PROJECT PROFILE

CT217 | Improving reliability and quality of electronics operating under challenging conditions [RESIST]

The RESIST project focuses on reliability for next-generation electronic systems, primarily in automotive and avionics. To this end, RESIST will develop reliability-focused design methods and solutions, and run-time adaptive techniques for dependable, integrated electronic circuits and systems that will be resilient to intrinsic and extrinsic failures in future process technologies.

Electronic systems in cars and planes are becoming more sophisticated. In-vehicle/in-flight systems are inter-connected to share information, monitor performance and enhance safety. In addition to being more complex, automotive systems demand more cost-efficient electronic components with smaller footprints for space-constrained applications, thereby requiring modern, but robust, semiconductor integration schemes for enhanced performance. Application conditions, like supply voltage or temperature, often cannot be changed and become even more severe, leading to much higher stress inside devices and a higher risk of system failure.

Similarly, the same evolution towards more intense integration can be observed in avionics systems as they try to achieve lower mass, while at the same time achieving higher levels of processing power to address the growing data-rates. Extending the life of electronic components is crucial for applications, such as satellites, in which replacement of non-functional circuits is impossible. All of this calls for new reliability-focused design approaches and solutions.

Towards a more resilient and reliable design

RESIST aims to develop cost-efficient, dependable integrated electronic circuits and systems in future technologies that enable resilience against intrinsic and extrinsic failures. The purpose of these design technologies is to compensate for the impact of static and temporal variability on design reliability and yield. The project also addresses complementary support activities such as characterisation, simulation, tooling and testing. Technology demonstrators are deployed for conceptual validation of the developed solutions, and to demonstrate their interaction with different applications.

In particular, RESIST's key measurable objectives are to:

- Increase the lifespan of embedded devices from today's 10-15 years to 25 years in the future for automotive, and 35 years for avionics;
- Enable an innovative 'design for resilience' approach for embedded devices that is at least twice more cost-effective than conventional redundancy practices for the same level of system reliability;
- Increase by at least 20%, the number of integrated components, or integration density of such components, for integrated electronic systems in cars and airplanes for the same or better level of system reliability;
- Reduce reliability-testing costs by 25%, and qualification time by 30% for integrated electronic components;
- Develop an early-warning system for health-monitoring system-components in safety-critical applications.

In addition, RESIST will also deliver the following demonstrators needed to validate the methodology needed to achieve the project's measurable objectives:

- Highly efficient and reliable driver for electro-motors usable in electrical vehicles or safety-critical applications, like electrical steering;
- Self-healing and self-regulating processors exploiting time redundancy;
- Resilience and health monitoring in safety-critical automotive networking solutions;
- Good Average Testing: a clever tool to select good circuits for aerospace applications.

PROJECT CONTRIBUTES TO

- Communication
- Automotive and transport
- Health and aging society
- Design technology

PARTNERS

NXP-NL
(project leader)
ATMEL Nantes SAS
BOSCH
AGI
Airbus Group Innovations,
Airbus Defence &Space GmbH
Heliox
IFX
IROC
MunEDA
NXP-D
ST-FR-CRO
Volkswagen AG
CEA-LIST
Fraunhofer IIS/EAS
Institut Polytechnique de Grenoble
ISEN Toulon
Reutlingen University
Technical University Delft
Technical University Eindhoven
Technical University Munich
University of Bremen

COUNTRIES INVOLVED

- The Netherlands
- France
- Germany

PROJECT LEADER

Pierre-Marie Dell"accio
NXP

KEY PROJECT DATES

01 September 2014 - 31 December 2017

www.resist-catreneproject.eu

Aligning with Europe's needs

RESIST's competent project consortium will comprise a total of 21 partners from three European countries. This healthy mix of academicians, end-users and industrial partners bring with them a deep knowledge of system design and system and circuit architectures, as well as, advanced CMOS processes, power electronics and testing, together with, reliability, failure analysis and yield engineering. Moreover, having overlapping areas of know-how makes project communication and collaboration easier.

This project also supports CATRENE's work area 'Design Technologies', as well as, Europe's Grand Challenge 'Design for Reliability and Yield', which relates to semiconductor devices. Furthermore, the developed design technologies will also underpin the R&D work planned in subsequent projects submitted to the other (sub) work areas: 'Automotive and Transport' and 'Safety and Security'

European automotive and avionics markets key beneficiaries

In general, project developments are expected to result in twice as many cost-effective, resilient solutions; an increase in the lifespan of embedded devices to more than 25 years; a 20% and higher component/integration density at the same level of reliability; and up to 30% reduction in reliability-testing costs. In addition, RESIST provides opportunities for European industry to gain competitiveness and increase market share in automotive and avionic electronics. Importantly, European vehicle and airplane manufacturers will be able to lower costs and improve functionality, making these suppliers significantly more attractive to customers worldwide.

Now, the automotive electronics market is highly lucrative and is expanding. It is characterised by high volume and low cost, and highly reliable electronics with high efficiency at high operating temperatures. Market estimates for automotive electronic systems rose from $177 billion in 2011, to $289 billion in 2018. Revenues increased by 11.6% (CY2011 versus CY2010), to $23.3 billion, including in-car entertainment (ICE). The trend towards an ever-increasing use of electronically controlled, electrically actuated systems will create new opportunities for electronic developers and automotive designers. The know-how that will be developed in RESIST can be directly used at various levels in the automotive value-chain to provide support for the envisaged market growth.

Applications in aeronautics and aerospace need an extremely high level of robustness, reliability and quality. The use of the most advanced high reliability CMOS digital technologies is crucial in satellite-based systems, and flight computers are mandatory to operate future generations to increase safety, allow for autonomous operations, and decrease energy consumption. There is therefore a strategic need for avionics and aerospace industries to deploy electronics in a harsh operational environment. Market estimates for avionics and space electronic systems rose from $200 billion in 2011 to $320 billion in 2018. Revenues increased by 6% (CY2011 versus CY2010), to $12 billion.

Then there are methodologies and solutions targeted by RESIST which can also be deployed in other industries and applications requiring high reliability and long lifespans, such as the European medical market. Another is in energy, where these two factors will substantially improve the return on Investment of solar-powered installations and photovoltaic (PV) systems. Here RESIST technologies are expected to achieve the required lifespan of 25 years for solar-panel electronics.

Finally, academia and research institutes will be able to exploit the knowledge gained for training and promotional purposes, essential for assisting such European institutions maintain a competitive edge. RESIST is also the ideal framework and opportunity for project partners, especially small and medium-size enterprises (SMEs), to broaden their expertise and be a part of a growing European 'reliability community', with all the accompanying (business) benefits.

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CATRENE (E! 4140), the EUREKA Cluster for Application and Technology Research in Europe on NanoElectronics, will bring about technological leadership for a competitive European information and communications technology industry.

CATRENE focuses on delivering nano-/microelectronic solutions that respond to the needs of society at large, improving the economic prosperity of Europe and reinforcing the ability of its industry to be at the forefront of the global competition.