FEBRUARY 2026

Decision & Control Laboratory

Politecnico di Bari — Department of Electrical and Information Engineering

D&C Lab

Politecnico di Bari

DEI DIPARTIMENTO DI INGEGNERIA ELETTRICA E DELL'INFORMAZIONE

http://dclab.poliba.it

https://www.linkedin.com/company/dandclab

https://www.youtube.com/channel/UCrroEhmYOtc2QACICqIsOkw

https://www.instagram.com/dandclab/

POLITECNICO DI BARI

WHERE ARE WE?

Italy → Apulia → Bari & Taranto

The heel of the Mediterranean boot

Italy & Apulia — where we are

Southern Italy — Apulia region

The heel of the boot

Italy

3rd largest economy in the Eurozone · 60M inhabitants

G7 member

Home of 3 world-class Polytechnics: Milan, Turin, **Bari**

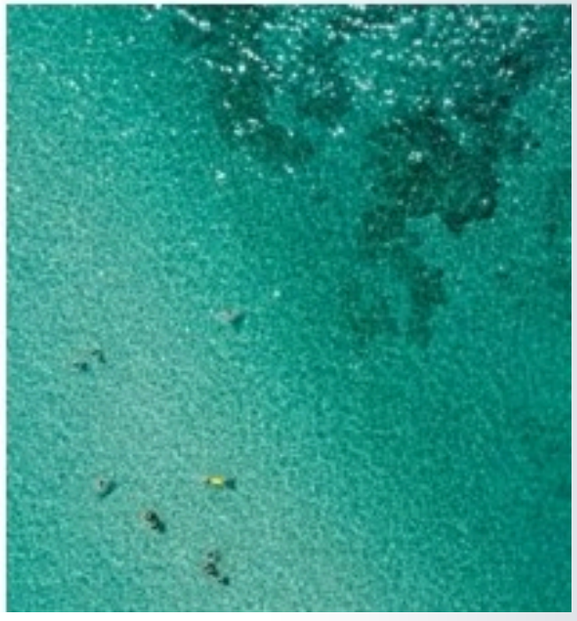
Strategic location

Center of the Mediterranean

Gateway between Western Europe and the Middle East

330k
Bari — regional capital

~80km
Bari → Taranto

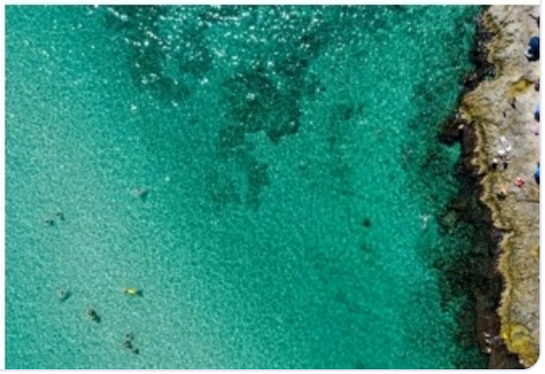


LIVING & STUDYING

DISCOVER APULIA

Mediterranean soul · Extraordinary landscapes · World-class cuisine · Low cost of living

Apulia — a land of culture & innovation



Landscape

Trulli of Alberobello, white towns of Valle d'Itria, beaches, National Parks

History & Culture

Greek, Roman, Norman and Byzantine heritage

Castel del Monte — Frederick II's 13th-century masterpiece

Growing tech scene

Emerging startup ecosystem

Smart specialization in agritech, energy transition & advanced manufacturing

Student life

Cost of living among the lowest in Italy

Vibrant nightlife in Bari old town

Easy travel across Europe

800km	**3**	**#1**	**4M**
of coastline	UNESCO World Heritage Sites	Italian olive oil production	tourists per year

Life in Apulia — food & Mediterranean living

A UNESCO Intangible Heritage cuisine

The Mediterranean diet was inscribed in 2010 — Apulia is its heartland

- Orecchiette pasta
- Burrata & Stracciatella
- Taralli
- Primitivo wine
- Extra-virgin olive oil
- Focaccia barese

Bari Vecchia (Old Town)

Labyrinthine alleys
Basilica di San Nicola
Fresh pasta made in the streets

Cost of living

Among the lowest in Italy
Student apartments from €300/month
Restaurant meal from €12
Rich public transport network

REGIONAL CAPITAL

BARI

Where tradition meets innovation
on the Adriatic coast

Bari — city profile

330k
inhabitants
Metro area: 1.3M

50k+
university students
across 3 institutions

300
sunny days/year

Transport hub
Bari Airport · 50+ direct routes · High-speed rail: Rome 3h, Naples 2h, Milan 5h

University & culture
3 major universities · Vibrant Bari Vecchia old town · Active cultural & social scene

Economy & innovation
Major Adriatic seaport

Growing tech sector · HQ of major Italian companies & startups

ITALY · APULIA · BARI

POLITECNICO DI BARI

The third Polytechnic in Italy

Founded 1990 · Engineering, Architecture & Design

Politecnico di Bari — a bit of history

1947 — **Engineering Faculty** established at Università degli Studi di Bari

1990 — **Architecture added — Politecnico di Bari is founded** as an autonomous institution

1997 — **Management Engineering** — expanding the offer

2002 — **Industrial Design** — creative & product design

2022 — **Digital Transformation** — latest degree programme

3rd Polytechnic in Italy

After Politecnico di Milano and Politecnico di Torino

Specialized in Engineering, Architecture and Industrial Design

Politecnico di Bari — some numbers

400
Lecturers
+40% in 5 yrs

250
Admin & technical staff

12k
Students

5
Departments
2 ANVUR Excellent

30
Degrees BSc & MSc

10
PhD programs

Enrollment growth
+50% enrollments over the last 10 years
3,342 new students in 2024/25

Staff growth
Teachers grew from 289 (2015) to 411 (2024) — a 42% increase driven by new hires and research funding

Research excellence
DMMM and DICATECh rated *Excellent* by ANVUR
Strong EU project portfolio (Horizon, PRIN, PON)

Politecnico di Bari — departments

ArCoD
Architecture, Construction and Design

DEI
Electrical and Information Engineering
Our department

DICATECh
Civil, Environmental, Land, Construction Eng. & Chemistry

DMMM
Mechanical Engineering, Mathematics and Management

DIF
Physics (joint Dept. with University of Bari)

Explore the full range of research activities, labs, and interdisciplinary centres

Research Catalogue ↗

Politecnico di Bari — graduate outcomes

AVG. GRADUATION AGE

24.8 Poliba vs 25.8 Italy avg.

12 months lower than national average

Source: AlmaLaurea 2025

EMPLOYMENT RATE
1 YEAR AFTER GRADUATION

91%

3rd Italian state university
+25% in the last 10 years

Source: AlmaLaurea 2025

FEMALE GRADUATES SALARY
VS NATIONAL AVERAGE

+13%

Poliba female graduates earn significantly more than peers

Source: AlmaLaurea 2023 (5 yrs after graduation)

Employability trend
growing from 67% (2014) to 91% (2024), closing the gap with Polimi and Polito

Gender outcomes
female graduates consistently outperform national averages in salary and employment speed

SCUDO — The PhD School at Poliba

Management Engineering
DRIG

Design for Heritage
CTI

Mechanical and Energy Engineering
DRIME

Sustainability Engineering & Civil Building
DRISS — Joint PhD

Engineering and Aerospace Sciences
DRISA — Inter-university with Univ. Bari

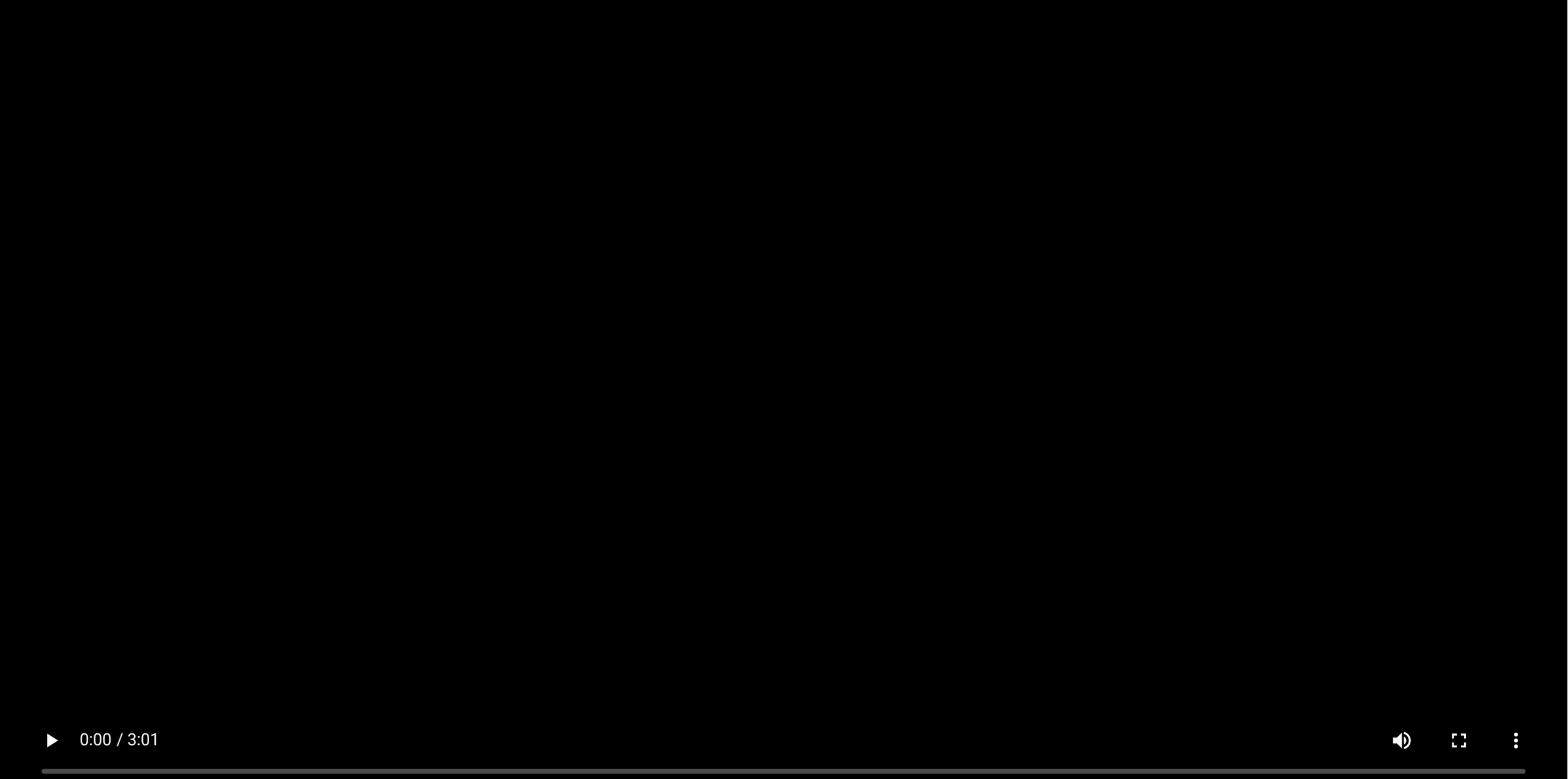
Risk and Environmental Development
DRSATE

