Emilio Benenati

About me

I am a Postdoc in the Division of decision and control systems at KTH, Stockholm. My research lies at the intersection between multi-agent MPC and game theory, focusing on stability guarantees, design principles, and numerical methods. I have work experience in robotics, and I strive to apply my findings on multi-robot coordination, autonomous driving, and power systems control.

Education and research experience

2025 - Now KTH Stockholm Sweden	**Post-doc** Topic: Multi-agent model predictive control Advisor: Prof. G. Belgioioso
2020 - 2025 TU Delft the Netherlands	**Ph.D.** in Systems and Control "Optimal selection and control in monotone and dynamic games" Advisor: Prof. S. Grammatico
2024 UC Santa Barbara USA	**Research visit** Topic: Contraction theory for time-scale separated systems Advisor: Prof. F. Bullo
2019 - 2020 Italian Inst. of Tech. Genova, Italy	**Research fellow** Topic: MPC control of jet-propelled aerial humanoid robots Advisor: Dr. D. Pucci
2018-2019 CU Boulder USA	**Research visit** Topic: Real-time power flow optimization for electric grids Advisor: Prof. E. Dall' Anese, Dr. M. Colombino
2016 - 2019 ETH Zürich Switzerland	**M.Sc.** in Robotics, Systems and Control Thesis: "Optimal Control of Electric Loads Using MDPs" Advisor: Prof. F. Dörfler
2013 - 2016 Univ. of Catania Italy	**B.Sc.** in Electrical Engineering (with honors) Thesis: "Control of a self-built robot arm using computer vision" Advisor: Prof. G. Muscato

Teaching and work experience

2021 - 2024 TU Delft the Netherlands	**Teaching assistant**: Model predictive control (M.Sc. course) I conducted frontal lessons, exercise sessions, written projects evaluation, oral examinations, and office hours
2021 - 2023 TU Delft the Netherlands	**M.Sc. thesis advisor** I proposed and led two thesis research projects in model predictive control and optimization, and applications to autonomous driving and energy distribution networks
2017 - 2018 ABB Baden Switzerland	**R&D Intern** Internship on automatic fault detection for electric drives using signal analysis and machine learning
2014 - 2016 Catania, Italy	**Private high school tutor** Mathematics and physics teacher for high school students

Other activities

- Winning team of the Autotrac 2020 European competition in autonomous driving
- Reviewer of more than 20 journal contributions to *IEEE Transactions on Automatic Control*, *Automatica*, *IEEE Transactions on Systems, Man and Cybernetics*, and *Control system letters*
- Reviewer of conference contributions for several editions of the *Conference of decision and control*, *European control conference*, and *IFAC world congress*
- Developer of the open source package DyNECT for game-theoretic MPC deployment

Selected publications

1. "Linear-quadratic dynamic games as receding-horizon variational inequalities"
   IEEE Transactions on Automatic Control, 2025 DOI: 10.1109/TAC.2025.3632150

   Game-theoretic MPC is a controller for non-cooperative multi-agent systems, which enables each agent to predict and account for others' actions. We developed a design principle that guarantees infinite-horizon optimality, and the first stability result for non-potential games, as well as connections with the well-studied variational inequality problem that enable computational tractability.

2. "Optimal selection and tracking of generalized Nash equilibria in monotone games"
   IEEE Transactions on Automatic Control, 2023 DOI: 10.1109/TAC.2023.3288372

   Generalized Nash equilibrium problems may admit multiple solutions. This may lead to jumps in the control action, when implementing a game-theoretic controller. We develop the first algorithms that compute and select the optimal Nash equilibrium, among potentially infinitely many.

3. "Probabilistic game-theoretic traffic routing"
   IEEE Transactions on Intelligent Transportation Systems, 2024 DOI: 10.1109/TITS.2024.3399112

   This work validates our design principles and numerical algorithms for game-theoretic MPC on the routing problem for multiple vehicle fleets on a road network. We prove that the vehicles reach their destinations with an appropriate terminal objective design, and we demonstrate reduced congestion with respect to a greedy strategy.

4. "The explicit game-theoretic linear quadratic regulator for constrained multi-agent systems"
   Submitted to *IEEE Transactions on Automatic Control* in 2025 DOI: 10.48550/arXiv.2512.07749

   Iterative solvers may be too slow at computing the input of a game-theoretic controller on applications that require high sampling rates. For games with linear dynamics and quadratic objectives, we compute the state-to-input map offline, and we demonstrate superior performance in terms of online computation time and solution precision. Moreover, we demonstrate real-time execution on an autonomous driving task.

5. "A semi-decentralized Tikhonov-based algorithm for optimal generalized Nash equilibrium selection"
   62nd IEEE Conference on Decision and Control, 2023 DOI: 10.1109/CDC49753.2023.10383583

   This work proposes an algorithm for computing the optimal solution to a generalized Nash game among infinitely many. Compared to the one proposed at point *2)*, we relax the quasi-shrinking assumption on the operator used to construct the iteration, thus making convergence easier to guarantee.

Languages

Italian	Native
English	Proficient - certified level C2
German	Basic
Polish, Dutch	Elementary

Interests

Guitar, music collection and production, hobby electronics, cooking