

COMPUTER AND CONTROL ENGINEERING

DAUIN - REASE: RESilient computing Architecture in the Space quantum communication Era

Funded By	DAUIN - Progetti ricerca MIUR e altri ministeri
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Context of the research activity	<p>Quantum Key Distribution (QKD) is a leading technology of Quantum Communication (QC) since it allows to realize a secrecy protocol, safe and resilient to any external attack. Recently, QKD transmitters have been successfully tested on CubeSat, enabling QCs for satellite.</p> <p>The final goal of the project is to develop and build an innovative architectural prototype, suitable for space satellite, integrating resilient reconfiguration capabilities, and validated with radiation beam campaigns.</p>
Objectives	<p>Cluster computation nodes based on radiation hardened self-reconfigurable Field Programmable Gate Arrays (FPGAs) will provide the optimal computational platform without introducing overhead in terms of performance such as data rate, throughput, memories interface access rate, when applying Radiation-Hardening Assurance (RHA) techniques at the cluster level.</p> <p>Simulation-based radiation particle interaction with matter based on fully integrated particle physics Monte Carlo tools will provide a prototype implementation compliant with the Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) radiation environment, necessary to improve the physical geometry of the cluster embedded within a satellite. Moreover, it will measure the criticality and sensitive position and study the fine cluster topology structure.</p> <p>A QKD communication data acquisition system and online data analysis will provide the monitoring systems integrated with the REASE computational architecture to provide the necessary measurement feedback performed during radiation beam testing using protons, heavy ions, and ultra-energetic heavy ions.</p> <p>A Dedicated Quantum Communication application to continuously sustain the transmission of new random data and analysis will be developed, implemented, and tested to provide the necessary feedback for robust and real-time quantum communication testbed.</p>

The REASE team includes experts in robust design techniques for reconfigurable architectures, quantum key distribution algorithms and implementation techniques for FPGA, radiation effects modeling on satellite physical structure, and radiation beam testing campaigns. The proposed project will take advantage of outstanding and promising results achieved by the REASE proponents in previous and ongoing projects.

Skills and competencies for the development of the activity

Design capabilities on FPGA devices, Knowledge of Embedded Microprocessors