Change Management in Civil Engineering
CMCEI — Industrial PhD with Acquedotto Pugliese

Smart and Sustainable Industry
SSI — Inter-university with Univ. Bari, *Our Department*

Electrical and Information Engineering
DRIEI — *Our Department*

Autonomous Systems
DAUSY — National PhD, *Our Department*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POLITECNICO DI BARI

DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING

Department of Electrical and Information Engineering

The **DEI Department** is one of five departments at Politecnico di Bari, hosting over **100 faculty members** and a wide network of research laboratories spanning electronics, telecommunications, control systems, and computer science.

Core research areas include power electronics, optoelectronics, signal processing, telematics & 5G networks, IoT & Industry 4.0, robotics, and smart energy systems.

DEI maintains active collaborations with leading international institutions and companies including **Thales Alenia Space, Leonardo, Nokia, Samsung, TIM**, and the **European Space Agency**.

Power Electronics | **Optoelectronics** | **Signal Processing** | **5G & IoT** | **Control Systems** | **Smart Energy** | **Robotics** | **Network Security**

100+
Faculty members

15+
Research labs

50+
Industry partners

DEI — POLITECNICO DI BARI

DECISION & CONTROL LABORATORY

Systems · Control · Optimization · Decision-Making

Applied to energy, manufacturing, transport & robotics

D&CLab at a glance

12	300	31	3	28	28
Active Members	Publications	Projects	Open-Source Tools	Int'l Collaborations	Industry Partners

Research focus

Systems, control, optimization and decision-making applied to energy systems, smart manufacturing, transport networks and advanced robotics

Mission

Bridging theoretical foundations with real-world engineering challenges through interdisciplinary research, open-source tools and international collaboration

D&CLAB

OUR GROUP

Professors · Researchers · Engineers · PhD candidates

Faculty & senior researchers

FULL PROFESSORS

Mariagrazia Dotoli
Scientific Coordinator

ASSOCIATE PROFESSORS

Raffaele Carli
Technical Responsible

ASSISTANT PROFESSORS

Paolo Scarabaggio
Assistant Professor (RTD-a)

Nicola Mignoni
Assistant Professor (RTD-a)

Lab Head — Mariagrazia Dotoli

Full Professor, Systems and Control Engineering at Politecnico di Bari

Academic Leadership
Rector's Delegate for European and International Research (since 2025)
Vice Rector for Research (2012–2013)
Member Academic Senate (20212-2015)

Editorial Leadership
Appointed Editor in Chief IEEE T-ASE (2026–2031)
Senior Editor IEEE T-ASE
Associate Editor IEEE TCST · IEEE TSMC

Conference Leadership
General Chair IEEE CASE 2024
General Chair MED 2021
Program Chair IEEE CASE 2020 · Program Co-Chair IEEE SMC 2028

PhD Programs
DAUSY — National PhD Program in Autonomous Systems (Coordinator)
Industry 4.0 Inter-university PhD (Founder)
Smart and Sustainable Industry PhD

Academic Impact
300+ publications
100+ journal papers
1 book

Research Projects
Horizon 2020 · Horizon Europe
PRIN · National & Regional Projects
EU Expert Evaluator FP6, FP7, Horizon 2020 since 2003

Technical Committees
IFAC TC DES
IEEE CSS DES
IEEE SMC Technical Committees

Society Roles
President - Italian Society of Professors and Researchers in Automatica
IEEE Fellow
Member - AdCom, IEEE RAS
Vice President - Membership and Student Activities, IEEE SMCS

IEEE Robotics & Automation Society

Appointed Editor in Chief IEEE T-ASE

IEEE RAS AdCom

IEEE SMC Systems, Man, and Cybernetics Society

VP of the IEEE SMCS

Vice President for Membership and Student Activities

President of SIDRA

Italian Society of Professors and Researchers in Automatica

DAUSY

PhD Coordinator

National PhD Program in Autonomous Systems

PhD candidates

Mojtaba Porghoveh

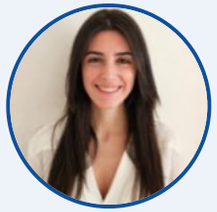
Angelo Catalano

Fabio Mastromarino

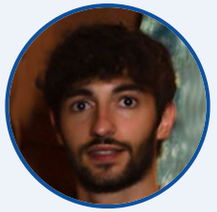
Federico Signorile

Maria Campobasso

Claudia Delprete

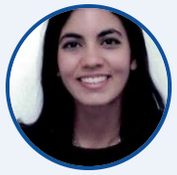


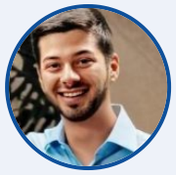
Valeriana Mancazzo



Pietro Maria Marvulli

Previous collaborators


Michela Prunella


Roberto Maria Scardigno


Graziana Cavone


Nicola Epicoco


Augusto Bozza


Seyed Mohsen Hosseini


Saba Askari Noghani


Roberta Pellegrino


Marco Falagario


Silvia Proia


Lucilla Dammacco


Giulia Tresca


Bahman Askari

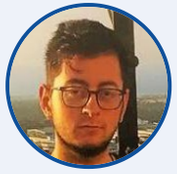

Fabio Sciancalepore


Martino Bruno


Marino Calefati


Claudio Manganiello


Virginia Montaruli


Giorgio Troccoli


Farideh Soheyli


Luigi Mazzoccoli


Silvia Stella

D&CLAB

RESEARCH NETWORK

Academic & industry collaborations spanning Europe, Asia and the Americas

Academic network

Academic partners

NL **Delft University of Technology**
Delft, Netherlands
Prof. Bart de Schutter · Railway transport optimization

NL **Delft University of Technology**
Delft, Netherlands
Prof. Sergio Grammatico · Game theory and applications

ES **Universitat Politècnica de Catalunya**
Barcelona, Spain
Prof. Carlos Ocampo-Martinez · Energy systems

CO **Universidad de los Andes**
Bogotá, Colombia
Prof. Nicanor Quijano · Energy systems

GB **University of Surrey**
Guildford, UK
Prof. Umberto Montanaro · Autonomous vehicles

FI **Aalto University**
Aalto, Finland
Prof. Valeriy Vyatkin · Industrial Automation

SE **Luleå University of Technology**
Luleå, Sweden
Prof. Valeriy Vyatkin · Industrial Automation

CN **Chinese Academy of Sciences**
Beijing, China
Prof. Fei-Yue Wang · Industrial Automation

JP **University of Tokyo**
Tokyo, Japan
Prof. Ryozo Ooka · Energy storage systems

FR **École Centrale de Lille**
Lille, France
Prof. Slim Hammadi · Co-modal transport systems

CN **Tsinghua University**
Beijing, China
Prof. Samuel Jia · Discrete event systems

SE **Chalmers University**
Chalmers, Sweden
Prof. Bengt Lennartson · Manufacturing systems scheduling

GB **University of Manchester**
Manchester, UK
Prof. Alessandra Parisio · Energy systems

ES **University of Zaragoza**
Zaragoza, Spain
Prof. Cristian Mahulea · Discrete event systems

PL **Cracow University of Technology**
Cracow, Poland
Prof. Lidia Żakowska · Transport optimization

DE **Helmut Schmidt University**
Hamburg, Germany
Prof. Alexander Fay · Factory automation

PL **AGH University of Science and Technology**
Cracow, Poland
Prof. Marek Miskowicz · Manufacturing systems control

US **New Jersey Institute of Technology**
Newark, USA
Prof. MengChu Zhou · Distributed production systems

FR **Université de Lorraine**
Metz, France
Prof. Antoine Salvatore Tabbone · Pattern recognition

FR **Aix-Marseille Université**
Marseille, France
Prof. Alessandro Giua · Discrete event systems

IT **Università di Cagliari**
Cagliari, Italy
Prof. Carla Seatzu · Intermodal terminals

IT **University of Genoa**
Genoa, Italy
Prof. Roberto Sacile · Rural systems

IT **University of Genoa**
Genoa, Italy
Prof. Michela Robba · Sustainable systems

DK **Danish Technical University**
Copenhagen, Denmark
Prof. J. Jantzen · Fuzzy systems and control

DE **RWTH Aachen University**
Aachen, Germany
Prof. D. Graf von Kaiserlingk · Soft computing in medicine

FR **Université Paris 7**
Paris, France
Prof. B. Bouchon-Meunier · Fuzzy systems and control

IT **University of Trieste**
Trieste, Italy
Prof. Ukovich · Healthcare and intermodal logistics, discrete event systems

US **Georgia Institute of Technology (Georgia Tech)**
Atlanta, USA
Prof. S. Reveliotis · Discrete event systems

Industry partners & consultancies

D&CLAB

RESEARCH PROJECTS

National, international & industry-funded projects

Selected projects

[CONSENSUS] Control and Optimization of Networked Smart ENergy Systems through User-driven and Sustainability-oriented strategies
National 2026–2031

[CORRECT] COntrol of RuRal Energy CommuniTies
National 2023–2026

[MAIA] Railway infrastructure active monitoring
National 2019–2022

[LAMRECOR] Advanced Logistics for the Mobility of people and freight
National 2010–2013

[Heavy Duty] Innovative System for Heavy-Duty engines
National 2000–2006

[UCCSM] Urban Control Center for the sustainable management of energy flows in Metropolitan Smart Cities
Regional 2016–2019

