Task #01 : Kinematic Motion Analysis in Sports Videos

Objective:

- ✓ Apply Lecture 2 concepts (body segments, skeleton, joints, mechanics types, kinematics , models/simplifications) to **analyze motions** in a **sports video** (e.g., soccer kicking, tennis serving, baseball pitching, basketball shooting, American football throwing).
- ✓ Be creative in your approach: Innovate by proposing novel **benefits from your motion analysis**, such as performance optimization, equipment design, or training apps.

Software:

- ❖ Use any **free/open-source motion analysis tool** (e.g., Kinovea, Tracker, OpenCV/MediaPipe, or similar).
- ❖ The selected tool **must** allow **extraction of**:
    - ✓ Joint angles
    - ✓ Segment trajectories
    - ✓ Linear displacement
    - ✓ Velocity and acceleration

Materials

- A clear sports video (e.g., soccer kick, tennis serve, basketball shot, baseball pitch, American football throw). **The analysis must focus on a single specific event within the video (maximum duration: 2 minutes).**

- Preferably a **side-view** recording to reduce projection error.

- A known **reference dimension** for calibration (e.g., athlete height, court markings, goal width).

Procedure:

1. Identify segments/joints (e.g., arm, forearm, thigh) and calibrate video. Creatively adjust methods (e.g., multiple reference points) for optimal accuracy.

2. Capture and analyze all motion types (linear: rectilinear/curvilinear; angular; rotational; circular; combined) using software tools. Calculate variables like displacement, velocity, acceleration. Innovate in capture techniques (e.g., high-frame-rate analysis, error correction algorithms) to maximize precision.

3. Discuss benefits from the analysis, such as improving technique efficiency, enhancing athletic performance, or developing innovative tools like AI coaching systems.

Requirements

1. Segment Identification

- Identification of relevant **body segments** (e.g., thigh, shank, foot, upper arm, forearm).

2. Kinematic Motion Analysis

❖ **Quantitative computation of** (with indication of the **mathematical equations** used for each calculation):
- Linear displacement
- Linear velocity
- Linear acceleration
- Angular displacement
- Angular velocity
- Angular acceleration

❖ **Clear identification of motion types:**
- Linear motion (rectilinear and curvilinear)
- Angular motion
- Rotational motion
- Circular motion
- Combined (general plane) motion

❖ **Graphical representation required:**
- Position vs time
- Velocity vs time
- Angle vs time

All ***calculated variables*** must be supported by ***numerical data*** and clearly explained methodology.

3. Scientific Support Requirement *(Bonus +)*

Any biomechanical interpretation or performance-related claim ***must*** be supported by ***peer-reviewed scientific literature***.

Examples:

- If you claim that "higher hip angular velocity improves kick performance," you ***must cite*** a scientific paper.

- If you claim that "optimal elbow extension timing increases throwing accuracy," you ***must reference*** published research.

Report Format (Maximum *3 Pages* – PDF)

Your report must include:

1. **Brief description of selected movement**

2. **Methodology**
   - Software used
   - Calibration method
   - Tracking approach

3. **Results**
   - Graphs (angles, displacement, velocity)
   - Screenshots from analysis

4. **Kinematic Interpretation**
   - Link results to Lecture 2 concepts
   - Cite scientific literature to justify conclusions