

Constraints beyond mathematics: Governance, responsibility, and ethics in learning-enabled aerospace systems

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Abstract: The increasing deployment of learning-enabled autonomy in aeronautical and space systems raises governance, regulatory, and ethical challenges that extend beyond traditional safety and robustness analyses. This talk examines how responsibility, liability, and governance considerations should be treated as explicit design constraints in the development and certification of learning-based aerospace systems. Focusing on both aeronautical and space applications, the discussion addresses responsibility allocation in autonomous space traffic management, highlighting how accountability must be distributed across planners, controllers, and learning components. Liability considerations for AI-enabled space systems are analyzed in relation to verification depth, explainability requirements, and acceptable levels of conservatism in control design. The talk further discusses the role of standardization in learning-enabled control architectures as a prerequisite for certification, interoperability, and reproducibility, and examines the trade-offs between open and proprietary autonomy stacks in terms of transparency, performance, and trust. Rather than framing these issues as abstract policy questions, the presentation emphasizes their direct impact on system architecture, verification workflows, and safety assurance strategies. The talk concludes by setting the stage for a guided round-table discussion with all speakers, aimed at translating governance and ethical considerations into concrete research priorities for the responsible deployment of learning-enabled aerospace systems.

Bio: Martina Mammarella received her B.Sc. and M.Sc. degrees in Aerospace Engineering from Politecnico di Torino in 2012 and 2015, respectively, and her Ph.D. (cum laude) in Aerospace Engineering in 2019. Currently, she is a researcher at the Cnr-Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni (CNR-IEIIT). She has obtained the Italian National Scientific Qualification for Associate Professor in both Systems and Control Engineering and Aerospace Engineering. Her research focuses on robust and stochastic model predictive control, system identification, and control of aerospace and autonomous systems, including spacecraft guidance, navigation, and control, and unmanned aerial vehicles. She has been involved in several Italian and European research projects and actively collaborates with international universities, research centers, and industry partners, contributing to projects on space systems, autonomous vehicles, and agricultural robotics. She is the author of numerous journal and conference publications in leading venues. Lately, Dr. Mammarella has been granted with a FIS2 Starting Grant (2025) to develop a morphing lunar communication network. She currently serves as Associate Editor for IEEE TCST and the IEEE TAES, and she is actively involved in several IEEE and IFAC technical committees.