Biomechanical Analysis for Workplace and Living Safety
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Biomechanical Modeling to Reduce Low-back Injury

**Background**
- 70% to 85% of people experience low-back pain (LBP) at least once in their lifetime
- Lifting tasks have been identified as risk factor for work-related musculoskeletal disorders (MSD)

**Approach**
- Research is mainly experimental (some modeling)
- Develop necessary instruments and methods
- Monitor human kinematics and kinetics
- Modeling human as mechanical system and estimate low-back biomechanical stress

![Lab experiment setup with motion capture system for lifting tasks]

Calculated low back stress using biomechanical models

Understand Patterns of Muscle Contraction at Work

**Background**
- Shoulder MSDs are among most prevalent work-related disorders
- Thirty eight shoulder muscles with complicated and unclear co-contraction pattern

**Approach**
- Research is experimental and theoretical
- Using electromyography (EMG) to measure 16 shoulder muscles to empirically understand shoulder muscle co-contraction pattern
- Shoulder biomechanical model formulated to predict muscle activities using optimization

![Measuring shoulder muscle activities using EMG with real-time visual feedback]

Theoretical shoulder biomechanical model for analyzing muscle activities

Fall Prevention for Older Adults; Focus on Staircase Use

**Background**
- Stair negotiation is one of most difficult and hazardous locomotion tasks for older adults

**Approach**
- Using inter-joint coordination to quantify and understand age-related degeneration of neuromuscular system

![Stair negotiation poses high physical demands and coordination requirements]

Phase angle is used to investigate inter-joint coordination

Target Funding Agencies

National Institute of Occupational Safety and Health (NIOSH) – R01
NSF – Cyber Human Systems (CHS)