[NEST] Network for Energy Sustainable Transition
National 2023–2026

[PICO&PRO] Integrated and connected processes for the industrial production evolution
National 2018–2022

[RES NOVAE] Networks, Buildings, Roads: New virtuous objectives for the Environment and Energy
National 2012–2015

[PRIN-COFIN 2007] Decision models for design and management of logistic networks
National 2007–2009

[SIDART] Integrated system for artistic goods diagnosis
National 2002–2005

[SEMINA] Evolved Systems for the Intelligent Mobility in Urban Agile Networks
Regional 2014–2015

[MICS] Circular and Sustainable Made in Italy
National 2023–2026

[RAFAEL] System for Risk Analysis and Forecast for critical infrastructure in the ApenninEs dorsaL Regions
National 2018–2021

[ERMES] Enhance Risk Management through Extended Sensors
National 2012–2015

[LISAR] Intersectorial Scientific Laboratory of Automation and Robotics
National 2000–2006

[DC-ECO] Decision and Control algorithms for flexible and efficient Energy COmmunities
Regional 2020–2023

[MinD] Mine Detection
Regional 2013–2014

D&CLAB

OPEN-SOURCE TOOLS

Software packages, simulators & datasets released to the community

Tools & resources

monviso package — active

Monviso.jl package — active

COVID-19 Dashboard dashboard — closed

D&CLAB

EVENTS & WORKSHOPS

Organized conferences, tutorials & special sessions

Organized events

2026-09-21 SCHOOL

SMC Summer School 2026

— Xi'an, China

Visit ↗

2026-01-19 SCHOOL

DAUSY Winter School 2026

— Bari, Italy

Visit ↗

2025 CONFERENCE

IFAC SENSYS 2025

— Bari, Italy

Visit ↗

2025 WORKSHOP

WIS 2025

— Bari, Italy

Visit ↗

2024 CONFERENCE

IEEE CASE 2024

— Bari, Italy

Visit ↗

2021 CONFERENCE

MED 2021

— Bari, Italy

Visit ↗

Workshops & special sessions

2026

Workshop IEEE CDC 2026

Co-STEM - Control for complex Socio-Technical systEMs

65th IEEE Conference on Decision and Control (CDC 2026)

Visit ↗

2026

Tutorial IEEE SMC 2026

NODES - Non-centralized Optimization for Distributed Energy Systems

2026 IEEE International Conference on Systems, Man, and Cybernetics (SMC 2026), October 4–7, 2026, Bellevue, WA, USA

Visit ↗

2026

Workshop IFAC WC 2026

Decision and Control Techniques for Power, Energy, and Sustainability

23rd IFAC World Congress, August 23-28, 2026, Busan, Republic of Korea

Visit ↗

2026

Special session IFAC WC 2026

Modeling, Control, and Design of Next-Generation Rural and Agricultural Energy Systems

23rd IFAC World Congress, August 23-28, 2026, Busan, Republic of Korea

Visit ↗

2025

Tutorial IEEE SMC 2025

Distributed Optimization for Energy Systems

2025 IEEE International Conference on Systems, Man, and Cybernetics (SMC), October 5–8, 2025, Vienna, Austria

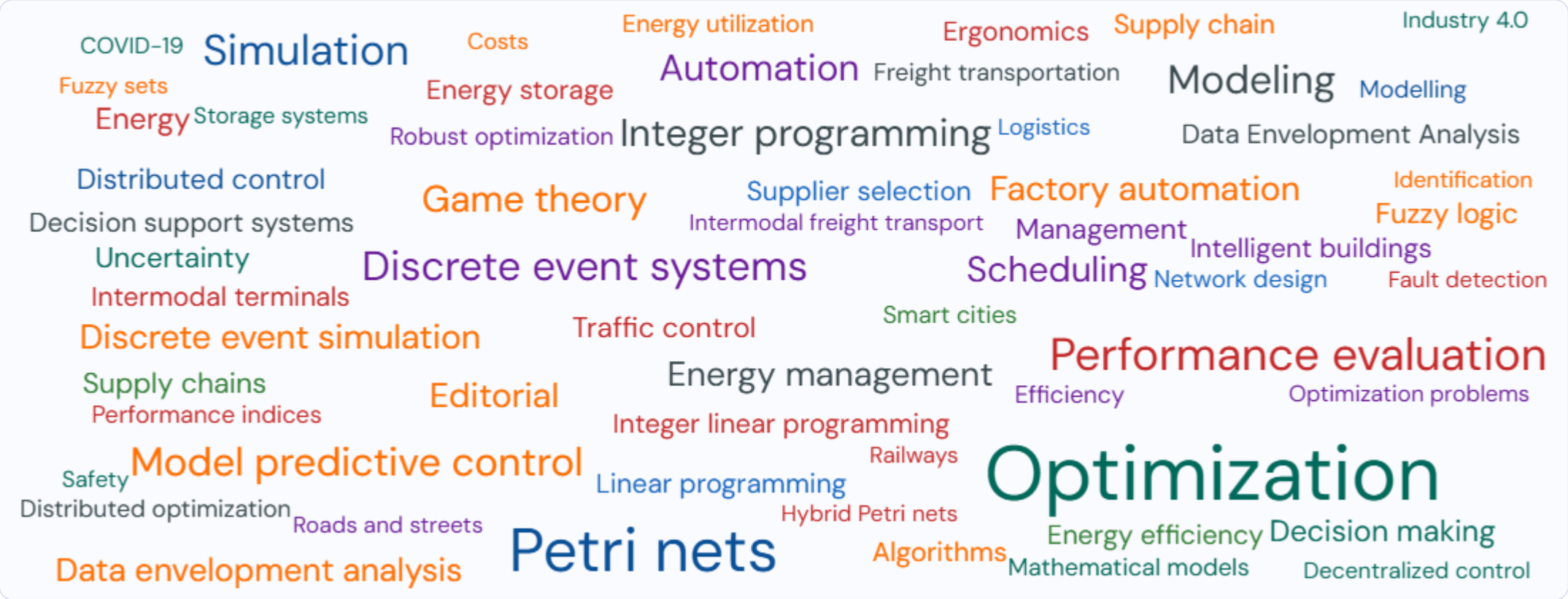
Visit ↗

D&CLAB

RESEARCH AREAS

Seven core scientific directions driving our work

Research keywords



Smart Energy Systems

Optimization and control of smart energy networks and energy communities

SELECTED SUBTOPICS

- Model Predictive Control for Energy Systems
- Photovoltaic System Optimization
- Decentralized Energy Community Control

RECENT PUBLICATIONS

Optimal Solar Tracking for Sustainable Crop Cultivation and Energy Generation in A...
2025 IEEE Conference on Control Technology and Applications, CCTA 2025 · 2025
Nicola Mignoni; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Decentralized Control of Crop Growth Conditions in Vertical Farms Under Dynamic En...
IEEE Transactions on Automation Science and Engineering · 2025
Kirill Zhukovskii; Paolo Scarabaggio; Polina Ovsiannikova; Pranay Jhunjhunwala; Raffaele Carli; Mariagrazia Dotoli; Valeriy Vyatkin

A Matheuristics for the Configuration of Automated Vertical Lift Modules Warehouse...
IEEE Transactions on Automation Science and Engineering · 2025
Giulia Tresca; Graziana Cavone; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Distributed Model Predictive Control for Real-Time Automatic Train Regulation of M...
IEEE Transactions on Automation Science and Engineering · 2025
Yin Tong; Graziana Cavone; Jiate Luo; Carla Seatzu; Mariagrazia Dotoli

Layout Optimization for Photovoltaic Panels in Solar Power Plants via a MINLP Appr...
IEEE Transactions on Automation Science and Engineering · 2025
Nicola Mignoni; Raffaele Carli; Mariagrazia Dotoli

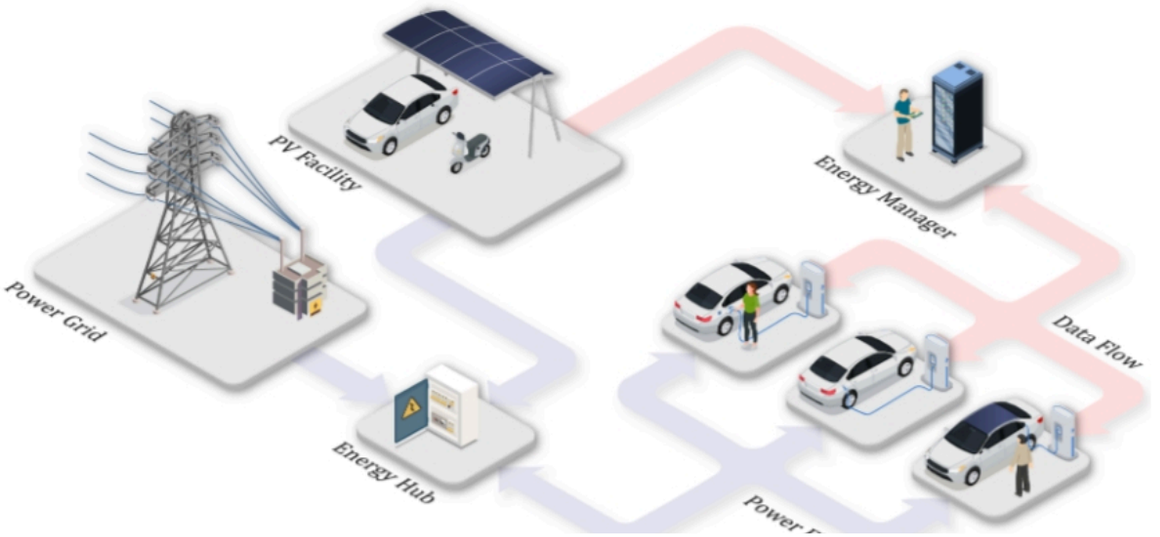
Smart Energy Systems – Model Predictive Control for Energy Systems

Challenge: Energy systems with renewable generation and storage require real-time optimal control under uncertainty.

MPC Framework:

- Predictive scheduling
- Robust MPC for microgrids under renewable and load uncertainty
- Rolling horizon optimization with forecast adaptation
- Field validation: cost reduction, energy demand reduction

Innovation: Integration of forecast models with optimization for real-time deployment.



