



College of Engineering
Department of
Mechanical & Industrial Engineering

The Robert W. Courter Seminar Series

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PFT 1263



Energy Absorption Strategies for Occupant Protection

by **Norman M. Wereley, Ph.D.**

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The ability to dissipate energy in vehicle systems, especially with the goal of protecting occupants from potentially injurious vibration, repetitive shock, crash and blast loads, is becoming a critical issue as the cumulative impact of these load spectra on chronic health and acute injury are becoming better understood. The objective of this talk is to discuss what properties are optimal for energy absorption (EA) applications such impact or shock load mitigation. Two primary strategies will be discussed in this talk: passive vs. semi-active energy absorbers. The first focus is the use of crushable materials to absorb energy. Two classes of passive materials will be discussed for AE applications including sintered and composite hollow glass foam materials, as well as elastomeric or plastic cellular materials. The second focus is the use of magnetorheological fluids (MRFs) in EA applications. The properties of the MRF can be optimized for a particular application. A number of key nondimensional parameters can be used to gain insight into how to define optimality for various applications including: Bingham number, Hedstrom number, Reynolds number, Mason number, dynamic range. Also, the trade-offs associated in designing an optimal MRF for a particular application are discussed. The advantages of passive versus semi-active EA strategies will be discussed.

*Dr. Wereley's current research interests are focused on active and passive vibration and shock mitigation (especially occupant protection systems) using primarily magnetorheological materials, and soft actuators and soft robotic systems. Dr. Wereley has published over 260 journal articles, 20 book chapters, over 275 conference articles, and over 20 patents. Dr. Wereley is the Editor-in-Chief of SAMPE Journal and Editor of the *Journal of Intelligent Material Systems and Structures* He also serves as an associate editor of *Smart Materials and Structures*, *MDPI Actuators*, and others. Dr. Wereley is the recipient of the ASME Adaptive Structures and Material Systems Prize (2012) and the SPIE Smart Structures and Materials Lifetime Achievement Award (2013). Dr. Wereley is a Fellow of AIAA, RAeS, VFS, ASME, SPIE, and the Institute of Physics. He is also a Senior Member of IEEE. Dr. Wereley has a B.Eng. (1982) from McGill University and M.S. (1987) and Ph.D. (1990) from the Massachusetts Institute of Technology.