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The **Human Motion Laboratory** at the University of Missouri – Kansas City is dedicated to measuring the characteristics of human motion. The lab includes:

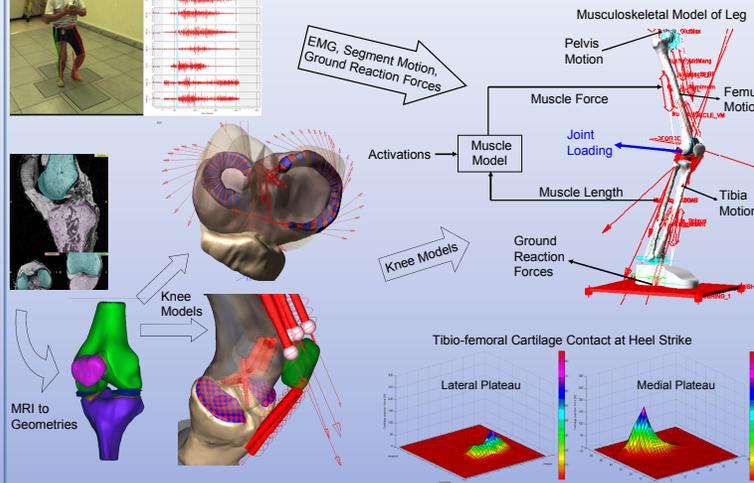
- VICON MX 6-camera motion capture system
- 4 AMTI OR6-6 force platforms
- Delsys Myomonitor IV 16-channel wireless EMG system

The scope of research that this lab supports includes aging, affective computing, psychophysiological biometrics, orthopedics, and human dynamics pathology. The specific research areas that the Human Motion Laboratory supports are:

- Computational Biomechanics
- Biometrics of Human Motion
- Experimental Biomechanics
- Body Area Sensor Networks

Computational Biomechanics

The Human Motion lab can directly measure the motion of body segments, ground reaction forces, and muscle activations. Knowledge of loads and motions within the body are also desirable, but typically cannot be directly measured. Computational models can be used to predict joint loading from gait measurements. The Musculoskeletal Biomechanics Research Laboratory at UMKC is using data from the Human Motion Lab coupled with subject specific musculoskeletal models to predict the loading on knee structures. This research has implications for anterior Cruciate Ligament (ACL) injury and repair, Osteoarthritis, tissue engineering, Total Knee Prosthetics, and meniscus injury, repair, and prosthetics.



Lower extremity model generated using OpenSim 1.8¹

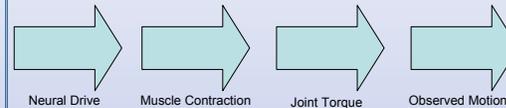
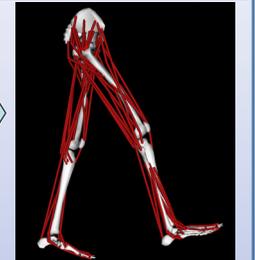
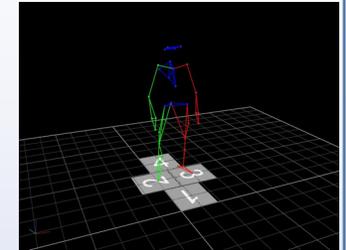
Experimental Biomechanics

Human Balance and Ambulation Research Laboratory (HBARL)

The HBARL's primary research focus is the study of human balance and mobility using experimental and computational biomechanics tools.

Current / Planned Projects

- Age-related changes in joint dynamics during a simulated fall
- Use of postural data for credibility assessment
- Fall risk rehabilitation based on musculoskeletal models of falls
- Investigating slip-related falls on different walking surfaces, including pervious concrete
- Fall risk detection among older adults
- Neurological manifestations of balance deficiencies



Body Area Sensor Networks

The Human Motion Laboratory is complemented with high-performance electronic test equipment such as a high-speed oscilloscope, a spectrum analyzer and a network analyzer. This equipment is being used to test and validate wireless motion sensors developed in the laboratory. Our lab also includes a number of circuit design and simulation software, data acquisition systems and prototyping tools.

Our wireless sensors incorporate diverse motion sensing modalities such as inertial (accelerometers and gyroscopes), ultrasound, and radio signals. These sensors provide a wearable platform that can be used to capture human motion in scenarios where it is difficult to have access to a controlled laboratory environment. Besides, their applicability of the study of human motion and biomechanics, we are applying wearable motion sensors to improve the quality of life of people with disabilities. We are currently working on a motion sensor that translates sign language gestures into spoken words.

Electronic Test Equipment

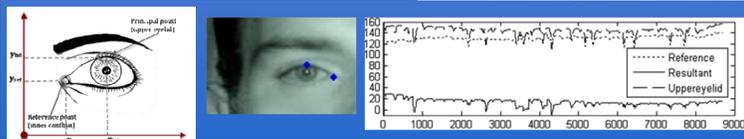
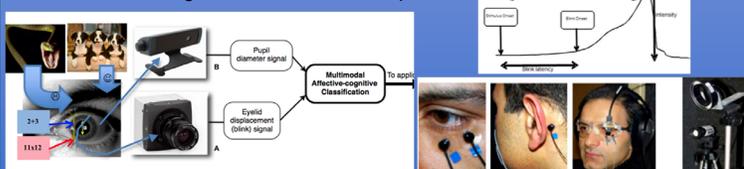


Fabricated Sensors



Biometrics of Human Motion (with Dr. Lovelace and Dr. Filion, Department of Psychology, UMKC, and Dr. Burgoon, NSF-CITeR/UA)

• Biometrics: the science and computational methods for discovering individuals' identities based on their specific biological or behavioral traits, such as those from fingerprints, the eyes, and human gait [B1]
 • We are using high-speed video analyses of blink reflexes, as well as postural and gestural information captured via forceplates, to enhance biometric-based security systems with non-obtrusive ocular and postural psychometric data.
 • Startle eyeblink measurements can reveal affective-cognitive states of a person [B2].
 • Using Vicon's MOTUS markerless tracking, we have shown that blink types can be derived from high-speed video [B3], instead of the current EMG-based practices.
 • Applications: video-based psychophysiological biometrics for detection of adverse affective states or, cognitive correlates of deception.



ACKNOWLEDGMENTS

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