Human Motion Control

Lecture 1: Introduction

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21-6-2009

People

Lectures

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Assignments and 'HMC helpdesk'

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Background

- Research at Delft University of Technology:
  - Shoulder & elbow biomechanics, motion control
  - Clinical applications: Orthopedics, Neurology, Rehabilitation
  - Assistive devices: Orthoses, Prostheses
- Research at University of Twente:
  - Human gait and balance: models, experiments
  - Clinical applications: Neurology
  - Assistive devices: Orthoses, Prostheses, FES
- Disciplines involved:
  - Medical: Orthopedics, Rehabilitation, morphology
  - Engineering: (Bio)mechanics, electronics, control
  - Biophysics: human movements sciences

Goal

- General understanding:
  - Problems and solutions
  - Multidisciplinary approach
- Research oriented
- Analysis of (biological) non-linear systems
- State of the art: Actual research questions
- Study goals:
  1. Knowledge of basic anatomy and physiology of the components of the neuromuscular system
  2. understand the system theoretical approach and control principles of human motion

Approach

- Morphology, anatomy, physiology
- Methods:
  - Modeling - computer simulations
    - Biomechanics
    - Control engineering
  - Experiments
    - Validation of models
    - Inter- and intra-individual differences
- Applications:
  - Knowledge: prediction, design of assistive devices
  - Clinical: diagnosis, treatment
  - Ergonomics: prevention

Lectures

- General anatomy
- Kinematics of human body
  - Human motion recording
  - Standardization
- Rigid body dynamics
  - Motion equations
  - Human parameters
- Muscle
  - Anatomy and Physiology
  - Muscle models
- Sensors
  - Proprioceptive sensors: muscle spindles and Golgi Tendon Organs
  - Central Nervous System

Lectures

- Neuromuscular control models
  - Theoretical background
  - Model development
  - System identification techniques
- Motor learning and adaptation

Assignments

- Assignments
  I. Muscle models: simulation of 1 DOF musculoskeletal model
  II. Afferent feedback: analysis of neuromuscular control model

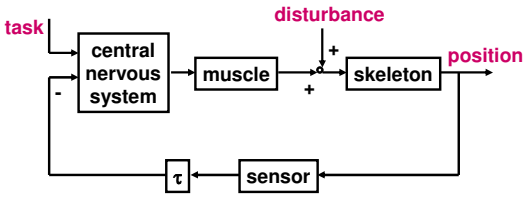
Biomechanics (subsections)

- Fluid biomechanics
  - Cardiovascular system
- Tissue biomechanics
  - Bone
  - Ligaments
  - Soft tissue: skin, organs, etc.
- Motion biomechanics (musculoskeletal system)
  - Bones, ligaments and joints
  - Muscles
  - Sensors / proprioceptors
  - Central nervous system (CNS)

Application motion biomechanics

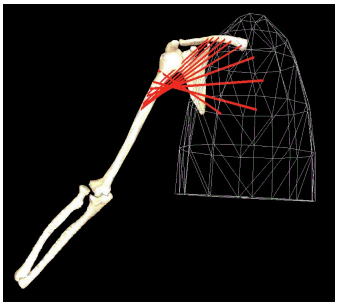
- Clinical applications
  - Orthopedics
  - Neurology
  - Rehabilitation
  - Gerontology and Geriatrics
  - Rheumatology
- Ergonomic applications
  - Prevention of work related injuries
- Sports
  - Improvement of performance
  - Prevention of injuries

Motion biomechanics: basic scheme



- Musculoskeletal system:
  - Bones, ligaments and joints
  - Muscles
  - Sensors / proprioceptors
  - Central nervous system (CNS)

Shoulder and Elbow model



Computer Assisted Surgical Planning