Pacing regulation for runners

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Background

Research has suggested that running injuries as a result of overload might be reduced by increasing step frequency [1]. Small increases in step frequency (+10%) result in a reduction in energy absorption in the joints of the lower extremities as well as a decrease in braking impulse and instantaneous vertical loading rate [1]. Auditory pacing is commonly used to prescribe a particular movement frequency in cyclic tasks, including locomotion [2]. In locomotion, auditory pacing can be readily implemented by using a headset. Auditory pacing could be provided to a runner continuously, however, research indicates that synchronizing to an external rhythm costs energy [3]. Intermittent pacing may thus be more energy efficient than continuous pacing. But what is an effective way to regulate pacing in order to increase or maintain step frequency, in a user friendly manner?

The project

The aim of the project is to determine which machine learning approach would be suitable to find an effective way to provide auditory pacing to a runner in order to increase or maintain step frequency, in a user friendly manner, based on measured parameters. A schematic overview of the system, including possible input parameters is shown below. In this master project, you will design, build and test a self-learning system for this purpose.

Output	Pacing protocol
Constraints	Step frequency, User friendliness
Input	Step frequency, Time, Athlete preference, Objective frequency, Heart rate, Running speed, Temperature

A key difficulty is that the available data is limited, but low-level, which suggests a deep learning approach that can learn from sensor data. At the same time, the interaction with the user imposes constraints on what controllers ("policies") can be used by the system, which makes current deep reinforcement learning (RL) approaches infeasible. We will explore if it is possible to connect ideas from deep RL and connect them with a partially specified controller that encodes the required constraints on interaction. Such a combined controller could then be trained via policy gradient or actor-critic techniques.

Interested?

For more information or to apply for the project, contact Anouk Nijs a.nijs@vu.nl and Rolf Starre R.A.N.Starre@tudelft.nl.

References

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