SELECTED PUBLICATIONS

- *Noghani et al., "Predictive energy scheduling of smart parking infrastructure with solar-powered electric vehicles," IFAC Journal of Systems and Control, 2025.*
- *Scarabaggio, Paolo, et al. "Distributed demand side management with stochastic wind power forecasting." IEEE Transactions on Control Systems Technology 30.1 (2021).*

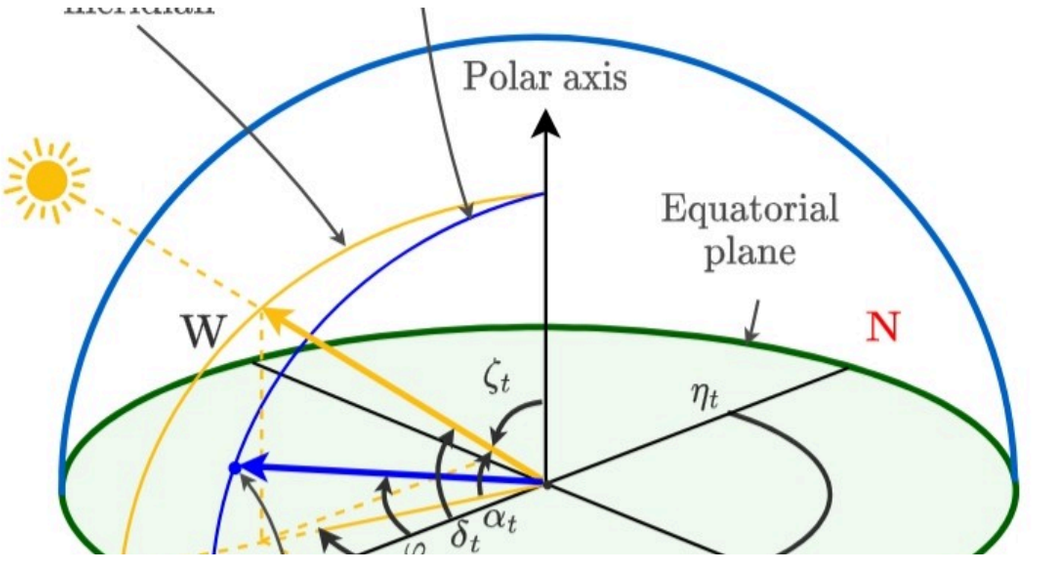
Smart Energy Systems – Photovoltaic System Optimization

Design Challenge: Optimal PV array layout requires modeling self-shadowing, irradiance variability, and geographical constraints.

Mathematical Approach:

- MINLP formulation with astronomical and geometrical models
- Tight parametrized convex relaxation for tractability
- Agrivoltaic optimization: crop yield vs. energy generation trade-off
- Near-optimal solutions in reduced computational time

Applications: Solar power plants, agrivoltaic systems, building-integrated PV.



SELECTED PUBLICATIONS

- *Mignoni et al., "Layout Optimization for Photovoltaic Panels in Solar Power Plants via a MINLP Approach," IEEE Transactions on Automation Science and Engineering, 2025.*
- *Mignoni et al., "An Overview on Non-centralized Control of Multi-energy Systems for the Optimal Operations of Energy Communities," Green Energy and Technology, 2025.*

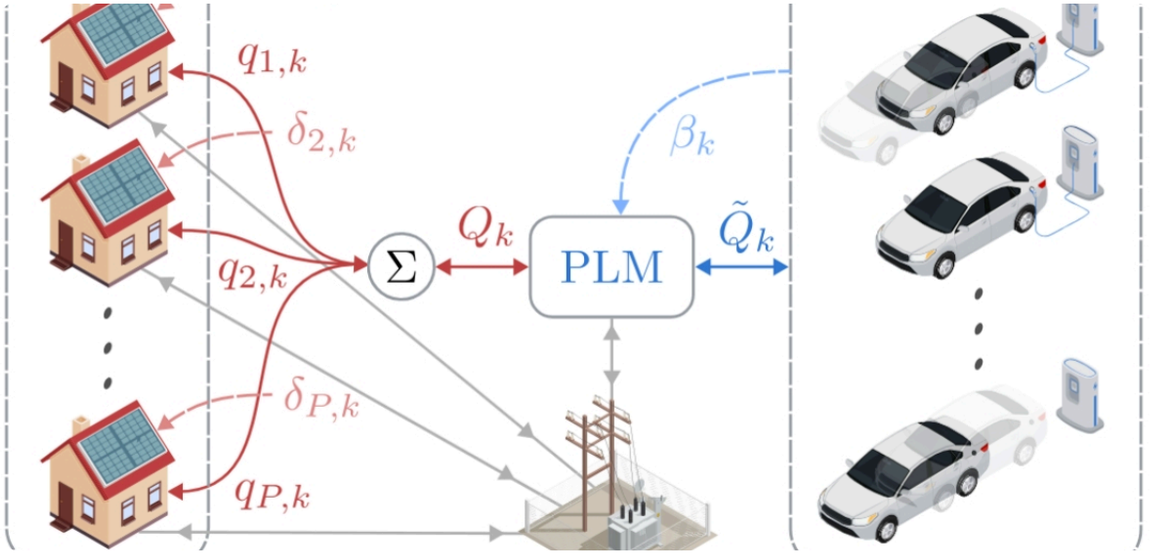
Smart Energy Systems – Decentralized Energy Community Control

Coordination Problem: Energy communities with shared resources require distributed control respecting individual autonomy.

Game-Theoretic Solutions:

- GNEP formulations for energy sharing and storage services
- Decentralized demand response via multi-block ADMM
- Transactive energy frameworks with price-based coordination
- Battery degradation control in shared storage systems

Impact: Enables scalable, privacy-preserving energy community operation.



SELECTED PUBLICATIONS

- *Mignoni, Nicola, et al. "Control frameworks for transactive energy storage services in energy communities." Control Engineering Practice 130 (2023): 105364.*
- *Mignoni et al., "Distributed Noncooperative MPC for Energy Scheduling of Charging and Trading Electric Vehicles in Energy Communities," IEEE Transactions on Control Systems Technology, 2023.*

Agricultural Automation

Automation and control of smart agricultural systems, agrivoltaics, and vertical farms

SELECTED SUBTOPICS

Agrivoltaic System Optimization | Vertical Farm Energy Management

RECENT PUBLICATIONS

Optimal Solar Tracking for Sustainable Crop Cultivation and Energy Generation in A...
2025 IEEE Conference on Control Technology and Applications, CCTA 2025 · 2025
Nicola Mignoni; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Decentralized Control of Crop Growth Conditions in Vertical Farms Under Dynamic En...
IEEE Transactions on Automation Science and Engineering · 2025
Kirill Zhukovskii; Paolo Scarabaggio; Polina Ovsiannikova; Pranay Jhunjhunwala; Raffaele Carli; Mariagrazia Dotoli; Valeriy Vyatkin

Generalized Nash Equilibrium Seeking for Crop Mix Selection in Sustainable Agricul...
2024 7th IEEE International Humanitarian Technologies Conference, IHTC 2024 · 2024
Nicola Mignoni; Paolo Scarabaggio; Sonia Marina Caselli; Raffaele Carli; Mariagrazia Dotoli

Energy Consumption Optimisation for Horticultural Facilities
IEEE International Conference on Emerging Technologies and Factory Automation, ETFA · 2024
Kirill Zhukovskii; Polina Ovsiannikova; Pranay Jhunjhunwala; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli; Valeriy Vyatkin

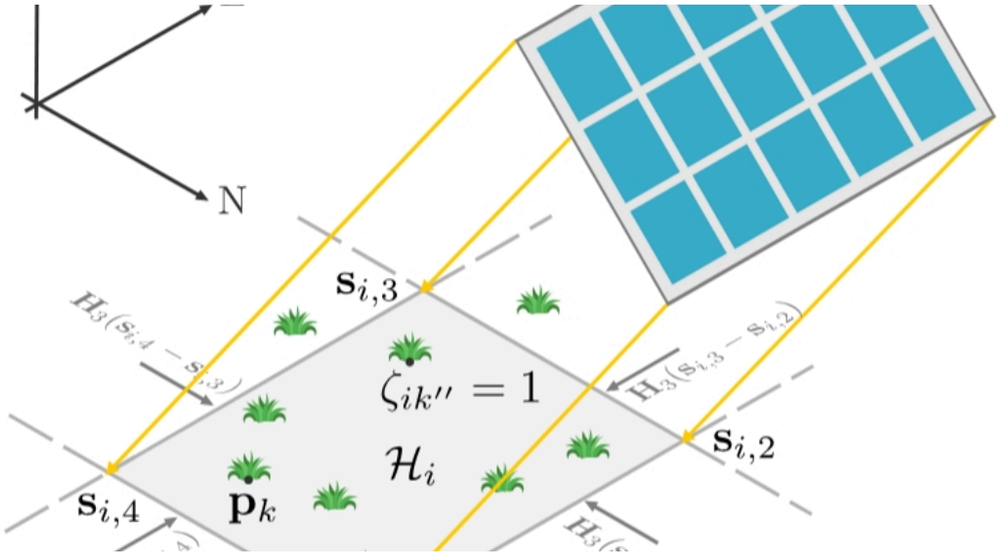
Agricultural Automation – Agrivoltaic System Optimization

Dual Objective: Maximize both crop yield and photovoltaic energy generation on the same land.

Optimization Approach:

- Optimal solar tracking balancing crop irradiance and PV energy
- MINLP formulation with convex relaxation for tractability
- Seasonal and daily irradiance pattern consideration
- Sustainable agriculture: food production + renewable energy

Impact: Increased land-use efficiency in agricultural systems.



SELECTED PUBLICATIONS

- *Mignoni et al., "Optimal Solar Tracking for Sustainable Crop Cultivation and Energy Generation in Agrivoltaics," IEEE Conf. Control Technol. Appl., CCTA, 2025.*
- *Mignoni et al., "Layout Optimization for Photovoltaic Panels in Solar Power Plants via a MINLP Approach," IEEE Transactions on Automation Science and Engineering, 2025.*

Agricultural Automation – Vertical Farm Energy Management

Challenge: Indoor farming requires optimization of energy-intensive climate control under dynamic electricity prices.

