Ph.D. in Information Technology
Thesis Defenses

May 24th, 2022
at 14:30
Room 25.S.1

Francesco ABBRACCIAVENTO – XXXIV Cycle

Reactive Trading: A control theoretical approach to financial engineering

Supervisor: Prof. **Simone Formentin**

Abstract:

In quantitative finance, stock trading methodologies are concerned with the definition of proper investment actions in view of maximizing a specified investor's utility function over a defined time horizon. Most of the existing approaches in financial practice aim at deriving forecast models to accurately predict future price returns, in order to adequately take effective investment decisions. However, due to the intrinsic high non-stationarity characterizing asset price dynamics, reliable future predictions are hardly achievable even resorting to complex modeling tools and negligible prediction errors may cause a huge detrimental impact on investor's utility. Alternatively to the mentioned traditional model-based strategies, novel trading policies relying on different return dynamics formulations have been recently theorized in control systems community. In this thesis, innovative control theoretical trading approaches are proposed, with the objective of deriving practical solutions to several problems of interest in modern quantitative finance. The common thread characterizing the presented methods concerns the exploitation of data-driven adaptive control techniques intended to overcome the literary issues connected to the prediction of price returns, by introducing trading methods independent on critical prior return model assumptions and resorting to a breakthrough trading-oriented identification rationale. The derived trading methodologies are extensively validated using real-market historical quotations, revealing significant outperformance in terms of investment results compared to the state of the art and some benchmark approaches from financial practice.

Gianluca PAPA – XXXIV Cycle

Active Control and Health Monitoring of Landing Gear Dynamics for the Optimization of Ground Handling in Aircraft

Supervisor: Prof. **Mara Tanelli**

Abstract:

In aircraft ground handling, active anti-lock braking systems support the pilot to safely decelerate with elevated performance, while ensuring safety and robustness in the face of highly varying operating conditions. Up to now, instead, no active system is employed for the control of the lateral dynamics on ground, which is controlled by the pilot via differential brake and/or steering input.

Aircraft ground handling strongly depends on three main variables. First, its structural parameters configuration, which strongly affects the aircraft lateral controllability, and the possibility for active systems to alter the ground handling properties. Second, the state-of-health of the landing gear components that are directly involved in the generation of the forces on ground, namely: shock absorber, tire and braking actuator. A fault or excessive wear of any of these components would induce unmodelled asymmetries and endanger the aircraft maneuverability. Third, the performance of the anti-lock braking controller, as a wheel-locking event would completely de-stabilize the aircraft dynamics, zeroing out its steerability.
This Thesis focuses on aircraft ground handling, and designs methods for the optimization of the aircraft lateral controllability, new advanced anti-lock braking systems, and health monitoring schemes for the landing gear components, namely shock absorber and braking actuator. The work has been mostly carried out in collaboration with Leonardo Aircraft Division, a major Aerospace Italian company. The experimental analysis and testing phase of the proposed approaches was performed on high fidelity software and hardware-in-the-loop testing platforms, including the real aircraft, allowing us to prove the effectiveness of the proposed control methods and approaches.

PhD Committee

Prof. **Giulio Panzani**, Politecnico di Milano
Prof. **Alessandro Beghi**, Universita' di Padova
Prof. **Damiano Varagnolo**, Norwegian University of Science and Technology (NTNU)