# 2003 EEK

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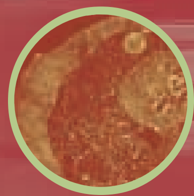
Electrical Engineering Kaleidoscope

SPRITES over BRAZIL



MAGNETIC fields TO ZAP MALARIA

the SCIENCE OF SOUND

VIKING 3 LANDS at UWEE

PLUS...

EDUCATION...PERSPECTIVES...FACULTY DIRECTORY...MILESTONES & INNOVATIONS...

# Approaching BORG— MELTING Human & MACHINES

**NO LONGER** just an element of science fiction, integrating human and robot entities into a single system offers remarkable opportunities for creating assistive technology. Humans possess naturally developed algorithms for control of movement, but are limited by muscle strength. Robotic manipulators can perform tasks requiring large forces, but artificial control algorithms do not provide the flexibility to perform under various conditions as well as humans. Combining these two entities into one integrated system under human control can benefit from the advantages of each subsystem.

Supported through an NSF grant, research conducted by EE professors Jacob Rosen and Blake Hannaford, Stephen Burns from UW's department of Rehabilitation Medicine, and graduate student Joel Perry, aims to design, build, and study the integration of a powered exoskeleton controlled by myosignals for the human arm. The exoskeleton robot worn by the human functions as a human-amplifier; its joints and links correspond to those of the human body. One of the primary innovative ideas of their research is to set the Human Machine Interface at the neuromuscular level and use the body's own neural command signals as one of the main command signals of the exoskeleton. These signals will be detected by surface electrodes placed on the operator's skin in the form of processed surface electromyography signals. This takes advantage of the musculoskeletal system's time delays, between when the neural system activates the muscular system and when the muscles generate moments around the joints. The myoprocessor is a model of the human muscle running in real-time and in parallel to the physiological muscle. During the time delay, the system will gather data on the neural activation level of the physiological muscle based on processed signals, the joint position, and angular velocity and predict the force generated by the muscle before physiological contraction occurs using the myoprocessor. By the time the muscle contracts, the exoskeleton will move the human in a synergistic fashion, allowing natural control of the exoskeleton as an extension of the operator's body.

The researchers anticipate that their findings will advance current knowledge in the field of modeling human muscles and their mathematical formulation, which can in turn be used to create novel devices in a long-term goal to develop assistive technology for individuals with various neurological disabilities.

PICTURED

POWERED EXOSKELETON SYSTEMS CONTROLLED BY MYOSIGNALS (ELECTROMYOGRAPHY—EMG) DEVELOPED BY DR. JACOB ROSEN. TOP LEFT: DR. ROSEN WEARING A ONE DEGREE OF FREEDOM SYSTEM (ELBOW JOINT). TOP RIGHT: GRADUATE STUDENT MOSHE BRAND FROM TEL-AVIV UNIVERSITY WEARING A THREE DEGREES OF FREEDOM SYSTEM (ELBOW AND SHOULDER JOINTS).