Joint Laboratories Scientific Day

These Scientific Days are meant to present the research topics and to disseminate the recent advances of researchers. **These presentations are open to everybody**, whether they are members of TIMA or not.

Scientific day on Dependability – Test, Safety and Security of Nano-electronic Systems

June 21st, 2022

***TIMA Laboratory*, Amphitheatre Barbillion– 46 Avenue Felix Viallet, Grenoble**

TIMA, LIRMM and INL laboratories are organizing a common scientific day dedicated to survey part of their current research on dependability issues, in present and future chips.

Conference and lunch are free of charge but require for logistic organization **online registration, before 27th of May**, on the following link: https://evento.renater.fr/survey/june-21st-scientific...-9shtfzmf

Hardware Security | Robustness, Reliability, Test | Emerging Computing | Hardware/ software codesign | Simulation and verification | Async design, non-uniform sampling | AMS/RF circuits and systems | Sensors and Actuators

	Morning Program: Safety and Security
9h30 – 9h45	**Welcome** – Mounir BENABDENBI & Arnaud VIRAZEL
9h45 – 10h10	Assessment of Radiation Effects on Attitude Estimation Processing for Autonomous Things – Tarso KRAEMER (TIMA)
10h10 – 10h35	Impact of Atmospheric and Space Radiation on Sensitive Electronic Devices – Luigi DILILLO (LIRMM)
10h35 – 10h55	**Break**
10h55 – 11h20	Predictive Fault Tolerance with consideration of the application – Luc NOIZETTE (TIMA)
11h20 – 11h45	Software Reliability Based on Basic Block Metrics Composition – Tiziano FIORUCCI (TIMA)
11h45 – 12h15	Design of trustworthy Integrated Circuits: how to counteract hardware Trojan horses and overproduction – Sophie DUPUIS (LIRMM)
12h15 – 13h45	**Lunch**

	Afternoon Program: Test and Round table on collaborative projects
13h45 – 14h10	Low-cost production test of ZigBee transmitters on standard digital ATE – Florence AZAIS (LIRMM)
14h10 – 14h35	A methodology for RF/mmW machine learning-based test and calibration using nonintrusive process monitors – Salvador MIR (TIMA)
14h35 – 15h00	IC Test Quality and Yield Improvement through the use of Machine Learning – Pierre D'HONDT (LIRMM)
15h00 – 15h20	**Break**
15h20 – 15h45	Evolutions of the Automated Testing Flow: a unified solution for interactivity, reuse and in-field approaches – Michele PORTOLAN (TIMA)
15h45 – 16h30	Roundtable on Future collaborative projects – Moderator: Alberto BOSIO (INL) Identifying synergies and discussion on how to build better project proposals
16h30 – 16h45	**Closing** – Mounir BENABDENBI & Arnaud VIRAZEL

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Abstracts

Assessment of Radiation Effects on Attitude Estimation Processing for Autonomous Things
Speaker: Tarso KRAEMER - TIMA

This work investigates and assesses neutron radiation effects on the attitude estimation (AE) processing, typically embedded in inertial navigation systems (INS) and upcoming autonomous things. Findings highlight the importance of radiation-induced critical failures that can upset the on-board AE processing, and consequently the inertial navigation. Radiation tests and analyses were conducted by considering as on-board AE processing the execution of classical AE algorithm on a multicore computer hardware exposed to 14-MeV neutron and thermal neutron radiation. Three computing strategies and different case-study scenarios were tested and compared. Results suggest that the contribution of radiation-induced soft errors to be mitigated on the embedded AE processing is essentially related to single-event functional interrupts that can lead the inertial navigation to critical failures.

Impact of Atmospheric and Space Radiation on Sensitive Electronic Devices
Speaker: Luigi Dilillo - LIRMM

Studying the radiation effects on electronic devices is essential for avionics and space systems. The shrinking technology nodes and increasing density of devices enhance the sensitivity of electronic systems to ionizing radiation. Due to their crucial role, memories and processors are the highest contributors to soft errors in systems, making them the best candidates for studying these effects. The team effort targets at studying the radiation environment in space and atmosphere and the main effects that the different types of ionizing particles that are present in these environments may produce on electronic devices. Furthermore, mainly focusing on Single-Event Effects (SEEs), the team works on analysis methodologies and tools for modeling SEEs and their impact on memories and microprocessors.

