Ph.D. in Information Technology
Thesis Defense

February 18th, 2026
At 2:30 p.m.
Room Beta - Building 24

Andres Ivan MARTINES ROJAS – XXXVIII Cycle

SELF-ADAPTIVE INTEGRATED PHOTONIC TRANSCEIVER FOR FREE SPACE OPTICS COMMUNICATIONS

Supervisor: Prof. Francesco Morichetti

Abstract:

Free-space optical (FSO) communication enables high-capacity, low-latency wireless links but is strongly affected by atmospheric attenuation, pointing errors, and turbulence-induced distortions. In clear-sky conditions, atmospheric turbulence becomes the dominant limitation, causing random amplitude, phase, and spatial fluctuations that degrade link reliability and challenge advanced optical modulation schemes. This thesis investigates the mitigation of atmospheric turbulence using photonic integrated circuits (PICs). A multi-aperture PIC based on a reconfigurable Mach–Zehnder interferometer mesh coherently combines distorted wavefront samples in real time under closed-loop control via on-chip power monitors, enabling adaptive turbulence compensation. The architecture is experimentally validated with NRZ and PAM-4 modulations at 25 Gbaud, and with complex modulation formats such as chaos-based signals, radio-over-FSO (up to 1024-QAM), and wavelength-division-multiplexed links across the C-band. Bidirectional PIC-to-PIC FSO links demonstrate a scalable, low-latency platform for turbulence-resilient FSO communications.

PhD Committee

Dr. Matteo Oldoni, **Politecnico di Milano**

Prof. Bernhard Schrenk, **Austrian Institute of Technology**

Prof. Oskars Ozolins, **Riga Technical University (RTU)**