



Colorado Science and Engineering Fair

2024 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: A ~~Comparative~~ Study of Numerical and Machine Learning Approaches to Tennis Swing Analysis

Finalist's Name: Stella Laird

School and City: Fairview High School, Boulder

Sponsor's Name: Paul Strode

Category: Mathematics & Computer Sciences (MACS)

Division: Senior (9th - 12th grades)

Abstract (250 words or less):

Tennis is a widely popular sport globally, yet the cost and time associated with accessing coaching services present significant barriers to many players. With lessons typically ranging from \$60 to \$150 per hour, the financial burden can deter aspiring players from receiving quality coaching. Moreover, a substantial number of tennis-related injuries stem from poor technique, illustrating the importance of high-quality coaching for players engaging in intense gameplay. This project aims to address these challenges by developing an affordable and accessible alternative to traditional live coaching.

The proposed solution involves the creation of a program capable of accurately identifying errors in a player's technique, thereby providing valuable feedback for improvement. Various numerical and machine learning methods were explored to determine the most effective coaching solution. While the numerical approach offers speed and efficiency with minimal computational requirements, its accuracy falls short, rendering it unsuitable for swing coaching applications.

In contrast, the utilization of convolutional neural networks (CNNs) trained to detect and classify different types of technique errors yielded promising results. These image classification CNNs demonstrated the ability to accurately identify several error types, with accuracies reaching close to 100% in some cases. Considering these promising results were achieved with an abnormally low amount of input data, this program has the potential for achieving high accuracy levels given a more robust training dataset. If further developed, the image recognition techniques in this project could form the basis for a viable alternative to live coaching, and demonstrate the feasibility of an artificial intelligence coaching application.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature: 

Date: 2/28/24

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with your Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.