BALLET TECHNIQUE ANALYZER

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ABSTRACT: Ballet training can be expensive, and dancers often practice between classes without real-time feedback from an instructor. This project developed a ballet technique analyzer using MediaPipe Pose and video-based movement analysis. It detects body landmarks, calculates camera-dependent technique metrics, and translates them into practice cues. For arabesque, it assesses hip alignment, torso lean, leg straightness, and shoulder–hip alignment; for plié, it measures torso lean, knee-to-toe alignment, and joint angles related to depth. Visual tracking, frame-by-frame measurements, and correction labels—such as "Keep the supporting hip over the foot"—turn qualitative technique observations into repeatable analytics for dance research.

AI Workflow

The AI workflow shows how the system converts dance video into measurable body-position data and interpretable technique feedback.

Recorded Video:
Dancer Uploads short video clip demonstrating a particular ballet step.

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MediaPipe pose landmarks
Compute vision maps key joints frame by frame.

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Body Coordinate calculations
Landmarks become angles, alignment, and relative position.

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Technique metrics
Rules assess turn out, torso lean, and hip placement.

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Correction queue + annotated video
A specific cue is paired with visual evidence from the movement.

Technique Metrics and Prototype Feedback Rules

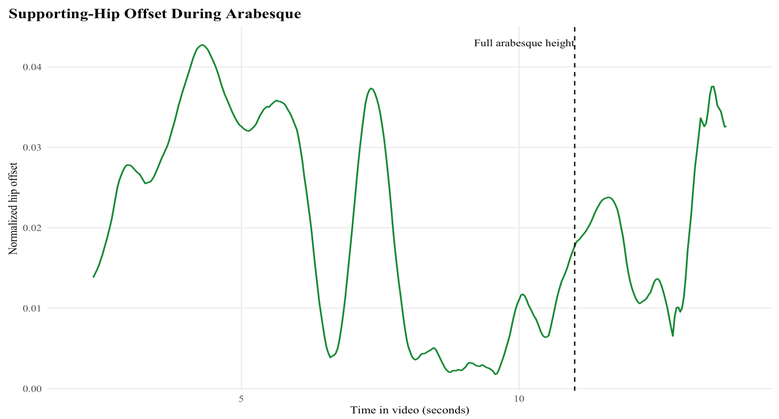
Metric	Definition	Decision and Coaching Tip
Torso lean (°)	Angle between shoulder midpoint–hip midpoint line and vertical	Average lean > 10° in side-view plié → "Keep the ribs over the hips."
Knee-to-toe offset	Horizontal knee-to-toe distance normalized by hip width	Offset > 0.35 → "Keep the knee tracking over the toe."
Working-leg straightness (°)	Angle formed by the working hip, knee, and ankle	Reported as an arabesque alignment metric; no independent correction cutoff currently used.
Supporting-hip offset ratio	Horizontal hip-to-ankle distance normalized by supporting-leg length	Offset > 0.35 → "Keep the supporting hip over the standing foot."

These metrics translate body landmarks into measurable technique cues. The prototype compares each measurement with a threshold to generate consistent feedback, while accounting for pose-tracking confidence and camera view. The thresholds are intended to support practice and require validation before being treated as ballet standards.

Arabesque: Supporting Hip Alignment



Arabesque at full height with MediaPipe pose tracking. Green lines show the detected pose landmarks and the supporting hip-to-ankle alignment reference.

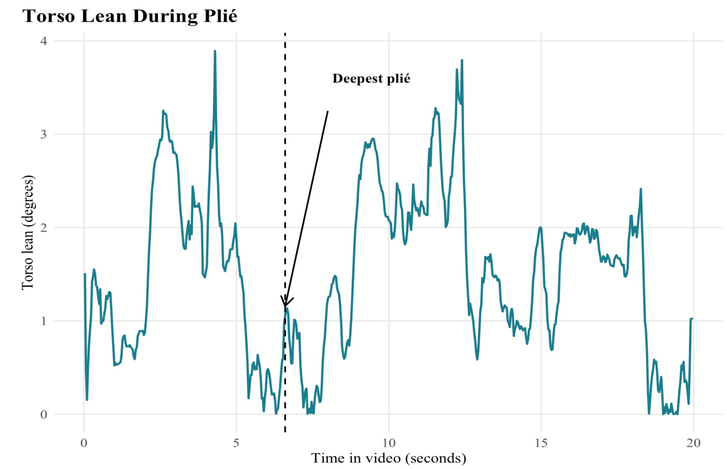


The supporting-hip offset ratio compares the supporting hip and standing ankle after normalization by leg length. Lower values indicate a hip closer to the supporting foot in this view. The supporting hip remained below the 0.35 correction threshold. At full arabesque height, offset was approximately 0.018, with larger deviations occurring during transitions before and after the position.

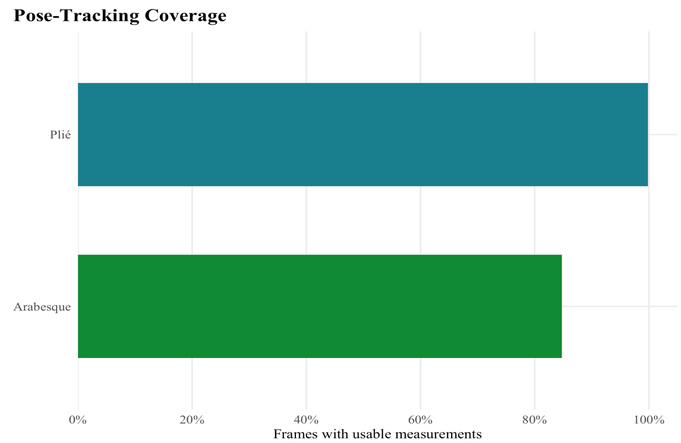
Demi Plie in First: Torso Lean



Torso lean is calculated as the angle between the shoulder midpoint–hip midpoint line and the vertical axis. It is a camera-dependent posture proxy.



At approximately 6.6 seconds, the dancer reached the deepest plié while maintaining a torso lean of approximately 1.0°. Torso lean remained below the 10° prototype threshold throughout the repetition, so no correction was triggered.



Pose tracking produced usable measurements for 99.8% of plié frames (599/600) and 84.8% of arabesque frames (356/420).

Limitations

- Correction thresholds are engineering values for prototype feedback, not universal ballet standards.
- Results are based on a limited number of demonstration clips.

Further Research

- Validate the system across a larger and more diverse set of dance videos to assess tracking reliability and consistency.
- Expand the system to additional ballet movements and technique metrics.
- Compare repeated attempts to measure changes in alignment and consistency over time.
- Evaluate whether the feedback is understandable and useful during practice.

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