EURIPIDES² Penta

CO-LABEL

PROJECT PROFILE

19007

Smart AI-based tools for ensuring reliable electronic devices for smart mobility and industrial production [Failure Analysis 4.0]

The Failure Analysis (FA) 4.0 project will address a fundamental challenge for the digital world: how to ensure that increasingly complex electronic systems operate with complete reliability and safety in daily use. This is essential in safety-critical applications such as autonomous vehicles and in digitalized industrial production (Industry 4.0). FA 4.0 will provide innovative AI-based tools and methods to analyse and avoid defects and failures during the development and manufacture of electronic components and systems. With its holistic approach spanning chip production, assembly & packaging, to board and system level, the project's outcomes will be crucial for the competitiveness of European electronic devices, especially in the demanding automotive and industrial sectors.

From self-driving cars to medical devices and smart homes, rapidly evolving digitalization and automation are transforming everyday life. Industrial production itself is becoming 'smarter' and ever-more automated. These trends offer enormous market potential for high-tech products based on increasingly complex electronic systems. However, these electronic components and systems (ECS) must combine advanced functionality with the ability to function faultlessly whenever required. Average usage of many electronic devices may rise from a few hours a day currently to over 20 hours a day. For instance, even when not on the road, the electronics in an electric vehicle will be active during the charging cycle. Thus, the electronics must not only reach rigorous automotive safety and quality standards, but also have a long lifetime.

At the same time, innovation in applications such as automotive electronics is very rapid and electronic systems are growing in complexity on many levels – in functional density, reduced footprint size, new materials and compositions, and the introduction of novel technologies including 3D integrated devices, hetero-integrated system in package, and high-density interconnects for printed circuit boards, to name a few. These developments are leading to extreme challenges for reliability, quality and manufacturing yield.

In applications where ECS are a key enabling technology, mastering the related reliability risks requires more effective process-related defect characterisation and failure analysis than currently exists. It also calls for holistic control of all the uncertainties along the process chain of component design, manufacture and quality management.

Today, however, failure analysis is carried out manually, driven by single tasks coming from production, reliability testing and field returns. This is time-consuming and does not allow for analysis of combined electrical and material testing and metrology data from along the manufacturing process flow. It is also susceptible to human error, and diagnostic tools are not linked to each other or a central database to provide information for the next steps in a failure analysis workflow.

Applying AI for smart failure analysis

To address these challenges, FA 4.0 will create cutting edge tools and methods for analysing, understanding and avoiding defect mechanisms and failure risks during development and manufacturing. It will develop a comprehensive, central recording analysis of metrology parameters and process-related inhomogeneities, tracked along the production process in correlation with existing failure catalogues. Newly discovered failure mechanisms identified in final components will be explored as part of a novel holistic approach for quality assurance and process improvement. This holistic analysis approach will be enabled by advanced FA tools with integrated smart preparation and signal analysis capabilities.

Above all, the project aims to apply breakthroughs in the field of AI research and data correlation to provide largely automated diagnostic tools combined in efficient failure analysis workflows. It will focus on two primary innovation areas 1) a next generation of efficient diagnostic tools and workflows, and 2) smart algorithms for failure identification and cataloguing.

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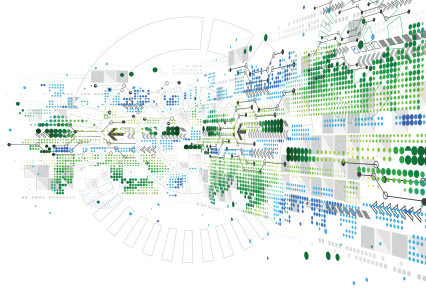


