

IT Talks

A SEMINAR SERIES FOR PHD STUDENTS IN INFORMATION TECHNOLOGY

Presentation 1
***Eleonora Bonelli*: From Laboratory to Practice: a Translational Biomechanics Approach to Sport Climbing**
Biomechanics provides quantitative methods for characterising human movement and can complement practitioners' observations and experience. However, translating biomechanical research into practical applications requires measurement approaches that are not only accurate, but can also be implemented under the constraints dictated by the activity under study.
Sport climbing provides an interesting case study for exploring these challenges. Its growing popularity and professionalisation have increased the relevance of understanding the physical and technical demands. However, biomechanical investigation of climbing presents specific methodological challenges. For example, the predominantly vertical orientation of movement and the infrastructure required for climbing complicate the use of conventional laboratory equipment. The movement itself involves complex whole-body coordination, with substantial contributions from both the upper and lower limbs and multiple contact points between the climber and the wall.
In this context, we adopt a translational biomechanics framework built around three complementary themes: characterising climbing movement, adapting measurement approaches to ecological conditions, and improving experimental setups by reducing the number of sensors where possible and integrating complementary data sources. Within this broader framework, the presentation focuses on electromyography (EMG), illustrating how it can be used to characterise common climbing positions, investigate patterns of muscular coordination, and explore sensor-reduction strategies to simplify data acquisition while balancing reconstruction accuracy and practical feasibility.

Presentation 2
***Riccardo Vianello*: Trajectory Planning and Optimization methodologies for High-Performance Autonomous Vehicles**
Autonomous racing represents a challenging testbed for developing high-performance algorithms, requiring real-time decision-making and reliable operation at the limits of vehicle handling. Beyond motorsports, advances in this field can contribute to improving the safety and robustness of autonomous driving systems. Within this context, the present research develops trajectory planning and optimisation algorithms aimed at maximising vehicle performance while ensuring safety and reliability. The proposed framework integrates global and local planning approaches. The global planning contribution focuses on offline minimum lap-time optimisation and the development of multi-vehicle racing strategies, providing references that improve the robustness and computational efficiency of local planning. The local planning contribution addresses real-time trajectory generation, enabling collision-free, high-performance manoeuvres while accounting for vehicle dynamics and operational constraints.

Presentation 3
***Riccardo Poli*: State Estimation Algorithms for Autonomous High-Performance Vehicles**
Autonomous racing demands accurate vehicle-state estimation and adaptation to changing tyre conditions near the handling limits. This research presents a multi-sensor localization framework based on an Extended Kalman Filter, supported by map-based monocular localization and Doppler-based radar velocity reconstruction. Probabilistic fusion of visual observations from multiple keyframes provides metric position estimates, while radar measurements enable longitudinal and lateral velocity and sideslip estimation. A performance-adaptation framework combines temperature-dependent tyre modelling with online tyre-limit proximity estimation to adjust the requested lateral performance. Experimental validation on autonomous racing platforms covers high-speed driving, degraded sensing conditions, and variations in tyre operating conditions.

The event will open with a networking reception.

19th November
11:30 am - 1:00 pm
Emilio Gatti Conference Room, Building 20

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