DAuSy Doctoral Research Seminars

The National Doctoral Program in Autonomous Systems (DAuSy) is pleased to announce a series of **research seminars** aimed at disseminating the doctoral activities carried out within the program. DAuSy Students will present their research to fellow postgraduate students and Professors, fostering scientific exchange and collaboration.

Dates: May 13, 20, and 27, 2026

Time: 5:00 PM – 7:00 PM (CET)

Platform: Microsoft Teams (online)

Each session includes **6 presentations**, with a **15-minute slot per speaker** (Q&A included). Participation is **free of charge**, but **registration is mandatory** by **May 7th, 2026**, for all sessions, via the links below:

Registration link for May 13rd, 2026: https://events.teams.microsoft.com/event/2b68c17c-55bf-4ca1-b76a-ba4c51dcace6@5b406aab-a1f1-4f13-a7aa-dd573da3d332

Registration link for May 20th, 2026: https://events.teams.microsoft.com/event/d97f2837-784e-4ef9-bc18-b6bac65ba3f6@5b406aab-a1f1-4f13-a7aa-dd573da3d332

Registration link for May 27th, 2026: https://events.teams.microsoft.com/event/52aec889-3d27-412e-b22f-905623a074a8@5b406aab-a1f1-4f13-a7aa-dd573da3d332

Academic Credits

DAuSy and PoliBa PhD students will be awarded ECTS credits for attending the seminars, in accordance with the PhD School's educational regulations.

Organising Committee

Prof. M. Dotoli, Prof. A. Cavallo, Prof. L. Giarrè, Prof. F. Pascucci, Prof. R. Carli

Contact & Info

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Visit the DAuSy website: https://dausy.poliba.it/

Technical Sponsors

PROGRAM

May 13, 2026 – Chair: Prof. L. Giarrè (Università di Modena e Reggio Emilia)

Speaker	Title
ABDELILAH BENREKIA (*Università degli Studi di Palermo*)	DC-Link Voltage Balancing in Three-Level NPC Inverters Using a PI–FORE Controller
IACOPO CAPOROSSI (*Università degli Studi di Siena*)	A nonlinear dynamic approach to the symptoms graph
JALEH FARMANI (*Università degli Studi di Roma "Tor Vergata"*)	FATS-V: Fusion by Agreement with Trust Scaling and Verification for Robust RGB--Thermal Object Detection
KIROLOS ROMANY ANWAR KAMEL (*Università degli Studi di Roma "La Sapienza"*)	Future GNSS In Space Measurements processing from LEO
FEDERICO PARMA (*Università degli Studi di Brescia*)	Embedding ISO 10218 Safety Compliance via Control Barrier Functions in Human-Robot Collaboration
FRANCESCO TUCCI (*Università degli Studi della Campania Vanvitelli*)	Model-reference data-driven control of switched linear systems: a preliminary study

May 20, 2026 – Chair: Prof. A. Cavallo (Università degli Studi della Campania "L. Vanvitelli")

Speaker	**Title**
CARLO BARBARA (*Politecnico di Torino*)	Control and Optimization Approaches for Fuel-Optimal Lunar Landing
ANDREA CASTELLANETA (*Politecnico di Bari*)	Servo-muscles for human-centric robotics
ANGELO CATALANO (*Politecnico di Bari*)	Robots-as-a-service in the digital industry
MUHAMMAD NOUMAN (*Politecnico di Bari*)	iBeacon Presence and Motion State Estimation from Irregular BLE Advertisement Logs
FEDERICO SIGNORILE (*Politecnico di Bari*)	Priority-Based Centralized Coordination of Multiple AGVs in Automated Warehouses
ANTONIO SPALLONE (*Università degli Studi di Napoli Federico II*)	Feedback control of a recirculating bioreactor with electrophoretic removal of inhibitory extracellular DNA

May 27, 2026 – Chair: Prof. F. Pascucci (Università Roma Tre)

Speaker	**Title**
ALESSANDRO ADAMI (*Università degli Studi di Padova*)	Neuro-Symbolic Robotic Planning: Intent-Driven Behavior Tree Synthesis and Synthetic Supervision
FABIO MASTROMARINO (*Politecnico di Bari*)	Efficient 3D Data Processing: Real-Time Geometric Extraction for Robotic Perception
ALELIGNE YOHANNES SHIFERAW (*Politecnico di Bari*)	Modelling and analysis of Rate-Dependent Indentation of Soft Materials for Smart Sensors and Soft Robotics
LUDOVICO DINDELLI (*Politecnico di Bari*)	An Adaptive Wavelet Approach for Denoising IFOG and MEMS Gyroscopes
ANTONELLO LONGO (*Politecnico di Bari*)	Distributed open-vocabulary autonomous navigation: from semantic-aware spatial perception to mission autonomy
SIMONA MONFREDA (*Politecnico di Bari*)	Explainable Transformer-Based Decision Support Systems for Dermatology