Predictive Fault Tolerance with consideration of the application
Speaker: Luc NOIZETTE - TIMA

This presentation proposes an approach to overcome the methodological limitations of the fault tolerance assessment methods currently used during radiation beam testing of digital complex components (SoC). In fact, these methods are not necessarily representative of the actual conditions in which the component will be used, particularly in terms of microarchitecture activity induced by the software load. This lack of representativeness results in an underestimation of the fault tolerance. However, technological changes of recent years have reduced the margins allowed in these estimations. So much so that nowadays, these underestimations of fault tolerance are no longer acceptable.

Software Reliability Based on Basic Block Metrics Composition
Speaker: Tiziano FIORUCCI - TIMA

In the context of functional verification, the focus has always been on hardware and its ability to be both resilient to errors and to recover from them autonomously. In order to evaluate these characteristics, an extensive use of fault Injection tools is made to achieve clear and granular results. These testing campaigns are carried out on the entire DUT and require a consistent amount of time and computational resources. Reducing these costs is a key issue. Modern techniques such as the Dysfunctional State Machine or proof of concept regarding the composability of single block fault injection campaigns (to obtain a library of components for which the reliability metrics are well known), has already been extensively discussed and proven on hardware. In this talk the application of these methodologies to software is presented for the first time. In order to do so, the software has been divided into Basic Block, atomic chunks of code having precise characteristics, that will ensure the possibility to study them singularly. We will then recompose them into a software product which reliability metrics are known, alleviating the need for complete fault injection campaign.

Design of trustworthy Integrated Circuits: how to counteract hardware Trojan horses and overproduction
Speaker: Sophie DUPUIS - LIRMM

The design and manufacturing of integrated circuits have become extremely complex operations. As a result, several steps in the design/manufacturing flow are nowadays geographically distributed throughout the planet. New trust vulnerabilities have therefore emerged, which include, among other, overproduction and malicious modification of circuits referred to as hardware Trojans horses.

To ensure un good level of confidence in ICs (despite various untrustworthy steps in the design/manufacturing flow), design methods that aim to protect circuits and/or verify their integrity are needed. This presentation details the activities that have been carried out at LIRMM for about decade about:

- Detection and prevention of the insertion of hardware Trojans horses
- Prevention of overproduction thanks to combinational logic locking

Low-cost production test of ZigBee transmitters on standard digital ATE
Speaker: Florence AZAIS - LIRMM

Low-power wireless microcontroller ICs are key components for the IoT market today. The traditional solution to test these components relies on the use of an ATE equipped with expensive RF resources. An interesting approach to reduce the testing costs is to develop digital solutions. This talk will focus on such a digital solution for RF testing of a ZigBee transmitter.

A methodology for RF/mmW machine learning-based test and calibration using nonintrusive process monitors
Speaker: Salvador MIR - TIMA

In the last few years, a wide variety of machine learning-based test strategies have been proposed for simplifying RF and mm-wave standard test and calibration procedures. These indirect techniques replace the direct measurement of functional specifications by simpler signatures that are strongly correlated to the target performances. Obviously, finding an appropriate set of signatures is a key step for defining a reliable indirect test protocol. In this talk, we will explore different proposals for building such a reliable set of signatures for a number of given case studies in the framework of RF and mm-wave integrated circuits.

IC Test Quality and Yield Improvement through the use of Machine Learning
Speaker: Pierre D'HONDT - LIRMM

Autonomous vehicles use more sensors and computational power, leading to an acceleration of the advanced processes adoption for critical automotive ICs. This early process adoption makes chips more prone to manufacturing defects. Cell-aware fault models have been proposed to target transistors-level defects found in modern technologies. However, cell-aware methodology deployment requires a long and costly characterization phase involving electrical simulations. This work proposes the use of machine-learning algorithm to help faster deploy cell-aware methodology, without relying on numerous electrical simulations. Experiments over several technologies have shown a 99.7% runtime reduction while maintaining quality.

Evolutions of the Automated Testing Flow: an unified solution for interactivity, reuse and in-field approaches
Speaker: Michele PORTOLAN – TIMA

Automation has been responsible for the most important breakthroughs in testing, and it is now a fundamental element of the electronics world. Unfortunately, its progress is now limited by several legacy solutions that are implicitly, and sometimes unknowingly, accepted. The duality Generation/Application of patterns is at the very heart of today's testing ecosystem, but it is being challenged by the very evolution it fostered. The IEEE 1687 standard is symptomatic to this: it proposes hardware and software solutions to boost hierarchical and instrument-based testing, but its full application brings the current Automated Test Flow close to breaking point. It is a typical scaling issue: everything seems fine for small-scale systems in the short term, but problems arises when looking at long-term. Inthis presentation, we will first focus on the long-term vision to uncover and explain these limiting elements, and then we will propose a new flow that both overcomes them and unleashes the full potential of new approaches.