Scientific breakthrough protects computers from cosmic radiation

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Researchers from France and Spain have developed a range of new technologies to make electronic systems tolerant to cosmic rays. These advances will allow electronic systems in aeronautical and space applications to become increasingly sensitive without compromising safety or reliability.

Cosmic rays strike the Earth all the time. They are powerful waves of high-energy radiation, and when they hit the planet's atmosphere, they create cascades of secondary particles that reach sea level at the rate of about 20 per cm2 per hour. The truth is that such cosmic rays – which are thought to mostly originate somewhere outside of the solar system – are usually not dangerous to humans by the time they reach Earth. But they can be dangerous to electronics.

The more precise and fine the work that goes into semiconductors and processing chips, the more vulnerable they become to these errant particles from beyond our solar system, which can strike them and cause errors of all kinds. At sea level the risk is great enough, but for any system that operates at higher altitudes – aeronautical and space applications, for example – the threat of hard, firm and soft errors caused by radiation is great. The OPTIMISE project, supported by EUREKA through its nanoelectronics cluster CATRENE, focused on improving the mitigation of such errors in safety-critical electronic systems – thereby improving their reliability.

Tolerant to a fault

CATRENE OPTIMISE brought together a huge consortium of 19 partners, drawn from academia, manufacturing, technology development and end-users in France and Spain, with the objective of protecting both power electronic and digital electronic systems from their radiation environments. The project ran for more than four years, between July 2009 and February 2014, and was led by Florent Miller of Airbus Group's Innovations department – which was known as European Aeronautic Defence and Space Company, Innovation Works department at the time of the project.

Indeed, the outcomes of the project constitute a breakthrough in fault-tolerant design, assessment methodologies and standardisation. The consortium was able to design and patent both fault-tolerant application-specific integrated circuits and fault-tolerant controllers for high-density memories. A new radiation-resistant library of cells was created, measuring only 90nm across, as well as IP block and sensor array systems that can detect inconsistencies in data and the locations of radiation particle impacts. Concerted effort was also put into the development of assessment tools and test methodologies, and their promotion in space, aeronautic and automotive test guidelines and standards.

The sterling efforts of the project partners to advance the standardisation of tools and methods for qualification, as well as the novel tools and methods themselves, will go a long way towards ensuring that Europe retains its competitiveness in this field in the long-term. The collaborations that began with CATRENE OPTIMISE have likewise

had lasting impacts. "We still maintain active cooperative links with most of the project partners – and indeed, many of these interactions are within the frame of further national and EU-level projects", Miller reveals.

Provided by Eureka Network