ABSTRACT

May 13, 2026 – Chair: Prof. L. Giarrè (Università di Modena e Reggio Emilia)

ABDELILAH BENREKIA (*Università degli Studi di Palermo*)

DC-Link Voltage Balancing in Three-Level NPC Inverters Using a PI-FORE Controller

This work focuses on a DC-link voltage balancing strategy for a three-phase neutral point clamped (NPC) inverter controlled by space vector PWM. A hybrid controller combining a proportional–integral (PI) regulator and a first-order reset element (FORE) is developed to improve transient response while ensuring stability. The approach operates at the duty-cycle allocation stage, exploiting redundant switching states without modifying the reference voltage. Experimental results demonstrate effective voltage regulation and improved system performance.

IACOPO CAPOROSSI (*Università degli Studi di Siena*)

A nonlinear dynamic approach to the symptoms graph

Over the last decade, complex dynamical systems approaches have significantly advanced the understanding of psychopathology. These models have effectively described phenomena such as hysteresis, by analyzing asymmetry in transitions between stable states; critical slowing down, which captures a system's loss of resilience; and deterministic chaos, reflecting sensitivity to initial conditions.

Parallel to these developments, the network approach has emerged as a key paradigm, conceptualizing mental disorders as graphs where symptoms act as nodes and their interactions represent edges. This framework links psychological transitions to graph properties like connectivity.

Building upon these foundations, the research conducted thus far aimed to identify and characterize, through a simulation-based study, a dynamical system that simultaneously exhibits hysteretic behavior and a metastable regime. By exploring the interplay between these two phenomena, we sought to better understand the mechanisms underlying the persistence of symptoms and the non-equilibrium dynamics between different psychological states.

More recently, our focus has shifted toward the empirical application of these concepts, specifically exploring how such complex dynamics can be verified within Ecological Momentary Assessment (EMA) datasets.

In our preliminary analysis of empirical data, we constructed a dynamic network based on the synchrony in the rate of change of questionnaire items. Within this framework, we quantified quasi-stationary regions—defined as metastates—for individual items using recurrence

quantification analysis (RQA) and Markovian optimization. Our findings revealed that an abrupt increase in the average degree of the network, coupled with a decrease in the correlation between node degree and the number of metastable states, preceded the depressive transition identified by the mean SCL-90 score.

Currently, we are developing a methodology to identify hysteretic regimes within the same EMA dataset. This approach utilizes Cross Recurrence Quantification Analysis (CRQA) to uncover the variable-parameter relationships among questionnaire items, ultimately aiming to estimate the resulting bifurcation diagram. By mapping these transitions, we seek to provide a robust empirical framework for detecting how shifting interactions between symptoms can trigger sudden and persistent changes in mental health states.

JALEH FARMANI (*Università degli Studi di Roma "Tor Vergata"*)

FATS-V: Fusion by Agreement with Trust Scaling and Verification for Robust RGB--Thermal Object Detection

Late fusion of RGB and infrared detections offers a detector-agnostic path to multi-sensor object detection, yet existing methods treat all fused clusters uniformly despite their fundamentally different reliability profiles. We show that weighted box fusion partitions detections into two structurally distinct cluster types: agreed clusters, where both sensors independently fire on the same region, and single-modal clusters, where only one sensor fires; their baseline precisions differ by up to 25 percentage points on our test sets. Building on this observation, we propose FATS-V (Fusion by Agreement with Trust Scaling and Verification), a two-stage confidence modulation framework that routes each cluster to a dedicated gating mechanism. Agreed clusters are rescaled by a lightweight logistic gate trained on two score features, achieving AUC=0.90 with negligible complexity. Single-modal clusters are processed by a cross-modal patch verifier that encodes firing and silent sensor crops through a shared contrastive encoder and combines visual embeddings with ten scalar context features to estimate true-positive probability. We evaluate FATS-V on four RGB+IR datasets spanning automotive, surveillance, and multi-class scenarios: M3FD (random and scene-aware splits), FLIR, and LLVIP. FATS-V achieves F1-scores of 84.62\%, 76.24\%, 82.07\%, and 94.26\% on these datasets respectively, with false positive counts of 545, 1069, 1293, and 282, representing reductions of 23–49\% over the WBF baseline while consistently outperforming all other fusion baselines including NMS fusion, average fusion, and ProbEn. On LLVIP, FATS-V also improves mAP50 to 96.68\%, confirming that confidence modulation benefits the full precision-recall curve and not only the operating point. We further demonstrate that at equal false positive budget, the cross-modal verifier preserves 2.4× more true positives than a global confidence threshold, providing empirical justification that the system exploits genuine cross-modal evidence rather than simple score re-thresholding.

