Human Movement Kinematics

Title of the Assignment:

Analyzing Human Motion: Concepts and Practical Applications of Kinematics

While key mechanical and mathematical principles will be reviewed throughout the course, students are expected to have a basic understanding of the following concepts:
- Vectors and vector operations
- Equations of motion for a projectile
- Newton's three laws of motion
- Work, energy, and power

Self-assessment of these topics is encouraged before the course begins.

Objectives:
- Understand the fundamental kinematic quantities: position, velocity, and acceleration.
- Apply kinematic principles to describe and analyze human movement.
- Interpret experimental data from human motion.

Topics to cover:
1. **Definition and Scope of Kinematics**
2. **Coordinate Systems and Reference Frames**
3. **Displacement, Velocity, and Acceleration in 1D, 2D, and 3D**
4. **Segmental vs Whole-body Motion**
5. **Use of Technology in Kinematic Analysis (e.g., Motion Capture Systems)**

Practical and Assignment-Based Activities

Activity 1: **Basic video-Based Motion Analysis (to be completed before the 1st session)**
- Watch a short motion capture video of a subject jumping (vertical_jump.mp3)
- Identify key events
- Estimate position-time and velocity-time characteristics.
- With a basic kinematic analysis, are you able to anlyse the height of the jump.

Activity 2: **Group Problem Solving**
- **To be completed before the 1st session**
  - Download the file Walking_Kinematics.csv
  - Plot the position,velocity and acceleration of the mid-point between the hip markers (hanche_D & hanche_G), ideally using Python.

- **To be competed during the 1st session**
  - Students work in pairs or small groups.

- Solve kinematics problems involving calculation of angular displacement and joint velocity from given data.

Activity 3: **Mini-Project Proposal (to be completed at home before the second session)**
- Write a 300-word project abstract proposing how kinematic analysis could be applied to a specific human movement (e.g., sprint start, sit-to-stand, tennis serve). Emphasis should be put on the description of methods.

Deliverables:
1. A filled-in worksheet with answers to the video analysis and numerical problems.
2. A one-paragraph mini-project abstract (submitted within 3 days).

Prepared by: Loïc Damm
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