



UNIVERSITÀ
DEGLI STUDI
DE L'AQUILA



disim



DEWS
CENTER OF EXCELLENCE

CENTER OF EXCELLENCE DEWS

Design methodologies for
Embedded controllers, **W**ireless
interconnect and **S**ystem-on-chip

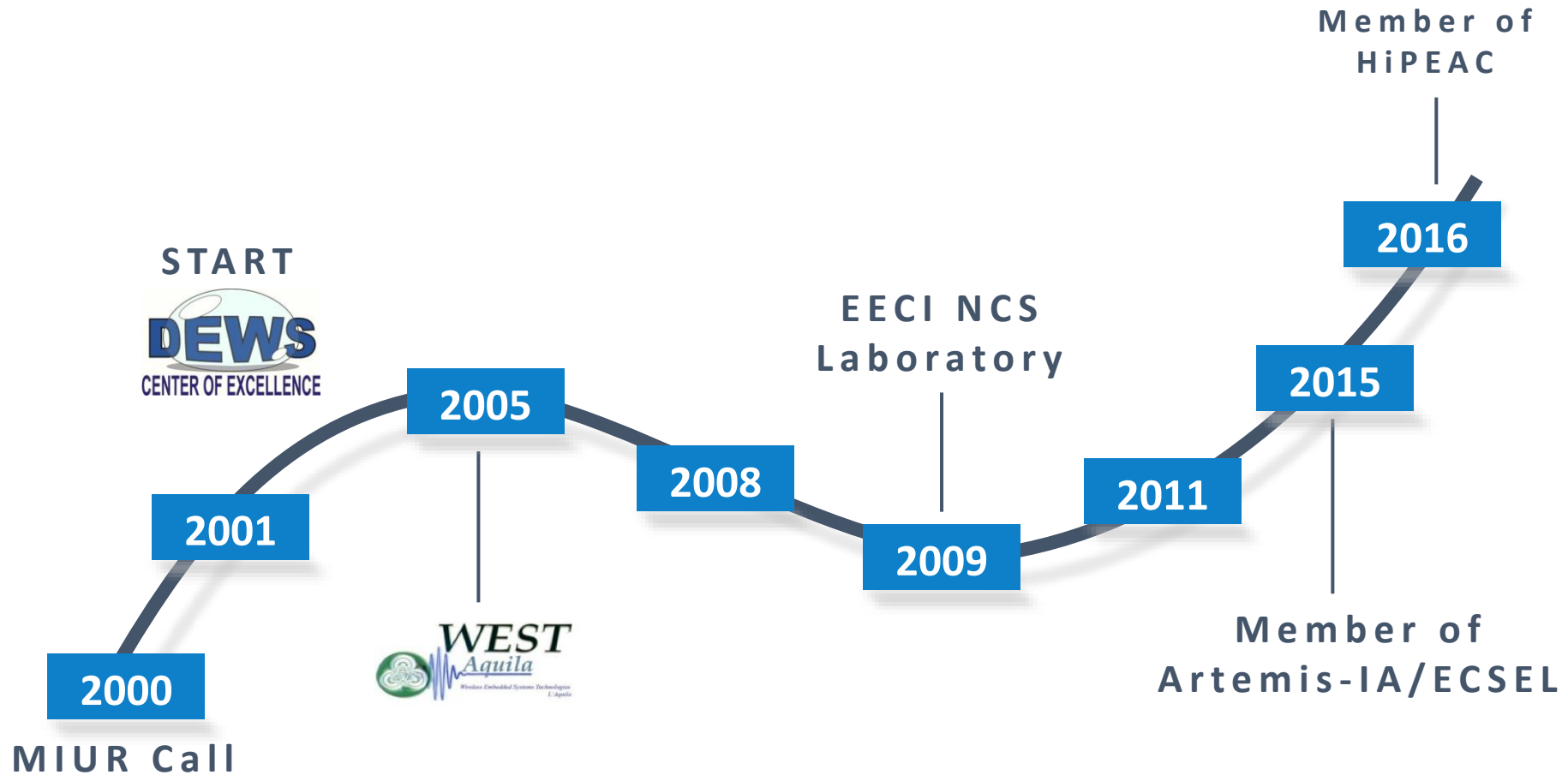


OVERVIEW

- Center of Excellence DEWS
 - Embedded Systems Design
 - Team & Topics
 - Funded Research Projects
 - Main Academic Publications & Events
 - Industrial Research Contracts
 - Memberships
 - Contacts

