COMPUTER AND CONTROL ENGINEERING

DAUIN - Sports Engineering for Endurance disciplines: From Models to a Virtual Personal Coach

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Context of the research activity	Training of athletes in endurance sports (long distance running, swimming, cycling) is still made in an ad hoc fashion, with limited use of scientific approaches and often in a standardized way. This PhD project aims to define personalized models of an athlete, built using dynamic systems theory exploiting physiological signals collected from wearable devices. Building on this model, an AI coach delivers personalized recommendations for training and race using innovative interfaces.
Objectives	The main objectives of the PhD program are the following: 1-Athlete modeling. Define an athlete-specific model of the performance (e.g. running pace and total time) based on defined metrics (available power, increasing fatigue, recovery rate) using physiological signals from wearable devices (e.g. heart rate, breathing rate, HRV and so on). 2-Athlete training. Building on the athlete model, and considering goals and constraints, develop other dynamical models capable of defining daily and weekly plans to train the athlete towards specific race goals. 3-Athlete race guidance. Apply the model to obtain race instructions (e.g. running pace) starting from real time physiological signals, race goals and real time fatigue state of the athlete. 4-In motion interface. Develop a convenient user interface (hands free, vision-free, usable even in stressful environment like a competition) to retrieve crucial information given by one of the athlete models. Altogether the models and interface compose a virtual personal coach for the athlete.
Skills and competencies for the development of the activity	• Full-stack development for web and mobile with Flutter, APIs, databases, CI/CD• AI and ML skills, model training and evaluation techniques• HCI for wearables in motion, concise messaging, timing and modality, usability testing• Dynamical systems and stability theory, signal processing, state-space models• Exercise physiology basics, MLSS and CP, recovery and fatigue, test protocols; • Strong teamwork, clear communication, agile delivery