KIROLOS ROMANY ANWAR KAMEL (*Università degli Studi di Roma "La Sapienza"*)

Future GNSS In Space Measurements processing from LEO

This study investigates the use of GNSS receivers onboard LEO satellites, focusing on advanced timekeeping through the application of the Greenhall Kalman filter. Onboard PVT-derived time biases are processed by the filter to optimally estimate an implicit timescale for future LEO constellations, effectively mitigating the impact of noisy clock measurements. By referencing the estimated LEO timescale, the filter enables precise determination of the temporal deviation 8 System Time (GST).

FEDERICO PARMA (*Università degli Studi di Brescia*)

Embedding ISO 10218 Safety Compliance via Control Barrier Functions in Human-Robot Collaboration

This work embeds ISO 10218 SSM safety directly into robot control using Control Barrier Functions. Instead of relying on instantaneous distance, it evaluates a hypothetical stopping trajectory accounting for human velocity and acceleration to predict true minimum separation. An optimal controller uses trajectory scaling and tube constraints to deviate safely while preserving path fidelity. Tests show a 63% error reduction over standard PD control methods.

FRANCESCO TUCCI (*Università degli Studi della Campania Vanvitelli*)

Model-reference data-driven control of switched linear systems: a preliminary study

In this presentation, we propose a preliminary study for the design of an adaptive data-driven control law for solving the model-reference problem of an unknown switched system.

The proposed strategy aims to regulate the switched system such that the closed-loop behavior matches the desired dynamics defined by a reference model. By treating the switching signal as an external disturbance with sufficiently long dwell times between consecutive switching instants, we develop a model-reference design procedure that provides stability guarantees. Finally, simulation results demonstrate the effectiveness of the proposed approach.

May 20, 2026 – Chair: Prof. A. Cavallo (Università degli Studi della Campania "L. Vanvitelli")

CARLO BARBARA (*Politecnico di Torino*)

Control and Optimization Approaches for Fuel-Optimal Lunar Landing

Research activities focus on the pin-point lunar landing problem with optimal fuel consumption. Beyond convex optimization approaches via SOCP, tracking MPC with multiple waypoints has been investigated. Finally, Economic MPC is addressed, shifting the focus from reference tracking to performance optimization, and emphasizing the construction of Lyapunov-like storage functions to enforce dissipativity, ensuring stability, feasibility, and convergence of the closed-loop system.

ANDREA CASTELLANETA (*Politecnico di Bari*)

Servo-muscles for human-centric robotics

Wearable robots span from haptics to assistance using many technologies. Motor-tendon systems are the state of the art for exosuits and other rehabilitative devices for their reliability, high torque and power density. Our body is compliant, and backdrivable high-torque motors have a bulky form factor. This presentation is about using electrofluidic fiber artificial muscles for wearable assistive garments. An example of artificial muscle and its position control will be presented.

ANGELO CATALANO (*Politecnico di Bari*)

Robots-as-a-service in the digital industry

This research develops a Robot-as-a-Service framework combining soft grippers, AI, and LLMs for flexible industrial automation. Current work focuses on Electroadhesion Suction Cups: a physics-based model predicts the minimum activation voltage for grasping curved objects from local surface curvature, validated experimentally. This enables curvature-driven grasp planning, a key step toward vision-based autonomous manipulation.

MUHAMMAD NOUMAN (*Politecnico di Bari*)

iBeacon Presence and Motion State Estimation from Irregular BLE Advertisement Logs

This study introduces a framework for processing Bluetooth Low Energy (BLE) advertisement logs acquired through Linux-based scanning utilities and Message Queuing Telemetry Transport (MQTT) pipelines. Preprocessing challenges, including control character contamination, syntactically irregular JavaScript Object Notation (JSON) payloads, and inconsistent Media Access Control (MAC) address representations, are resolved through log sanitization, event classification, and session reconstruction. iBeacon identifiers are extracted, Received Signal

Strength Indicator (RSSI) measurements are discretized into proximity classes, and device motion state is estimated using Median Absolute Deviation (MAD)-based analysis.

FEDERICO SIGNORILE (*Politecnico di Bari*)

Priority-Based Centralized Coordination of Multiple AGVs in Automated Warehouses

Conflict and deadlock prevention in automated warehouses requires scalable coordination methods for multiple AGVs operating on shared transportation resources. This seminar presents centralized priority-based continuous-time multi-agent path finding methods for AGV coordination, and examines whether these approaches are mature enough to become state-of-the-art industrial solutions for traffic control, as well as the main gaps that still limit their adoption.