Decentralized Control:

- Multi-agent GNEP for crop growth condition control (light, temperature, humidity)
- Shared energy constraints create strategic coupling between zones
- Dynamic market participation with price-responsive strategies
- Integration with renewable energy and storage

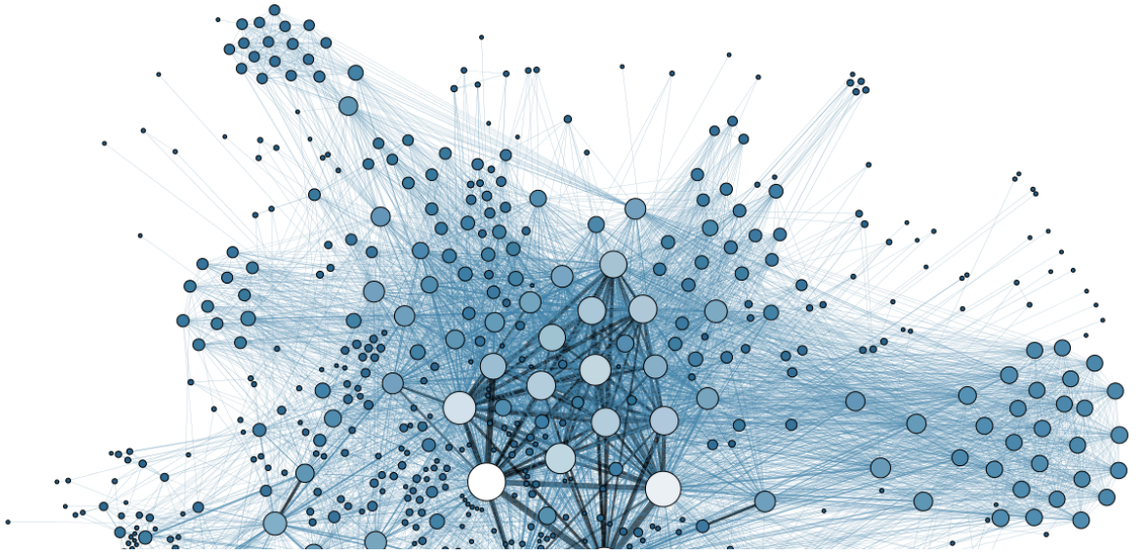
Benefit: Reduced operating costs while maintaining crop quality.

SELECTED PUBLICATIONS

- *Zhukovskii, Kirill, et al. "Decentralized Control of Crop Growth Conditions in Vertical Farms under Dynamic Energy Markets." IEEE Transactions on Automation Science and Engineering (2025).*
- *Zhukovskii, Kirill, et al. "Energy consumption optimisation for horticultural facilities." 2024 IEEE 29th International Conference on Emerging Technologies and Factory Automation (ETFA). IEEE, 2024.*

Networked Systems

Management, modeling, and control of complex interconnected systems



SELECTED SUBTOPICS

Game-Theoretic Control Frameworks

Distributed Optimization and Control

RECENT PUBLICATIONS

Decentralized Control of Crop Growth Conditions in Vertical Farms Under Dynamic En…

IEEE Transactions on Automation Science and Engineering · 2025

Kirill Zhukovskii; Paolo Scarabaggio; Polina Ovsiannikova; Pranay Jhunjhunwala; Raffaele Carli; Mariagrazia Dotoli; Valeriy Vyatkin

The Enhanced Factory for Extra-Terrestrial Space Technology Operations: Conceptual…

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Claudio Sassanelli; Brendan P. Sullivan; Elia Sindoni; Riccardo Cambertoni; Raffaele Carli; Angioletta Rita Catalano; Francesco Lucchini; Francesco Costantino; Fabrizio Dughiero; Mariagrazia Dotoli; Salvatore Digiesi; Idiano D'Adamo; Luca Settineri; Sergio Terzi

A Novel Agent-Based Approach for Dynamic Emotion Modeling in Social Networks

IEEE Transactions on Cybernetics · 2025

Xiaokun Wu; Limeng Lu; Mariagrazia Dotoli; Giancarlo Fortino; Min Chen

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Local Generalized Nash Equilibria With Nonconvex Coupling Constraints

IEEE Transactions on Automatic Control · 2025

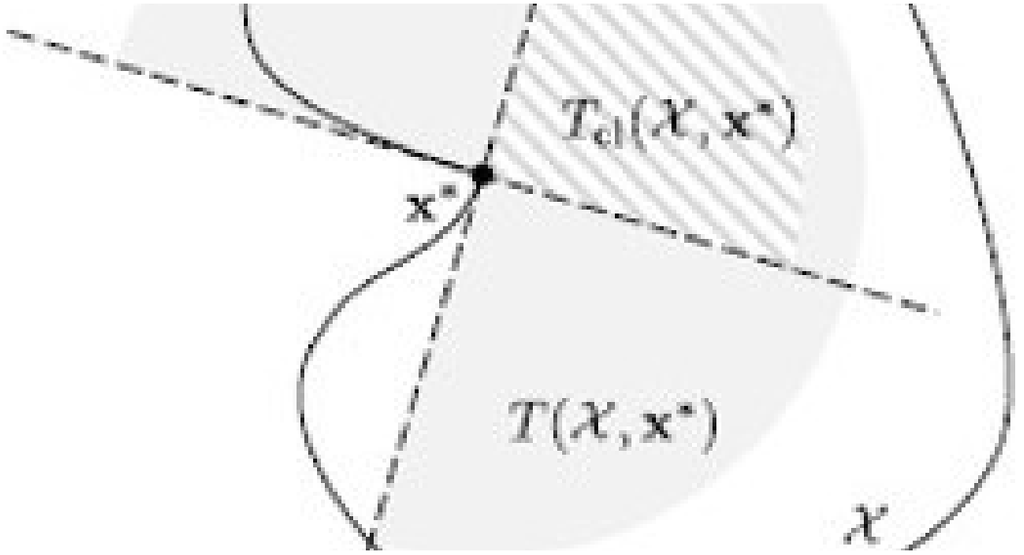
Paolo Scarabaggio; Raffaele Carli; Sergio Grammatico; Mariagrazia Dotoli

Networked Systems – Game-Theoretic Control Frameworks

Challenge: Networked systems with strategic agents require equilibrium concepts that handle coupling constraints and distributed decision-making.

Our Approach:

- Generalized Nash Equilibrium (GNE) formulations for coupled constraints
- (Local) equilibrium concepts with stability guarantees
- (Quasi-)variational inequality characterizations
- Fixed-point algorithms with convergence under monotonicity conditions



Applications: Optimal power flow, energy communities, multi-agent resource allocation.

SELECTED PUBLICATIONS

- *Scarabaggio et al., "Local Generalized Nash Equilibria With Nonconvex Coupling Constraints," IEEE Transactions on Automatic Control, 2025.*
- *Mignoni et al., "Control frameworks for transactive energy storage services in energy communities," Control Engineering Practice, 2023.*

Networked Systems – Distributed Optimization and Control

Problem: Large-scale networked systems require scalable algorithms that respect communication constraints and agent autonomy.

Solution Framework:

- Consensus-based coordination for swarms and vehicle fleets
- Distributed MPC for coupled subsystems
- ADMM and proximal methods for decomposition
- Transactive energy frameworks with convergence guarantees

Key Advantage: Scalability to hundreds of agents with provable performance.

SELECTED PUBLICATIONS

- *Hosseini et al., "Distributed control of electric vehicle fleets considering grid congestion and battery degradation," Internet Technology Letters, 2020.*
- *Carli, Raffaele, and Mariagrazia Dotoli. "A distributed control algorithm for waterfilling of networked control systems via consensus." IEEE control systems letters 1.2 (2017): 334-339.*

Intelligent Manufacturing

Advanced control and optimization of smart manufacturing processes

SELECTED SUBTOPICS

- Model Predictive Process Control
- Data-Driven Fault Detection and Diagnosis

RECENT PUBLICATIONS

Decentralized Control of Crop Growth Conditions in Vertical Farms Under Dynamic En...
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Kirill Zhukovskii; Paolo Scarabaggio; Polina Ovsiannikova; Pranay Jhunjhunwala; Raffaele Carli; Mariagrazia Dotoli; Valeriy Vyatkin

Safety Compliant, Ergonomic and Time-Optimal Trajectory Planning for Collaborative...
IEEE Transactions on Automation Science and Engineering · 2025
Silvia Proia; Graziana Cavone; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Predictive energy scheduling of smart parking infrastructure with solar-powered el...
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Virtual Design of Complex Manufacturing Systems by Digital Technologies: The Case ...
Lecture Notes in Mechanical Engineering · 2024
Lucilla Dammacco; Raffaele Carli; Vito Lazazzera; Michele Fiorentino; Mariagrazia Dotoli

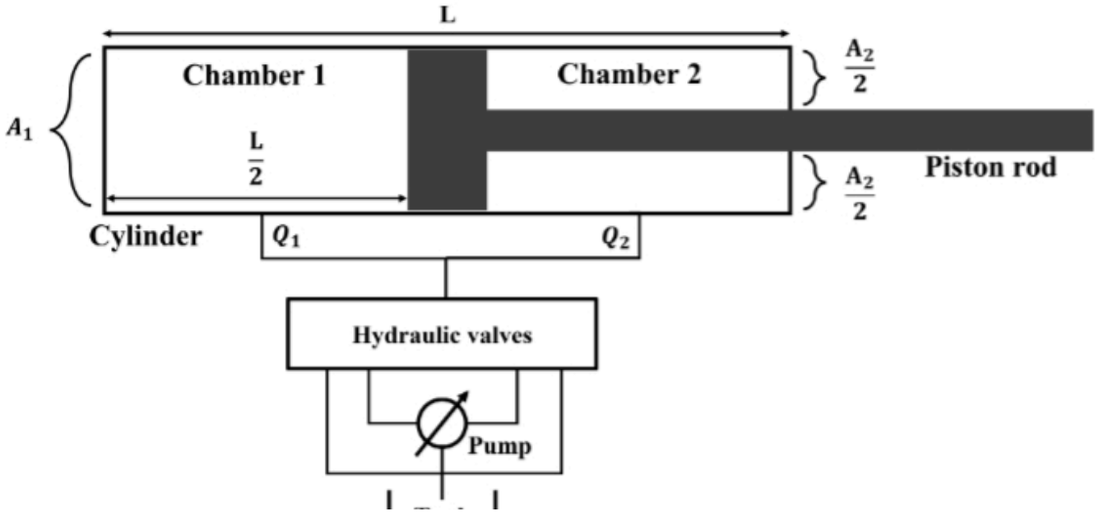
Intelligent Manufacturing – Model Predictive Process Control

Industrial Need: Manufacturing processes require real-time optimal control to ensure quality and efficiency.