KEY APPLICATION AREAS

- Transport and Smart Mobility
- Digital Industry

ESSENTIAL CAPABILITIES

- ECS Process Technology, Equipment, Materials & Manufacturing

PARTNERS

cyberTECHNOLOGIES GmbH
Direct conversion AB
Ecole des Mines de Saint Etienne
Ericsson AB
Excillum AB
Fraunhofer Institute for Microstructure of Material and Systems IMWS
Gimic
Infineon Technologies AG
Jean Monnet University (Saint-Etienne) in Lyon University
Kern Microtechnik GmbH
Materiex AB
Matworks GmbH
Orsay Physics
PVA TePla Analytical Systems GmbH
RISE IVF AB
Robert Bosch GmbH
STMicroelectronics Grenoble 2 SAS
STMicroelectronics (Tour) SAS
STMicroelectronics (Rousset) SAS
TESCAN ORSAY HOLDING
University of Stuttgart

COUNTRIES INVOLVED

- Czech Republic
- Germany
- France
- Sweden

PROJECT LEADER

Dr. Klaus Pressel
Infineon Technologies AG

KEY PROJECT DATES

01 April 2020 - 31 March 2023

Using AI-based algorithms, targeted working hypotheses can be derived more quickly and confirmed with only a few analysis steps. New approaches in the fields of automated and self-learning image processing, measurement systems and failure analysis methods could also be utilized for defect control. Linking smart and more automated failure diagnostic tools along the process chain (in line with concepts derived from Industry 4.0) and correlating these with degradation mechanisms and failure catalogs offers great potential for improving the efficiency and quality of production and reducing manufacturing costs.

Furthermore, these fast and powerful tools for failure recognition and interpretation, as well as for correlation to available metrology and electrical testing data along the manufacturing process chain, will be key for further technological developments.

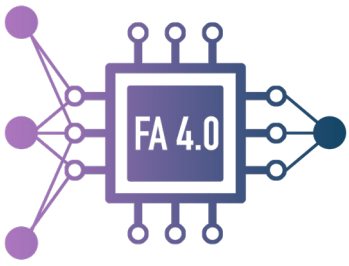
Expertise across the entire value chain

FA 4.0 is able to take its holistic approach by bringing together research institutes and companies from across the entire value chain, including leading semiconductor and electronic system suppliers and medium and small businesses (SMEs). The project will strengthen the strategic alliance of European semiconductor manufacturers, FA tool providers and research institutes, and leverage their combined expertise in failure analysis, methodologies and tool supply to develop these new solutions for smart failure analysis.

Strategic market access and new opportunities

The market importance of FA 4.0 is huge. As demand for high-tech products for applications like autonomous driving, electric vehicles, smart industry, energy efficiency, 5G telecommunications and Internet of Things (IoT), and medical applications grows, reliability and quality are no longer an 'add-on' to technological innovation but an essential requirement for market access. Experts in the field have stated that "Reliability is emerging as the top priority across the hottest growth markets for semiconductors, including automotive, industrial and cloud-based computing..." . Moreover, AI is seen as having a key role in enabling this reliability. Thus, the outcomes of FA 4.0 will be of crucial importance to ensuring the European electronics industry has access to the strategic markets of the future. In addition, the project will open up opportunities for European failure analysis equipment manufacturers.

In effect, the collaboration in FA 4.0 between semiconductor and system suppliers, diagnostic tool manufacturers and leading research institutes will strengthen the European ECS industry's global competitiveness to design and manufacture reliable, high quality and cost-effective products. The close cooperation between the partners in the consortium will allow European companies to deliver both innovative electronic products and the required failure analysis tools that increase reliability and quality and shorten product development cycle times.



EURIPIDES² / AENEAS Office
44 rue Cambronne
F-75015 Paris - France
Tel. +33 1 40 64 45 80
Fax +33 1 40 64 45 89
euripides@euripides-eureka.eu
penta@aeneas-office.org

EURIPIDES² and PENTA are two EUREKA Clusters.

PENTA purpose is to catalyse research, development and innovation in areas of micro and nanoelectronics enabled systems and applications.

EURIPIDES² promotes the generation of innovative, industry-driven, pre-competitive R&D projects in the area of Smart Electronic Systems.