

ITEA held its first annual Technology Review from June 6-10, 2004, in Monterey, California. The review featured 70 technology presentations across a broad spectrum of topics of importance to the test and evaluation (T&E) community. There were 230 participants from laboratories, universities, industry and, of course, T&E centers and agencies. This edition of "TechNotes" highlights three of the presentations and technologies from the review. A complete CD of the presentations from the event can be obtained by e-mailing a request to ITEA at itea@itea.org.

Out-of-this-world testing

A featured Technology Review speaker was Dr. Robert Mitcheltree from the National Aeronautics and Space Administration's (NASA's) Jet Propulsion Laboratory. Dr. Mitcheltree led the Descent and Landing Validation for the *Spirit* and *Opportunity* Mars Rover Program. He chronicled the tense moments prior to descent and landing of the vehicles; the exhilaration when telemetry again burst from the rovers; and the validation tests that enabled the successful mission. In his presentation, "How on Earth Do You Test a Mission to Mars," he outlined two key components of the test program that uncovered design flaws and eventually saved the missions. Parachute tests highlighted a weak parachute that failed prematurely under the intense loads. This design was corrected and successfully passed subsequent developmental and operational testing. NASA also conducted skidding tests on the protective balloon, simulating the bouncing and abrasion that would eventually occur on Mars. Specially designed test instrumentation captured the balloon's unexpected rupture as it collided with rocks during simulated landings. Further analysis determined that the impact load did not rupture the balloon, but instead, the material tore as it skidded across the rock before bounding forward.

Epoch-by-Epoch™ GPS technology: Providing precise positioning

Dr. Jeffrey A. Fayman and Dr. Lydia Bock of Geodetics, Incorporated, presented a program to evaluate the precise positioning performance of global positioning system (GPS)-based Epoch-by-Epoch (EBE) technology for T&E applications. During a test program, EBE software was integrated with a number of commercial and military receivers. These receivers were then tested in both live and simulated tests, under strenuous environments, including high dynamics and extended range from a GPS reference receiver base station.

EBE yielded cm-level real-time accuracies (one standard deviation) for all of the high dynamic aircraft maneuvers that were evaluated. In addition, EBE technology was shown to have significant advantages over conventional GPS real-time kinematic (RTK) algorithms in several ways, including: (1) an instantaneous integer ambiguity re-initialization (as compared to a post-processing package, which required 8 seconds to

resolve the integer ambiguity); (2) extended ranges from the base station over which dual-frequency GPS receivers can provide precise positioning; and (3) graceful degradation when a full set of measurement data is not available. In these tests, the data were edited manually after the solutions were generated to remove outliers. Robust data editing in real-time is planned for future work.

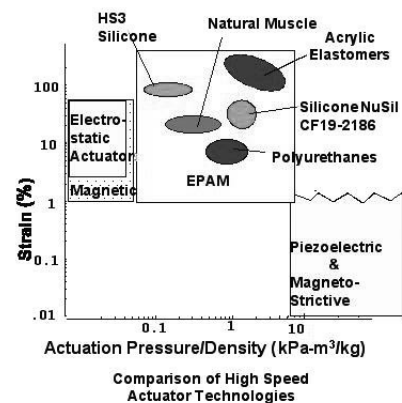
Electro-active polymers (EAPs): "Artificial muscles"

Ron Pelrine, SRI International senior scientist, described a new class of polymers that change dimension when electrically stimulated. The materials are also termed "artificial muscles." The key feature is demonstrated very large strains (10 percent to more than 300 percent) compared to more common materials, such as piezoelectrics. EAPs, such as acrylic elastomers, expand in one direction and shrink in another under applied voltage.

Typical properties, compared to natural muscle, are shown in the diagram below. These materials also develop pressures over 1,000 psi. Devices with 1, 2 and 3 degrees of freedom have been developed. In a linear actuator configuration, EAPs are 85 percent lighter than a corresponding electromagnetic actuator. Demonstration devices include "wall-climbing inch worms" and "multi-legged walkers" (photo inset, below). Potential applications in T&E include

Dielectric Elastomers Fill Muscle Gap

- ▼ Dielectric Elastomer EAPs have a unique combination of performance and operational characteristics
- ▼ Good Overall Performance is key to versatility
- ▼ Low Cost is also key



snake-like manipulators for improved access in severely constrained spaces; low-cost embedded diagnostic manipulators; large-strain sensors; and controlled surfaces for many-point probing. □