ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

MUR DM 117/Collins Aerospace - Dependable architectures for inference models execution in avionic systems

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Advanced Laboratory on Embedded Systems S.r.l. [P.iva/CF:10356221001] Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	LAZARESCU MIHAI TEODOR - mihai.lazarescu@polito.it
Contact	LAZARESCU MIHAI TEODOR - mihai.lazarescu@polito.it LAVAGNO LUCIANO - luciano.lavagno@polito.it
Context of the research activity	The research aims the design of reliable avionics systems that include machine learning components on FPGAs, considering the trade-offs between performance, reliability, and certification constraints. It explores fault-tolerance strategies using algorithmic and domain knowledge to improve efficiency. Progetto finanziato nell'ambito del PNRR - DM 117/2023 - CUP E14D23002000004
	The introduction of advanced autonomy capabilities and the transition to advanced embedded platforms are two concurrent and intertwined drivers in the avionics domain today. Heterogeneous computing platforms can provide the level of computing power required to support advanced features, such as machine learning (ML) components, within the Size, Weight, Power, and Cost (SWaP-C) constraints of the emerging class of small, energy-constrained vehicles. Safely integrating ML components into advanced embedded platforms, especially when considering high levels of hardware acceleration, requires new techniques to address hardware reliability, including fault tolerance, detection, and recovery. This research activity aims to define methods, tools, and reference architectures for the design of dependable avionics systems, including machine learning components, taking into account:

Objectives	- Optimal design strategies required to meet contrasting functional and non-functional requirements (lower error, computation time, SWaP-C constraints, reliability) when considering FPGAs as an implementation platform. - In particular, strategies that address fault tolerance (algorithmic redundancy, diversity, architectural redundancy, etc., using both algorithm characterization and domain knowledge to improve the overall efficiency of the solution). The proposed approach is intended to support the overall development and integration of avionics systems and must therefore take into account the constraints imposed by the aerospace certification process. The research topics are mainly related to digitalization, innovation, competitiveness and culture PNRR mission to strengthen the national research system and its integration with the productive system, with particular attention to strategic sectors such as aerospace, biotechnology, health, agri-food, green chemistry, cybersecurity and artificial intelligence, as well as to the green revolution and ecological transition PNRR mission to promote renewable energy, sustainable mobility, circular economy and environmental protection. Progetto finanziato nell'ambito del PNRR – DM 117/2023

Skills and competencies for the development of the activity	A plus for doctoral candidates is knowledge of: - Machine learning, particularly for avionics applications. - FPGA programming and hardware acceleration. - Fault tolerance methods and strategies for embedded systems. - Avionics systems design and development, including aerospace certification. - Research, communication, and collaboration skills.