MPC Solutions:

- Adaptive MPC for nonlinear hydraulic actuators in deep drawing
- Iterative linearization for complex process dynamics
- SOCP formulation for real-time feasibility
- Industry 4.0 integration: validated in automotive production

Results: Zero-defect production with reduced cycle times.



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- *Askari, Bahman, et al. "Data-driven fault diagnosis in a complex hydraulic system based on early classification." IFAC-PapersOnLine 55.40 (2022): 187-192.*

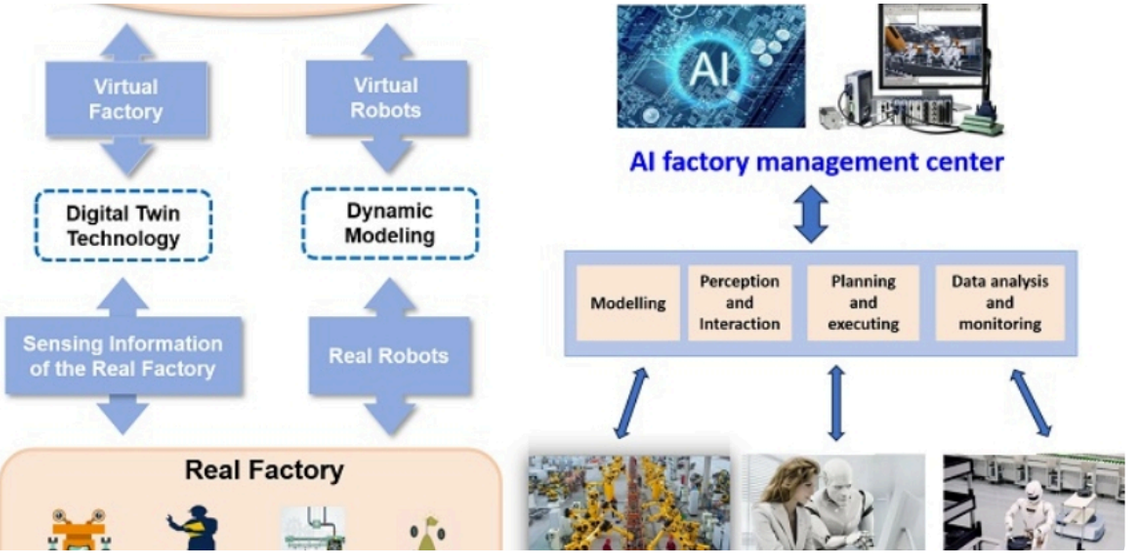
Intelligent Manufacturing – Data-Driven Fault Detection and Diagnosis

Challenge: Early fault detection in complex systems with limited labeled data and real-time requirements.

Machine Learning Approach:

- Semi-supervised learning with graph-based label propagation
- Early time-series classification for hydraulic systems
- Adaptive constrained clustering for anomaly detection
- Online data-driven control with semidefinite programming

Advantage: Proactive maintenance with minimal downtime.



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- *Askari, Bahman, et al. "Data-driven fault diagnosis in a complex hydraulic system based on early classification." IFAC-PapersOnLine 55.40 (2022): 187-192.*

Robotic Systems

Industrial, mobile and medical robotic systems with distributed coordination

SELECTED SUBTOPICS

Safe and Ergonomic Human-Robot Collaboration

Aerial and Mobile Robot Coordination

RECENT PUBLICATIONS

CASE 2024: Pioneering Innovations in Automation and Systems Engineering [Conferenc...
IEEE Robotics and Automation Magazine · 2025
Mariagrazia Dotoli; Yu Sun; Carla Seatzu; Paolo Scarabaggio

Voxel-Based Hierarchical Approximate Convex Decomposition for Efficient 3D Represe...
IEEE International Conference on Automation Science and Engineering · 2025
Fabio Mastromarino; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

An Integrated Control Framework for Safe and Ergonomic Human-Drone Interaction in ...
IEEE Transactions on Systems, Man, and Cybernetics: Systems · 2025
Silvia Proia; Graziana Cavone; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Safety Compliant, Ergonomic and Time-Optimal Trajectory Planning for Collaborative...
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Silvia Proia; Graziana Cavone; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

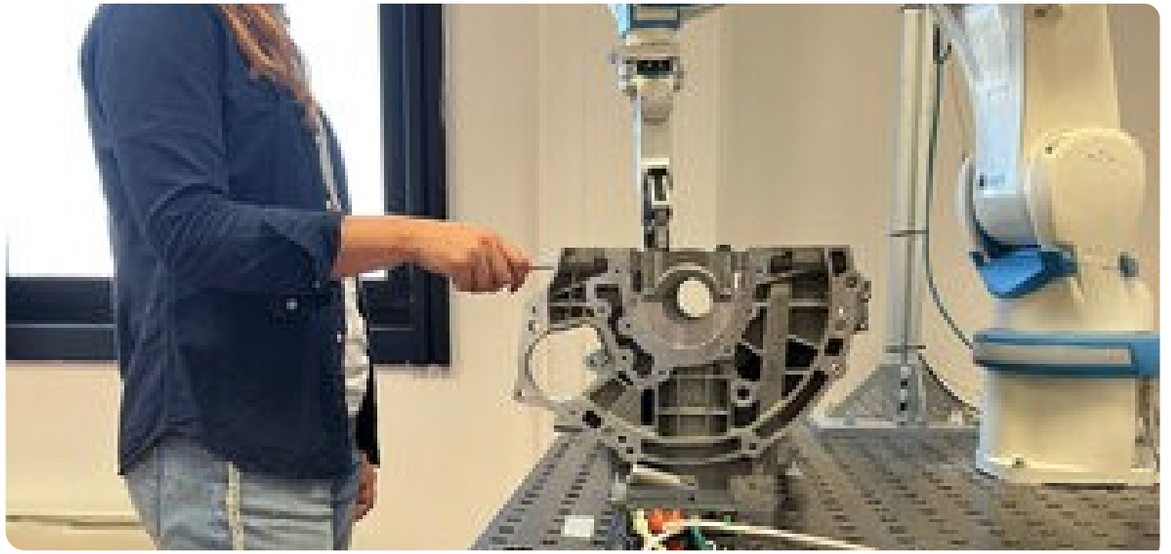
Key Factors for Social Acceptance of Robots in the Industrial and Service Oriented...
Springer Proceedings in Advanced Robotics · 2024
Silvia Proia; Graziana Cavone; Raffaele Carli; Mariagrazia Dotoli

Robotic Systems – Safe and Ergonomic Human-Robot Collaboration

Industry 4.0 Requirement: Collaborative robots must ensure ISO safety compliance AND worker ergonomics.

Multi-Objective Trajectory Planning:

- SOCP formulation balancing time-optimality and RULA ergonomic index
- Speed and Separation Monitoring (SSM) integrated in kinematics
- Pareto-optimal solutions for different performance trade-offs
- Experimental validation: reduced musculoskeletal disorders risk



Applications: Assembly tasks, material handling, quality inspection.

SELECTED PUBLICATIONS

- *Proia et al., "Safety Compliant, Ergonomic and Time-Optimal Trajectory Planning for Collaborative Robotics," IEEE Transactions on Automation Science and Engineering, 2025.*
- *Proia et al., "Control Techniques for Safe, Ergonomic, and Efficient Human-Robot Collaboration in the Digital Industry: A Survey," IEEE Transactions on Automation Science and Engineering, 2022.*

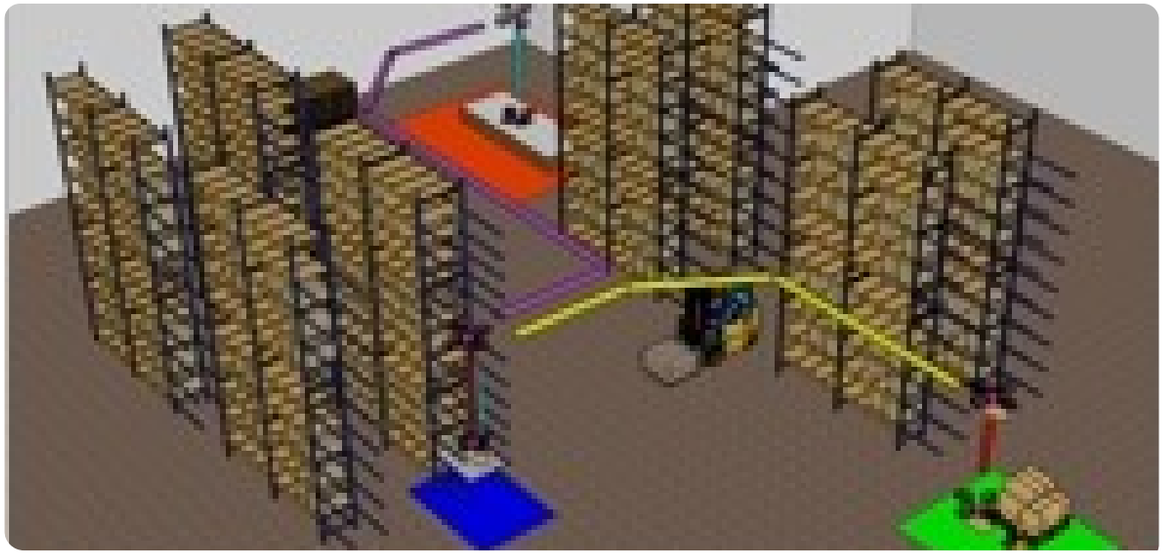
Robotic Systems – Aerial and Mobile Robot Coordination

Emerging Applications: Human-drone interaction in warehouses and multi-robot coordination for infrastructure.

