COMPUTER AND CONTROL ENGINEERING

MUR DM 118 - Solutions to support the Public Administration in developing and certifying V2X safety and security

Funded By	Dipartimento DAUIN MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584]
Supervisor	CANTORO RICCARDO - riccardo.cantoro@polito.it
Contact	SONZA REORDA MATTEO - matteo.sonzareorda@polito.it CANTORO RICCARDO - riccardo.cantoro@polito.it
Context of the research activity	Autonomous electric vehicles, as well as the communication infrastructure making use of the 5G network, pose severe challenges to the Public Administration in terms of new regulations and procedures for safety and security. This research aims at developing software and hardware to ease such transition, specifically targeting fault-tolerant solutions, Electrical/Electronic/Programmable Electronic Safety-related Systems (E/E/PES), and cybersecurity for automotive. Progetto finanziato nell'ambito del PNRR - DM 118/2023 - CUP E14D23002620006
	Research objectives Autonomous electric vehicles and 5G networks are expected to play a prominent role in the future. The quality of safety-critical systems will influence the management of IoT infrastructure and connected cars by the Public Administration or private bodies. Releasing and verifying V2X safety and security regulations will be of utmost importance, and procedures will need to be implemented to verify compliance with existing and upcoming standards. The work in this proposal is expected to significantly improve the safety and security of electronic systems, thus facilitating the work of the Public Administration in developing and certifying safe and secure V2X communications. The research team's expertise in electronic design automation (EDA) will be leveraged to develop robust methodologies that are both practical and effective. Furthermore, this research is aligned with the goals of the National Centers on Sustainable Mobility and HPC, as well as the Extended Partnership on Artificial Intelligence, which further emphasizes its significance in advancing the state-of-the-art in this field.

Objectives	The objectives of this research are summarized as follows: - Identify a suitable hardware platform for V2X applications and suitable software to be used as a representative benchmark for the qualification activities. - Assess dependability figures on the identified hardware/software infrastructure to identify failure modes, critical parts of the design that require hardening, and suitable safety mechanisms. - Develop an innovative qualification flow to allow the Public Administration and private bodies to apply safety and security regulations on the IoT infrastructure and connected cars. Outline of possible research plan First year: - Conduct a thorough literature review on dependable and secure electronic systems and V2X communication systems, as well as available safety and security standards, to identify the most recent and relevant research works. - Select a suitable hardware platform for V2X applications, considering a variety of RISC-V based systems publicly available and using IP cores from industrial partners when available. - Identify suitable software for mobility and IoT applications. - Develop a preliminary assessment methodology for the identified hardware and software infrastructure and define suitable failure modes. Second year: - Qualitatively and quantitatively assess the weaknesses of the identified V2X infrastructure. The work will include fault injection experiments as well as approaches based on formal methods. - Identify the critical parts of the design that require hardening (hardware or software) and devise new safety mechanisms and security solutions. - Cooperate with the Public Administration to identify the necessary actions to focus on when defining the developed hardening solutions, as well as how to integrate them in a system-level qualification flow. Third year: - Develop a comprehensive assessment methodology tailored to the needs of the Public Administration in collaboration with EDA partners that cooperate with the research group, leveraging their expertise in electronic design automation to refine and optimize the assessment process. - Evaluate the proposed methodologies extensively through simulations and testing. - Collaborate with industry partners to validate their effectiveness on real-world applications. List of possible venues for publications The candidate will prepare and submit papers to top-tier conferences and journals in the field of electronic systems, embedded systems, and fault tolerance. Possible venues for publications could include:

	- IEEE Transactions on Computers - IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems - IEEE Transactions on Very Large Scale Integration (VLSI) Systems - International Conference on Computer-Aided Design (ICCAD) - International Test Conference (ITC) - IEEE European Test Symposium (ETS) - Design, Automation and Test in Europe Conference (DATE) - RISC-V Summit Projects The research is consistent with the themes of the National Centers on Sustainable Mobility and HPC, as well as with those of the Extended Partnership on Artificial Intelligence, in which members of the CAD group participate. The research will be supported by industrial partners involved in active collaborations. Synopsys is involved in research activities on functional safety and reliability, and provides licensed tools, IP cores, and support. Infineon is also involved in the frame of research contracts on electronic system dependability.

Skills and competencies for the development of the activity	- Background in digital design and verification. - Solid foundations on microelectronic system and embedded system programming - Experience with fault modeling and testing techniques for digital circuits, such as stuck-at faults, transition faults, and path-delay faults. - Knowledge of EDA tools, particularly for fault simulation.