Multi-disciplinary Collaborations in Measurement of Human Motion

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Bioengineering is a broad and rapidly-growing discipline defined as the application of engineering principles to biological systems. Although bioengineering is diverse in nature, the study of human movement is common to many bioengineering subdisciplines such as biomechanics and biometrics. Biomechanics is the science that examines the forces acting upon and within a biological structure and effects produced by such forces [1]. Measurement of ground reaction forces, limb motion, and muscle activation are fundamental research components in musculoskeletal biomechanics. Researchers in this field have used these measurements to quantify human gait, balance, and posture in a multitude of applications including age-related fall risk [2-4], muscle fatigue [5-7], and balance-related pathologies such as Parkinson's disease [8-10], and stroke [11, 12]. Additionally, these measurements play a vital role in computational biomechanics models. For example, the inverse dynamics method incorporates measured ground reaction forces and body motions to calculate the net reaction forces and torques acting on body joints [13].

Biometrics is the science of confirming or discovering individuals' identities based on their specific biological or behavioral traits [14]. Gait is one such modality which can be used for biometric identification. It is based on the uniqueness of an individual's locomotion patterns [15]. In addition, we are interested in high-speed video analyses of micro-saccades and blink reflexes for spoof-proofing of biometric identification systems, biometric identification, and psychometry. We have shown that startle blink intensity can be derived from high-speed video [18], enabling video-based psychophysiological biometrics for detection of subject-specific affective-cognitive information [19].

The Human Motion Laboratory at the University of Missouri – Kansas City is dedicated to measuring the characteristics of human motion. The lab includes a VICON MX 6-camera motion capture system, 4 AMTI OR6-6 force platforms, and a Delsys Myomonitor IV 16-channel wireless EMG system. This equipment represents an experimental infrastructure mutually supporting the biomechanics and biometrics research efforts of four research labs. The scope of these research efforts includes aging, affective computing, psychophysiological biometrics, orthopedics, and human dynamics pathology. The lab capitalizes on a synergistic environment for characterization and measurement of human movement and the interrelated nature of the research activities. The four main research areas that the Human Motion Laboratory supports are:

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

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