Control Framework:

- Safe human-drone interaction with 3D SSM adaptation
- Consensus-based control for UAV swarms
- LQR/iLQR with artificial potential fields for collision avoidance
- Applications: inventory management, inspection, last-mile delivery

Innovation: Extending ground HRC safety standards to aerial robotics.



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- *Proia et al., "An Integrated Control Framework for Safe and Ergonomic Human-Drone Interaction in Industrial Warehouses," IEEE Transactions on Systems, Man, and Cybernetics: Systems, 2025.*
- *Carli et al., "Consensus-Based Algorithms for Controlling Swarms of Unmanned Aerial Vehicles," Lecture Notes in Computer Science, 2020.*

Digital Twin and Virtualization

Digital twins and virtual environments for analysis, simulation and predictive maintenance

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Medical Digital Twins | Virtual Manufacturing Systems

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Pharmacometric and Digital Twin modeling for adaptive scheduling of combination th...
Computer Methods and Programs in Biomedicine · 2025
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Automated Pathomic Analysis of Angiogenesis and Immune Profiles unveils an Interpr...
IEEE Journal of Biomedical and Health Informatics · 2025
Michela Prunella; Nicola Altini; Rosalba D'Alessandro; Annalisa Schirizzi; Giampiero De Leonardis; Graziana Arborea; Maria Teresa Savino; Anna Maria Valentini; Raffaele Armentano; Angela Dalia Ricci; Claudio Lotesoriere; Raffaele Carli; Mariagrazia Dotoli; Gianluigi Giannelli; Vitoantonio Bevilacqua

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Virtual Design of Complex Manufacturing Systems by Digital Technologies: The Case ...
Lecture Notes in Mechanical Engineering · 2024
Lucilla Dammacco; Raffaele Carli; Vito Lazazzera; Michele Fiorentino; Mariagrazia Dotoli

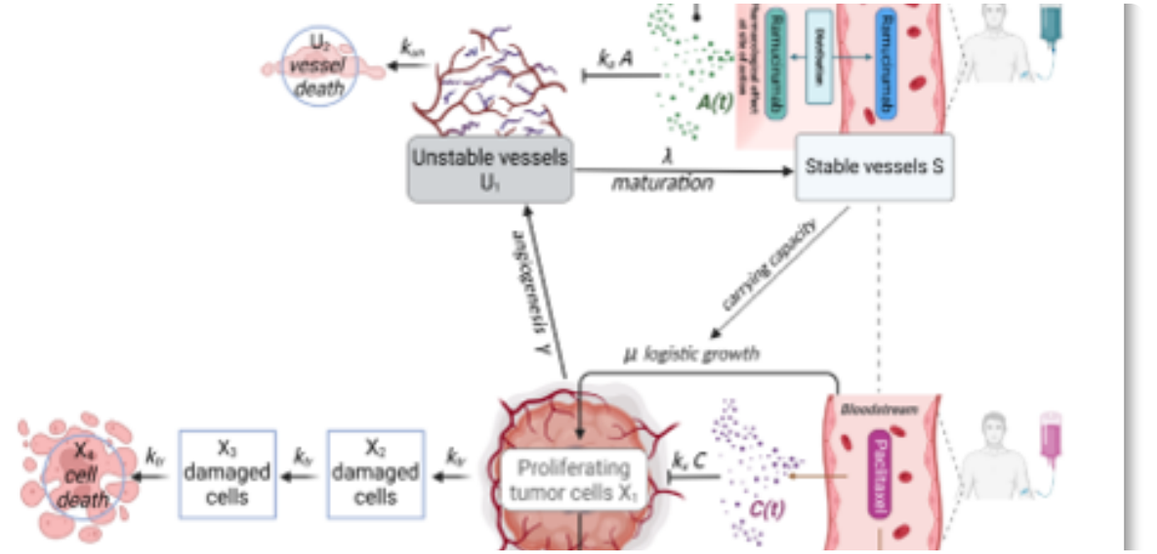
Digital Twin and Virtualization – Medical Digital Twins

Application: Personalized medicine through pharmacometric modeling of cancer therapy response.

Our Digital Twin:

- Pharmacokinetic-pharmacodynamic model of tumor development
- Virtual patient cohort generation from real-world data
- Adaptive therapy scheduling with digital biomarkers
- Clinical validation: drug reduction with equivalent outcomes

Impact: Informs clinical trial design and personalized treatment protocols.



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- *Scardigno et al., "CALIMAR-GAN: An unpaired mask-guided attention network for metal artifact reduction in CT scans," Computerized Medical Imaging and Graphics, 2025.*

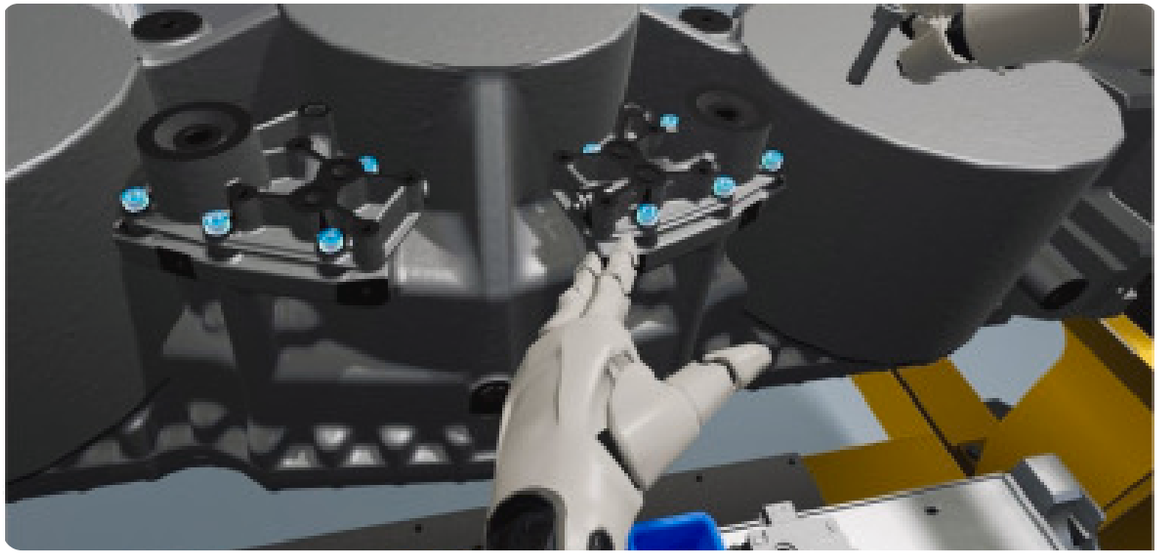
Digital Twin and Virtualization – Virtual Manufacturing Systems

Industry Challenge: Complex manufacturing system design requires validation before physical implementation.

VR-Based Methodology:

- Virtual commissioning of production lines with immersive environments
- Ergonomic analysis through virtual golden zone definition
- Discrete-event simulation for bottleneck detection
- Reduced commissioning time in automotive applications

Tools: Integration of VR, simulation, and digital twin technologies.



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- *Dammacco, Lucilla, et al. "Designing complex manufacturing systems by virtual reality: A novel approach and its application to the virtual commissioning of a production line." Computers in Industry 143 (2022): 103761.*
- *Dammacco, Lucilla, et al. "Simulation-based design for the layout and operation of AGVs in sustainable and efficient manufacturing systems." 2022 International Conference on Cyber-Physical Social Intelligence (ICCSI). IEEE, 2022.*

Freight and Logistics Systems

Optimization of logistics networks, supply chains and multimodal terminals

SELECTED SUBTOPICS

- Integrated Routing and Loading Optimization
- Automated Warehouse Design

RECENT PUBLICATIONS

A Matheuristic Approach for Delivery Planning and Dynamic Vehicle Routing in Logis…
IEEE Transactions on Automation Science and Engineering · 2025
Giulia Tresca; Hadrien Salem; Graziana Cavone; Hayfa Zgaya-Biau; Sarah Ben-Othman; Slim Hammadi; Mariagrazia Dotoli

A Framework for the Automated and Optimal Design of Vertical Lift Modules
IEEE Transactions on Systems, Man, and Cybernetics: Systems · 2025
Nicola Mignoni; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

A Matheuristics for the Configuration of Automated Vertical Lift Modules Warehouse…
IEEE Transactions on Automation Science and Engineering · 2025
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An Integrated Control Framework for Safe and Ergonomic Human–Drone Interaction in …
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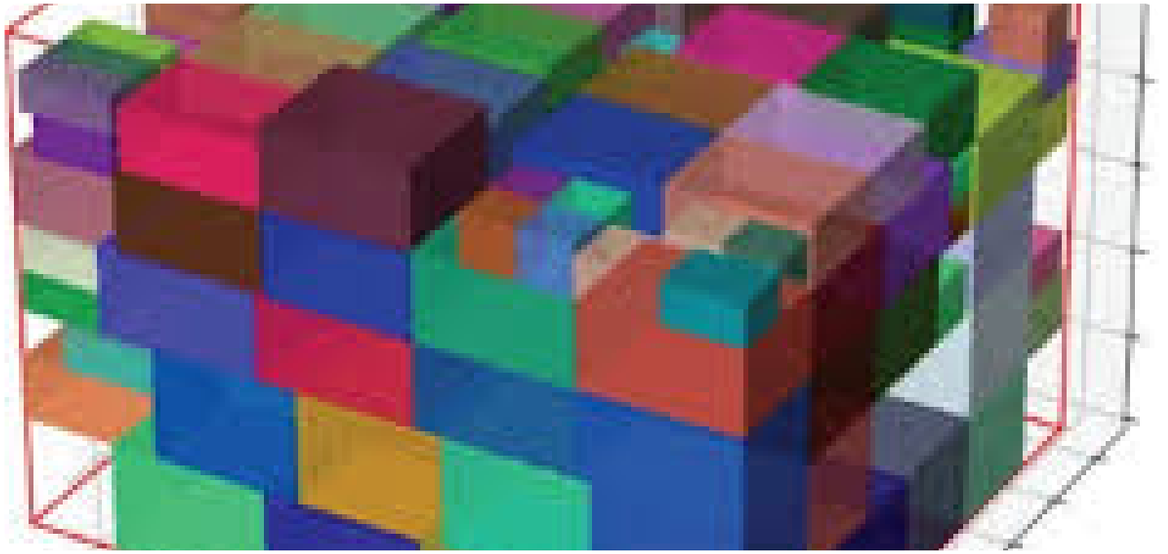
A Compact Convex Quadratically Constrained Formulation for a Class of Delivery Sch…
Proceedings of the IEEE Conference on Decision and Control · 2024
Nicola Mignoni; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Freight and Logistics Systems – Integrated Routing and Loading Optimization

Logistics 4.0: Joint optimization of vehicle routing and 3D container loading for delivery efficiency.

