and temperatures at high spatio-temporal resolution. He was recognized for this work with the R. E. Peterson award in 2018 for the best paper published in the Journal of the Dynamic Behavior of Materials. He was also the recipient of a Breakthrough Graduate Scholar Award from the University of South Carolina in 2017 that recognizes doctoral students who show promise for distinguished careers in research. His research interests are in the mechanics of materials at extreme pressures, strain rates, and temperatures.

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