

CSE541 Computer Vision

Weekly Report 5

**Landing Error Scoring System for Basketball: A Computer Vision Approach**

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### **Aim:**

Applying the theoretical equations to calculate the angles and distances for annotation.

### **Introduction:**

To implement the previously discussed algorithm on the video frames, we will initiate the task of annotating video frames, by dividing them into 200 frames. For annotating them, we will be using Roboflow, and for calculating the angles we have started learning Kinovea as a tool. As the provided video, has tilt which can affect the values of each angle, we will be preprocessing each video frame to bring them to 0 degrees. So, the significant steps to implement are key point selection and annotation on both frontal and lateral videos, calculating lateral trunk flexion error as a binary classification problem, and stance error as a multiclass classification problem.

### **Steps to implement:**

**Key point selection and annotation:**We would be dividing each ‘frontal’ video into 200 frames.To calculate the lateral trunk flexion, we need the following key points: left\_shoulder, right\_shoulder, hip\_midpoint (calculated from right\_hip and left\_hip key points). Furthermore, we would need the following key points for stance width: left\_shoulder, right\_shoulder, left\_ankle, right\_ankle.

The coordinates would be first normalized by multiplying the y-axis pixel values by the inverse ratio. In the next processing stage, we will identify irregular movements and incorrect postures **[1]** based on the calculations described below.   
  
We plan to use Roboflow for annotating the key points, as well as the errors which are discussed below.

**Lateral Trunk Flexion:**

During jump landings, lateral trunk flexion is essential for preserving postural stability and control. An athlete’s performance may suffer, and their risk of injury may rise due to biomechanical inefficiencies brought on by excessive lateral trunk flexion.

For each frame, we will calculate the angle between the hip midpoint and the shoulder midpoint. An error is identified if the angle between the two lines does not equal 0° or 180° **[1]**. This deviation from the expected alignment indicates lateral trunk flexion during the landing phase.

**Stance width:**

For each frame, the following measurements will be calculated:  
 1. The Euclidean distance between the right and left shoulder key points.

2. The Euclidean distance between the right and left ankle key points.

Narrow Stance Error occurs when the ratio of the shoulder distance to the feet distance is greater than 1, indicating that the distance between the shoulders is relatively wider than the distance between the feet, suggesting an incorrect stance.

Wide Stance Error occurs when the ratio of the shoulder distance to the feet distance is less than 1, indicating that the distance between the shoulders is relatively narrower than the distance between the feet, suggesting an incorrect stance that might affect the agility of the athlete.

Normal stance would be when the ratio of the shoulder distance to the feet distance is exactly equal to 1, which is the ideal case but we would be setting a threshold of 0.2, which implies ratios within this range [0.8,1.2] detect a correct stance, while those outside it indicate deviations suggesting incorrect stance.

### **Conclusion:**

In conclusion, our approach for implementing the Landing Error Scoring System (LESS) for basketball jump landings involves key point selection, annotation, and error calculation. By using tools like Roboflow and Kinovea, we aim to calculate parameters including lateral trunk flexion and stance width, which are crucial for assessing postural stability and injury risk. This methodology can identify irregular movements and incorrect postures. Moving forward, integrating LESS into our algorithm will provide comprehensive insights into jump landing errors.

**Next steps and goals:**

1. Once we get the required dataset, we will be practically implementing the above steps on the dataset.
2. We will be training our model on our dataset as well as the other group’s dataset.

### **References**

1. Sharma, S., Divakaran, S., Kaya, T., Taber, C., & Raval, M. S. (2023). A Framework for Biomechanical Analysis of Jump Landings for Injury Risk Assessment. In 2023 IEEE 28th Pacific Rim International Symposium on Dependable Computing (PRDC) (pp. 327-331). IEEE. doi:10.1109/PRDC59308.2023.00052