Matheuristic Algorithm:

- Static phase: offline routing and loading plan generation
- Dynamic phase: real-time re-routing under disruptions (traffic, accidents)
- Genetic algorithm for dynamic event handling
- Validated on Italian logistics company: minimized costs and empty space



Impact: Automation of delivery planning with real-time adaptation.

SELECTED PUBLICATIONS

- *Tresca et al., "A Matheuristic Approach for Delivery Planning and Dynamic Vehicle Routing in Logistics 4.0," IEEE Transactions on Automation Science and Engineering, 2025.*
- *Tresca et al., "Automating Bin Packing: A Layer Building Matheuristics for Cost Effective Logistics," IEEE Transactions on Automation Science and Engineering, 2022.*

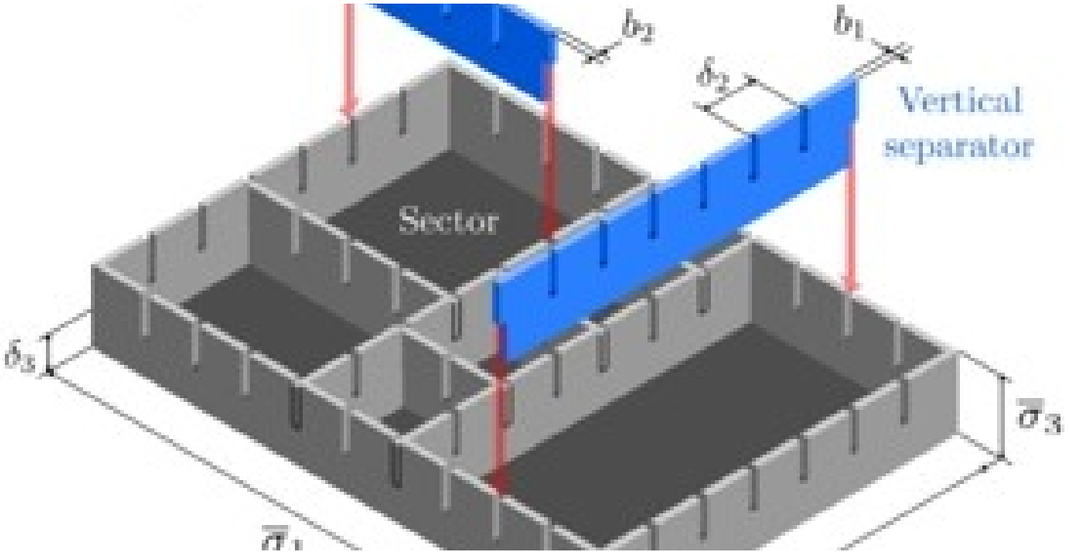
Freight and Logistics Systems – Automated Warehouse Design

Challenge: Optimal design of automated storage systems balancing capacity, throughput, and cost.

Optimization Framework:

- Vertical Lift Module (VLM) configuration via MILP/MINLP
- Multi-objective optimization: space, time, operational cost
- Integration with order picking and inventory strategies
- Scalable to large-scale warehouse systems

Deliverable: Automated design from high-level requirements to detailed layout.



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- *Tresca et al., "A Matheuristics for the Configuration of Automated Vertical Lift Modules Warehouses," IEEE Transactions on Automation Science and Engineering, 2025.*
- *Mignoni et al., "A Framework for the Automated and Optimal Design of Vertical Lift Modules," IEEE Transactions on Systems, Man, and Cybernetics: Systems, 2025.*

Passenger Transport Systems

Planning and real-time management of public transport systems

SELECTED SUBTOPICS

Real-Time Train Control and Rescheduling

Intelligent Transportation Systems

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Distributed Model Predictive Control for Real-Time Automatic Train Regulation of M...
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IEEE Transactions on Automation Science and Engineering · 2025
Silvia Proia; Graziana Cavone; Paolo Scarabaggio; Raffaele Carli; Mariagrazia Dotoli

Online Data-Driven Control of Nonlinear Systems Using Semidefinite Programming
IEEE Control Systems Letters · 2024
Augusto Bozza; Tim Martin; Graziana Cavone; Raffaele Carli; Mariagrazia Dotoli; Frank Allgower

Optimal Control of Drones for a Train-Drone Railway Diagnostic System
IEEE International Conference on Automation Science and Engineering · 2023
Silvia Proia; Graziana Cavone; Raffaele Carli; Mariagrazia Dotoli

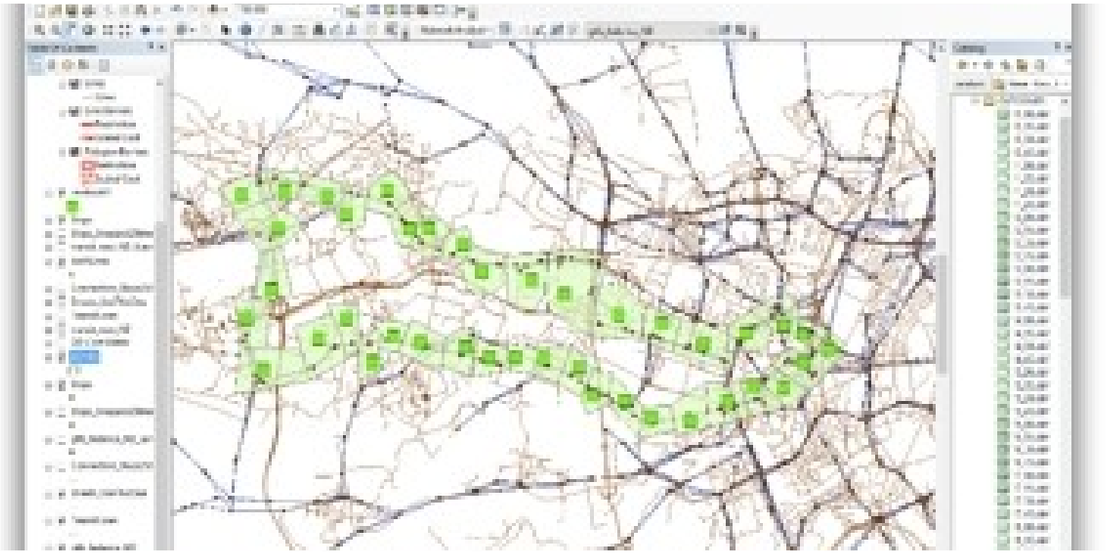
An Integrated Model Predictive Control Method for the Rescheduling of Metro Traffi...
Proceedings of the American Control Conference · 2022
Yin Tong; Wei Xu; Mariagrazia Dotoli; Graziana Cavone

Passenger Transport Systems – Real-Time Train Control and Rescheduling

Operational Challenge: Metro and railway systems require real-time rescheduling during disruptions.

Distributed MPC Framework:

- Automatic train regulation for metro networks with transfer coordination
- State-space modeling of train dynamics and passenger flows
- MILP for discrete decisions (backup train deployment, route changes)
- Scalable to large multi-line networks



Objective: Minimize delays while maintaining service quality.

SELECTED PUBLICATIONS

- *Tong et al., "Distributed Model Predictive Control for Real-Time Automatic Train Regulation of Metro Networks With Transfer Connections," IEEE Transactions on Automation Science and Engineering, 2025.*
- *Cavone et al., "A decision making procedure for robust train rescheduling based on mixed integer linear programming and Data Envelopment Analysis," Applied Mathematical Modelling, 2017.*

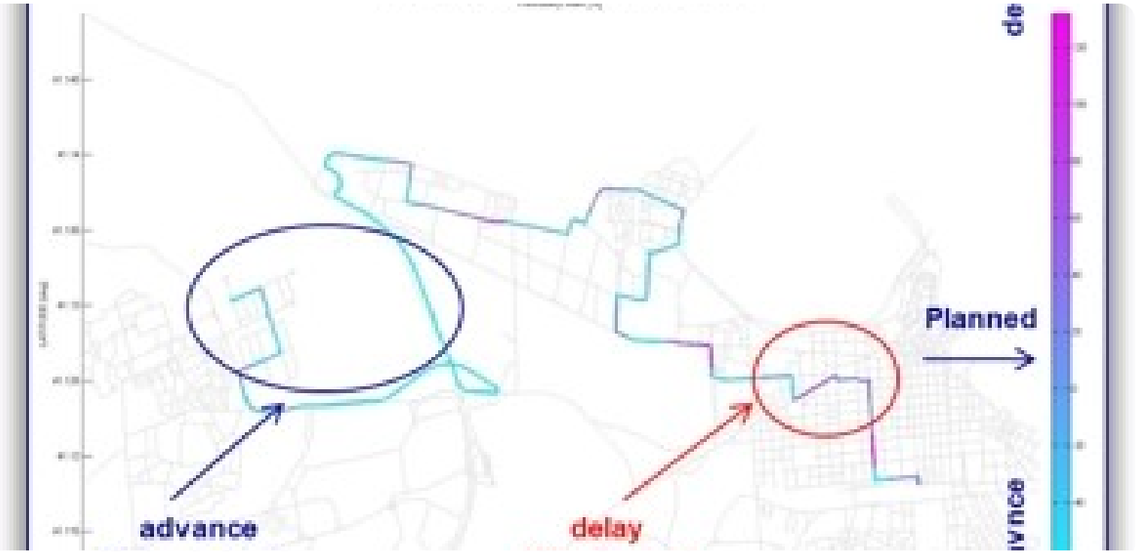
Passenger Transport Systems – Intelligent Transportation Systems

Problem: Urban mobility requires real-time information and optimization for efficient passenger flows.

Multi-Agent Approach:

- Advanced traveler information systems for route optimization
- Traffic congestion monitoring through probe vehicles
- Robust timetabling and rescheduling under uncertainty
- Data-driven control for nonlinear traffic dynamics

Benefits: Reduced congestion, improved passenger experience.



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