Phase 1 Static Analysis
Program can recognize, critique and evaluate various fencing actions from a reasonably static position. Actions can be evaluated on form, time, velocity, acceleration, distance covered. This could include a routine (fixed or dynamic) that the program prompts the student to perform and then gives a score in a variety of statistics. Use monthly, it can help a student see how they are improving and where they need more work.

Footwork Actions (with or w/o sword):

- En Guard
- Advance
- Retreat
- Lunge
- Recover
- Fleche
- Jump Forward
- Combinations of the Above (ex. Advance-Lunge)

Bladework Actions, possibly on a target dummy or coach:

- Attack Lines (straight, angulation, flank, etc to different parts of the target)
- Parry Riposte (several parries, ripostes to different targets)
- Disengages/Coupes (avoiding the parry)

Phase 2 Dynamic Analysis of Form and Technique
The program analyzes form and technique in either real time or uploaded video shot from a variety of angles. It can create a curated selection of video to show both the best and worst form of a session or bout. In addition to the Phase 1 feedback, Phase 2 can include feedback on reaction time. Recognizes how a form break costs time (acceleration, response time, etc) on a following action (ex. when you stood up here, your lunge was XX% slower than you are capable of). Even better if it shows that correct technique would have turned that failure into a success!

Highlighted section is a key metric that currently we can only approximate as coaches and students usually nod and ignore in response. If we can give them hard data on this, they are far more likely to change their behavior/form.

Robo-coach
Once Phase 2 is complete, it should be possible to create a coaching program. The computer is set up near a strip and puts a fencer through a lesson, either pre-programmed or computer generated from a library of drills. Ideally, the program would provide real-time voice corrections and be able to replay recent video, possibly with an ideal overlay to show what the student is aiming for.

For bladework, it can be set up near a target and give verbal cues to what actions the fencer should perform, or, if in front of the fencer, visual cues.

Phase 3 AI Generated Bout Critique/Decision Analysis

The program learns to recognize fencing patterns (distance, timing, habits, etc) and provides feedback on a bout. Useful feedback might include:

Your Habits: Here are your most commonly repeated actions, they result in your point XX% and your opponent takes advantage of them to score XX%. Your opponent usually scores against them by…, you score from the habit by… The biggest factor that determines who scores is (distance, who goes first, how often you use the action, etc).

Opponent's habits: Same as above with reversed roles.

Form and Technique Critique: Including how much your form helped/hurt you and how much your opponent's form helped/hurt you.

Strengths/Weaknesses comparison: Both form/technique and decision making.

Suggest actions for certain situations: Based on your abilities: "You appear to like this action and it would likely have been a better choice for you in these instances" or on elite fencers' choices: "Lee Keifer often uses this action in this situation with XX% chance of success".

This feedback might take into account fatigue, adaptation of fencers to repeated actions, fencers' history against each other, etc. Eventually, it would be great if the program could look at the 5 most recent videos available of a coming opponent and show a fencer probable openings to prep them for a match.

Expected Uses

Phase 1: The program would provide an impartial assessment of a fencer's improvement in different metrics for a variety of actions. This can be used to adapt training programs or for a youth "non-competition" event.

Phase 2: The program has 2 potential uses. 1. It can provide routine instruction when a coach is unavailable (during vacation or if the student lives too far away). 2. It can analyze video and provide empirical data on a student's performance.

Phase 3: The use of AI can potentially analyze large amounts of video data and provide unique insights on strategy and tactics. At worst, it should be able to find critical moments in a bout (if nothing more than flagging the 10 seconds leading to a touch) and at best, it will be able to offer critique of a match and advice for a coming bout (possibly with video).

Timeline

I would hope to have a decent Phase 1 by December and be working towards Phase 2 by January/February.

Phase 3 I would expect to take significantly longer (possibly beyond the scope of the team for this year) as this part of the coaching is currently more art than science, though AI might be able to crank through video data and surprise me how quickly it can learn.