Arthur S. Iberall Distinguished Lecture

December 4, 2009 ⌘ University of Connecticut ⌘ 4:00 p.m.

Liberman Conference Room, Bousfield Psychology Building

Great Ideas Before Their Time: Iberall's Homeokinetics and Webb's Mechanical Counterpressure Revolutionize Performance on Earth and Mars

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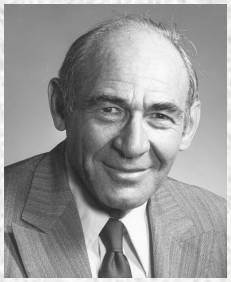
Abstract

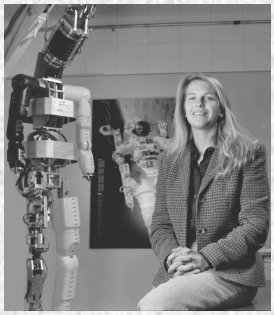
Exploring the moon and Mars and enhancing mobility on Earth can benefit from incorporating complex systems thinking into alternative design approaches. Planetary surface extra-vehicular activity will require locomotion, long traverses, climbing, and intelligent integrated information systems. Current spacesuits, however, are designed for limited translation; activities are performed almost entirely with the hands and arms. The rigidity and mass (~130 kg) of current gas-pressurized spacesuits make them inadequate for planetary surface locomotion and exploration. The MIT BioSuit™ System, in contrast, incorporates ideas of homeokinetics from Arthur Iberall and mechanical counterpressure from Paul Webb into a "second skin" capability with applications not only for space missions but medical rehabilitation and extreme sports activities as well.

In many respects, the BioSuit™ System mimics Nature. The "epidermis" of our second skin suit is patterned from 3D laser scans that incorporate human skin strain field maps for maximum mobility and natural movements based on Iberall's groundbreaking concept of lines of non-extension. This allows accurate modeling of how to maintain constant mechanical counter-pressure that is needed to prevent pooling of fluid over most of the body. The result is a minimum energy expenditure suit for exploration. Wearable technologies can be embedded throughout the BioSuit™ System to place the explorer in an information-rich environment enabling real-time mission planning, prediction, and visualization. The BioSuit™ System concept strives to augment human capabilities for Earth and Mars by coupling human and robotic abilities into a hybrid of the two, to the point where the explorer is hardly aware of the boundary between human performance and robotic activities. Current Earth applications include enhanced mobility for pathology, such as a "soft exoskeleton" that assists children with cerebral palsy to walk.

ARTHUR S. IBERALL DISTINGUISHED LECTURE SERIES



Dedicated to the exploration of connections between physical processes and their manifestations in nature, life, humankind, mind, and society. The series honors the physicist, Arthur S. Iberall (1918-2002), whose intellectual legacy includes homeokinetics, a method of applying the laws of thermodynamics to all self-organizing systems. His applied research contributed significantly to the development of the first space suit, the high-speed dental drill, stove surface burners, the fancy-stitch sewing machine, and the electric knife.



Dava Newman, MacVicar Faculty Fellow and Professor of Aeronautics and Astronautics and Engineering Systems, is Director of the Technology and Policy Program at MIT. Her research on human performance across the gravity spectrum has been conducted on the Space Shuttle and the Russian Mir space station. Her research in extravehicular activity addresses life support technologies, human-robotic cooperation, and space suit design. She was named one of *Time Magazine's* Best Inventors of 2007 for her BioSuit™ system.