

Next-Generation Autonomous Aerospace Systems: Immersive Technologies, AI, Multidisciplinary Design Optimization and Aircraft Design

Dr. Mohsen Rostami's research program aims to advance next-generation autonomous aerospace systems through the convergence of immersive technologies, artificial intelligence, multidisciplinary design optimization, and advanced aircraft design. His work is motivated by the need for aerospace platforms that are not only more efficient and autonomous, but also more interactive, adaptive, and human-centered. At the core of this vision is the integration of virtual, augmented, and mixed reality with digital twins, haptics, and AI-enabled decision support to create intelligent environments for mission operations, training, maintenance, and collaborative control. This includes immersive control centres for space mission management, multi-user XR-based ground control stations, extended reality communication environments, and synthetic-data-driven mixed reality frameworks for assisted maintenance. Complementing these efforts is a strong focus on advanced aerospace vehicles, including urban air mobility systems, hybrid airships, and stratospheric airship platforms, as well as the development of novel design and optimization methodologies. Through the MAPLA platform and related MDO frameworks, Dr. Rostami explores how data-driven tools, physics-based models, and uncertainty-aware optimization can accelerate the design of small aircraft and unconventional aerial systems. Together, these activities define a forward-looking research agenda focused on shaping intelligent aerospace ecosystems in which autonomy, immersive human-machine interaction, and optimization-driven design work together to support the future of aviation and space systems.

Dr. Mohsen Rostami is an aerospace engineer, educator, and researcher currently serving as a Postdoctoral Research Fellow and Lecturer in Aerospace Engineering at Toronto Metropolitan University. He holds a Ph.D. in Aerospace Engineering, two master's degrees, and a Professional Engineer (P.Eng.) license in Ontario. Over the past decade, Dr. Rostami has developed a strong academic and professional profile in aerospace dynamics and control, aerospace systems, avionics, and multidisciplinary design optimization.

Dr. Rostami's research has focused on the design and optimization of small aircraft, eVTOL concepts, hybrid airship systems, and intelligent aerospace platforms. During his doctoral studies, he developed MAPLA, a multidisciplinary analysis and design optimization platform that integrates aerodynamics, propulsion, performance, weight and balance, and stability and control for small conventional and eVTOL aircraft. This work enabled both deterministic and uncertainty-aware optimization and supported applications ranging from conceptual aircraft sizing to route and trajectory optimization using real air-traffic data.

In parallel with aircraft design, Dr. Rostami has expanded his research into extended reality (XR), digital twins, haptics, and artificial intelligence for aerospace and space applications. Through collaborations with industry and research partners, he has contributed to XR-enabled ground control stations, immersive mission planning platforms, and human-machine interaction systems for autonomous operations. In his current postdoctoral work, Dr. Rostami is developing an

Immersive Control Centre for collaborative space mission operations, combining XR, digital twins, and AI-assisted decision support.