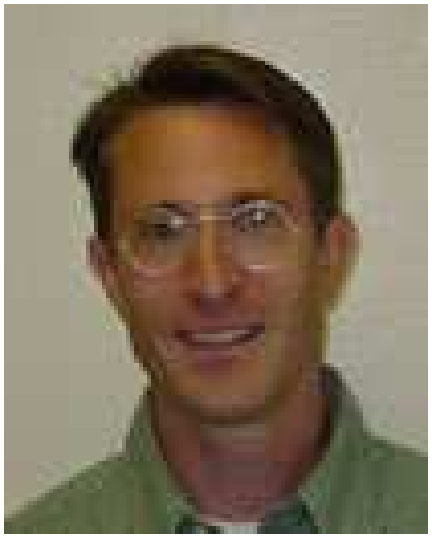

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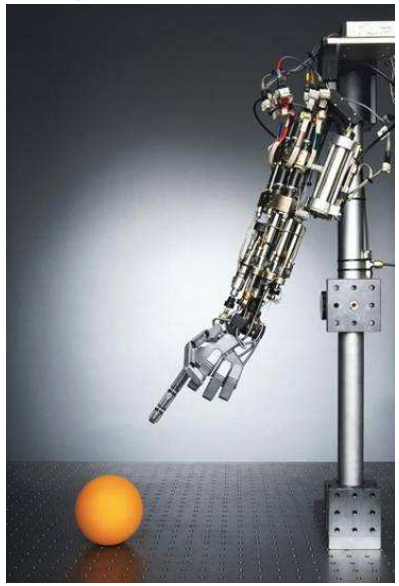
Research Interests

- Design, modeling, and control of electromechanical devices and systems
- Design and control of advanced prosthetic limbs
- FES gait restoration
- High power density actuation
- Haptic interfaces and telemanipulator systems

Research Highlights



Honors

- Vanderbilt Chancellor's Research Award, 2008
- ICORR Best Paper, 2007
- ASME FPST Best Paper, 2003
- Vanderbilt Engineering Best Paper Award 1997

Professional Activities

- ASME DSC Robotics TC
- ASME DSC Mechatronic TC
- Associate Editor, *ASME JDSMC*, 2001-2004
- Chair, ASME DSC Robotics TP, 1998-2000
- ASME DSC Fluid Control Panel, 2003-present

Frontiers in Prosthetic Limb Technology

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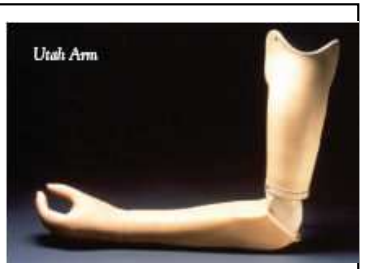
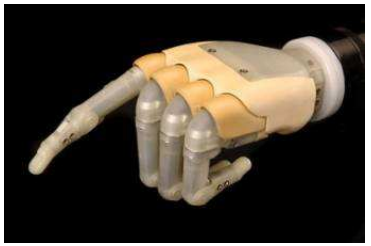
- State-of-the-art myoelectric upper extremity prostheses utilize electrical signals from muscles to drive electric motors
- Myoelectric approach provides a single input signal, which must be multiplexed between DOF's
- Lack of sensory feedback to user limits functionality
- State-of-the-art lower extremity prostheses are energetically passive
- Power and torque required for powered joints stretch power and actuator technology
- Interface and control with user is unsolved issue
- Lack of sensory feedback significant issue


Otto Bock C-leg



Utah Arm


Touch Bionics


Ossur PowerKnee


Ossur Power Ankle


Vanderbilt Blue Hand

Societal Implications

- Restore functionality and thus improve quality of life of tens of thousands of upper and lower extremity amputees worldwide
- Similar technology can be leveraged to restore function to spinal cord injured and many other musculoskeletal impaired persons

Accomplishments to Date

- Upper extremity: Body-powered prostheses, single-channel myoelectric prostheses, limited degrees of freedom
- Lower extremity: Microprocessor modulated damper knee joints, regenerative knee joints, powered knee joints

Challenges

- Reliable, natural, high-bandwidth, high-fidelity, multi-channel neural interface
- Near anthropomorphic levels of power, force, dexterity, degrees of freedom, robustness, reliability, mass
- Bilateral user interface (closing the loop with afferent information)

5/10/20 Year Vision

- 5 year: Highly functional upper and lower extremity prostheses with reduced order user interface
- 10 year: Improved functionality in limbs, direct user interface
- 20 year: Near anthropomorphic capability, bilateral user interface