

AI-Aided Intelligent Fitness Assessment

The promulgation of the *National Student Physical Health Standards* has effectively promoted primary, secondary, and college students to pay attention to the development of their own physical health and motivated them to actively engage in physical exercise. By installing cameras around sports venues, students' sports movements can be captured in real time to analyze their exercise postures. For example, in teaching of standing long jump, by recording and analyzing a series of detailed data on students' physical changes, such as the leg force at the moment of take-off, arm swing trajectory, body posture in the air, and landing posture, teachers can comprehensively understand the strengths and weaknesses of each student's movements, thereby providing targeted improvement plans.

Using images captured by cameras, AI-aided human pose estimation technology can locate the key point positions of small-scale human bodies in complex scenarios. Using AI-based human pose recognition algorithms can track the posture of exercisers and obtain motion videos and position coordinate information of human body key nodes in different frames during movement. Please establish mathematical models to solve the following problems:

Problem 1 Annex 1 contains the videos, position information, and results of two standing long jump exercisers. In which, the position information includes the position coordinates of 33 key nodes (see Annex 2) of the exercisers throughout the entire standing long jump process in different frames of the video. Please determine the take-off and landing moments of the exercisers during the standing long jump, and describe the movement process of the airborne phase (from take-off to landing).

Problem 2 After a short period of professional training, standing long jump performance can be significantly improved. Annex 3 contains the standing long jump videos, position information, and results of some standing long jump exercisers before and after their postures were corrected by coaches. Annex 4 contains personal physical fitness reports of the exercisers, including age, height, weight, and body fat percentage, etc. Please analyze the main factors affecting standing long jump performance of exercisers based on the relevant materials.

Problem 3 Based on the models and results of Problems 1 and 2, combining with the standing long jump video, position information in annex 5, and personal physical fitness data of Exerciser 11 in Annex 4, predict the actual standing long jump performance of this exerciser.

Problem 4 Based on Problem 3, please provide posture training suggestions for improving the standing long jump performance of Exerciser 11 in a short period of time, as well as the ideal standing long jump performance that this exerciser may achieve after short-term training.

Description of Annexes

- Annex 1 Movement information data of exercisers 1 and 2
- Annex 2 Schematic diagram of human body key nodes
- Annex 3 Movement information data of exercisers before and after posture adjustment
- Annex 4 Exercisers' physical fitness reports
- Annex 5 Movement information data of exerciser 11