Ph.D. in Information Technology
Thesis Defense

October 15th, 2026
At 09:00 a.m.
Room Alpha - Building 24

Alessandro TICOZZI – 38th Cycle

DIGITAL CONTROL OF FORCE-FEEDBACK MEMS ACCELEROMETERS
Supervisor: Prof. Giacomo Langfelder

Abstract:

Inertial sensors are widespread in numerous fields, including consumer, automotive, industrial, military and aerospace applications. All these sectors are in continuous expansion, thereby the need for inertial sensors keeps increasing. In particular, micro electro-mechanical systems (MEMS) inertial sensors have dominated the consumer and automotive markets over the last three decades, thanks to their low cost, small size and low power consumption. In contrast, high-end applications have traditionally relied on more expensive and bulky technologies. Recent research in the MEMS field has focused on improving the MEMS sensors performance to narrow the gap with the high-end solutions. The increasingly demanding automotive field requirements for autonomous driving specifications, combined with the advantages in terms of cost and size, have driven the research in the MEMS field. The main challenges lie in the improvements in terms of noise and stability. Moreover, for accelerometers, additional requirements include extending the bandwidth and the full-scale range to ensure reliable operation in harsh environments. Within this context, this Thesis presents the study and development of an innovative force-feedback MEMS accelerometer to achieve low stability and high dynamic range (DR), in order to obtain performance comparable with quartz accelerometers. The primary contribution is the design of a novel digital-domain controller based on a state-space feedback approach. A discrete-component closed-loop prototype is implemented and experimentally validated, demonstrating a DR of 118 dB and a stability of 5.5 μg. Finally, the Thesis outlines the key steps toward the implementation of an ASIC integrating the proposed digital control architecture.

PhD Committee

Prof. Paolo Frigerio, **Politecnico di Milano**

Prof. Takashiro Tsukamoto, **Tohoku University**

Prof. Alessandro Nastro, **Università degli Studi di Brescia**