SMU Department of Mechanical Engineering

SEMINAR

"Strain Rate Effects in Biomaterials – Understanding Accident Injuries and Designing Treatments"

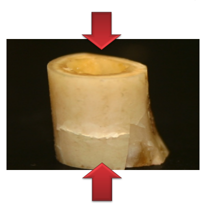
Professor Nikhil Gupta

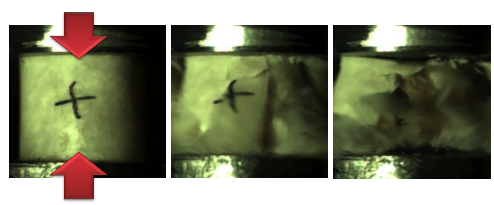
Composite Materials and Mechanics Lab, Polytechnic Institute of New York University

Friday, Novemer 2, 2012
3:00 p.m. – 4:00 p.m.
Junkins 110

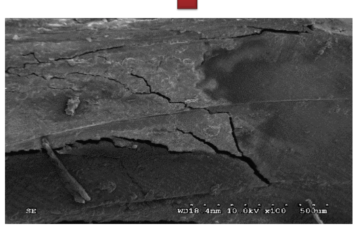
Abstract: High speed deformation conditions are relevant to military as well as to civilians. Armors may encounter ballistic impact and blast, while automobiles may crash at high speeds. Understanding the response of armor and automotive materials at such loading rates is as important as understanding their effect on humans. The response of soft and hard tissue to mechanical loading is significantly different. The hard tissue, femur bones, is selected for initial studies. This presentation is aimed at discussing the high strain rate compression test technique and the results obtained on rabbit femur bones. The bones were also characterized under quasi-static compression to enable comparison with the high strain rate results. The quasi-static compressive moduli of the epiphyseal and diaphyseal regions were measured to be in the range of 2–3 and 5–7 GPa, respectively. The strength at high strain rate was measured to be about twice the quasi-static strength value. A large number of small cracks initiated on the specimen surface close to the incident bar. Coalescence of crack branches leading to fewer large cracks resulted in specimen fragmentation. In comparison, the quasi-static failure was due to shear cracking. The difference in the failure mode based on strain rates is important for designing protective gears and developing treatment protocols.

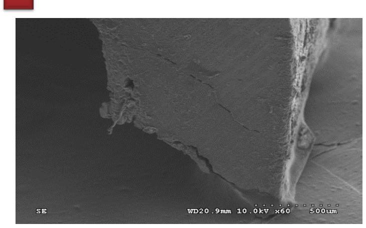
Quasi-static compression failure





Compressive failure at 225 s^{-1} strain rate





Cracking pattern in rabbit femur bone compression tested at strain rate of 225 s^{-1}

Bio: Dr. Nikhil Gupta is an Associate Professor in the Mechanical and Aerospace Engineering Department at the Polytechnic Institute of New York University. He is the director of the Center for Mechanics of Multifunctional Materials and the Composite Materials and Mechanics Laboratory. His research is focused on developing lightweight advanced composite materials with high damage tolerance and energy absorption under dynamic loading conditions. In addition, his group is also studying bones and soft tissues for understanding injuries sustained under dynamic loading. His research has been supported by the Office of Naval Research, Army Research Laboratory and the National Science Foundation. He is serving as the Chairman of the Composites Manufacturing Division of the American Society for Composites. He is the recipient of the American Society for Materials (ASM-International) Visiting Lectureship Award-2009 and the Summer Faculty Fellowship Award-2009 from the Air Force Research Laboratory at Wright Patterson Air Force Base. His research has been extensively covered in news media including videos produced by Discovery Channel, Scientific American, Reuters and articles published by National Geographic, Scientific American, American Ceramic Society, Wards Auto, and popular news outlets.