ANTONIO SPALLONE (*Università degli Studi di Napoli Federico II*)

Feedback control of a recirculating bioreactor with electrophoretic removal of inhibitory extracellular DNA

We study feedback control of a continuous bioreactor with a recirculating loop, where extracellular DNA accumulates and inhibits microbial growth. An electrophoretic filtration unit is used for selective DNA removal. We compared two control strategies, adaptive UKF–MPC and a simpler bang–bang/lookup policy, using cumulative profit as the main metric. Both kept DNA below inhibitory levels, but UKF–MPC achieved better economic performance.

May 27, 2026 – Chair: Prof. F. Pascucci (Università Roma Tre)

ALESSANDRO ADAMI (*Università degli Studi di Padova*)

Neuro-Symbolic Robotic Planning: Intent-Driven Behavior Tree Synthesis and Synthetic Supervision

This research presents a unified neuro-symbolic framework for autonomous robotic control that bridges the gap between high-dimensional multimodal perception and structured, interpretable execution. Traditional robotic architectures typically struggle with the opaque nature of end-to-end motor policies or the rigidity of pre-programmed routines. This work overcomes these limitations by specializing Vision-Language Models to synthesize executable Behavior Trees directly from natural language instructions and RGB observations. Central to this approach is a robust Sim-to-Real methodology that operates in two directions. First, an active perception Real2Sim pipeline allows a robot to autonomously plan contact-rich interactions to estimate unknown physical parameters, such as mass and friction, which are then used to instantiate high-fidelity digital twins. Second, a synthetic supervision strategy enables the model to internalize complex task logic by training on thousands of procedurally generated simulated scenes and automated symbolic annotations. By representing robot policies as hardware-agnostic symbolic trees rather than raw motor commands, the system achieves successful zero-shot transfer from simulation to physical manipulators. Experimental results on multiple robotic platforms demonstrate that this framework ensures task-level reactivity and logical consistency, providing a scalable and verifiable path for deploying foundation models in unstructured, real-world environments without the need for manual real-world data collection.

FABIO MASTROMARINO (*Politecnico di Bari*)

Efficient 3D Data Processing: Real-Time Geometric Extraction for Robotic Perception

This seminar introduces a real-time pipeline for planar surface extraction from 3D point clouds. Integrating robust estimation with high-speed spatial clustering, the architecture isolates physical instances with ultra-low latency on standard CPUs. This methodology abstracts massive point sets into lightweight geometric primitives, significantly reducing computational overhead to facilitate high-frequency obstacle avoidance and scene understanding in robotic applications.

ALELIGNE YOHANNES SHIFERAW (*Politecnico di Bari*)

Modelling and analysis of Rate-Dependent Indentation of Soft Materials for Smart Sensors and Soft Robotics

This work presents a unified viscoelastic contact framework for the indentation of soft materials based on a modified power-law relaxation model. Finite-element simulations validate the analytical solutions for spherical and conical indenters under ramp and triangular loading

conditions. The framework captures rate-dependent force response, apparent modulus, and hysteresis, offering a useful tool for the mechanical characterization of soft materials used in smart sensors, wearable devices, soft robotics, and biological interfaces.

LUDOVICO DINDELLI (*Politecnico di Bari*)

An Adaptive Wavelet Approach for Denoising IFOG and MEMS Gyroscopes

We propose an Adaptive Threshold Wavelet (ATW) algorithm designed for the real-time denoising of gyroscopic signals. Unlike conventional methods that assume Gaussian noise, the ATW models sensor-specific noise using a Generalized Gaussian Distribution (GGD). The core innovation lies in a dynamic thresholding strategy: an adimensional parameter K quantifies signal discontinuities, allowing the algorithm to automatically lower the threshold during rapid angular variations to preserve critical signal details. Experimental results on IFOG and MEMS sensors demonstrate that ATW achieves a signal-to-noise ratio (SNR) enhancement of up to 12.4 dB. It consistently outperforms Kalman filters and standard wavelet techniques, particularly in dynamic environments and non-Gaussian noise conditions.

ANTONELLO LONGO (*Politecnico di Bari*)

Distributed open-vocabulary autonomous navigation: from semantic-aware spatial perception to mission autonomy

In the presentation I will cover the 3 main aspects to enable autonomous systems in accomplishing spatially distributed tasks based on open-vocabulary commands (work I developed at NASA JPL and now at FieldAI). The first thing is how to build a semantic rich representation of the world that the robot can use to navigate, the second is how to enable attention-based trajectory prediction on moving objects for a smart follow me and the third is how to build the whole brain of the robot in a mission autonomy framework for complex structured multi-robot missions.

SIMONA MONFREDA (*Politecnico di Bari*)

Explainable Transformer-Based Decision Support Systems for Dermatology

The research work focuses on intelligent decision support systems integrated with telemedicine within a proximity healthcare framework for dermatology. First, transformer-based models for skin lesion classification are investigated to assess how they can combine diagnostic performance with explainability. Then, qualitative and quantitative analyses are used as key tools to improve transparency, strengthen clinical trust, and support decision-making.