CENTER OF EXCELLENCE DEWS

Design methodologies for **E**Embedded controllers, **W**ireless interconnect and **S**ystem-on-chip



CENTER OF EXCELLENCE DEWS

RESEARCH LINES

Distributed Systems and Optimization

Heterogeneous Complex Systems Modeling and control

Autonomous and Intelligent Agents Coordination

Mixed IC Systems and HW Digital Processing Design

Smart Factory (Sensors Design and Interfaces)

Software Analysis and Design

Embedded Systems Design

Multimedia Signal Processing

EMBEDDED SYSTEMS DESIGN: TEAM



**LUIGI
POMANTE**
Assistant Professor



**TANIA
DI MASCIO**
Assistant Professor



**CLAUDIA
RINALDI**
Assistant Professor



**PAOLO
GIANNATEMPO**
Post-Doc



**VITTORIANO
MUTILLO**
Post-Doc



**MARCO
SANTIC**
Post-Doc



**GIACOMO
VALENTE**
Post-Doc



**WALTER
TIBERTI**
Post-Doc



**FEDERICA
CARUSO**
Ph.D. Student



**GABRIELLA
D'ANDREA**
Ph.D. Student



**VINCENZO
STOICO**
Ph.D. Student

EMBEDDED SYSTEMS DESIGN: TOPICS

- **1. embedded ICT (eICT)**
- **2. Embedded Systems Monitoring**
- **3. Dynamic Partial Reconfiguration**
- **4. Electronic System-Level HW/SW Co-Design**
- **5. Wireless Sensor Networks**
- **6. Neural Networks**
- **7. Assistive Technologies**
- **8. eICT for New Arts**

1. embedded ICT (eICT)

- Experimentation and analysis of all the ICT typically involved in the embedded systems domain (both traditional and high-performance)

HW

- **uC:** Microchip/Atmel, Texas Instruments, etc.
- **DSP:** Texas Instruments, etc.
- **FPGA:** Xilinx, Altera/Intel
- **PSoC:** Xilinx, etc.

SW

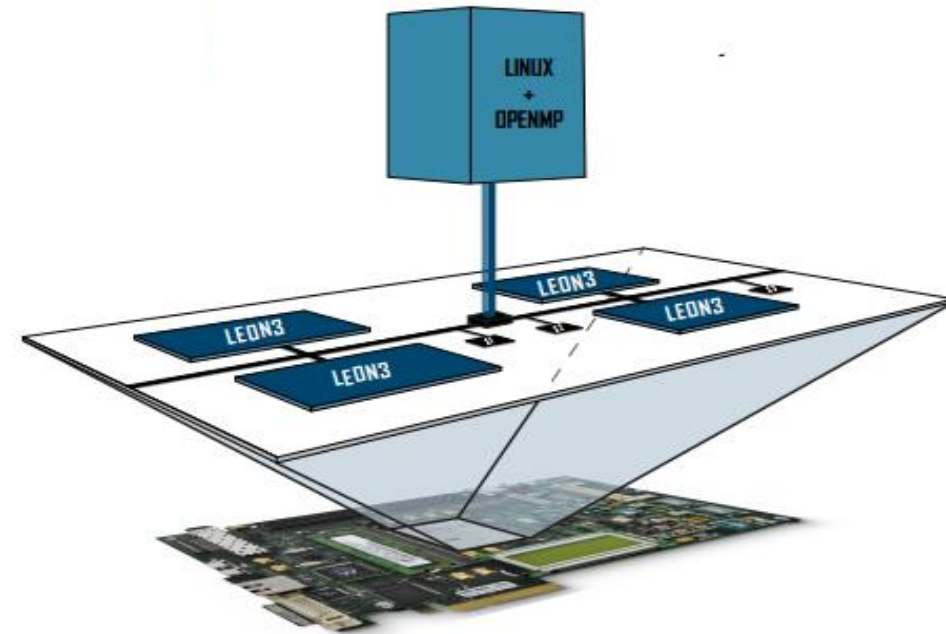
- **Bare-metal C/C++**
- **EOS/RTOS/HPV:** Linux, FreeRTOS, VxWorks, RTEMS, PikeOS, Xtratum

COMMUNICATION PROTOCOLS

- **Wired:** USB, SPI, I2C, UART, RS485, CAN, etc.
- **Wireless:** IEEE 802.15.11, IEEE 802.15.4, BT, LORA, etc.

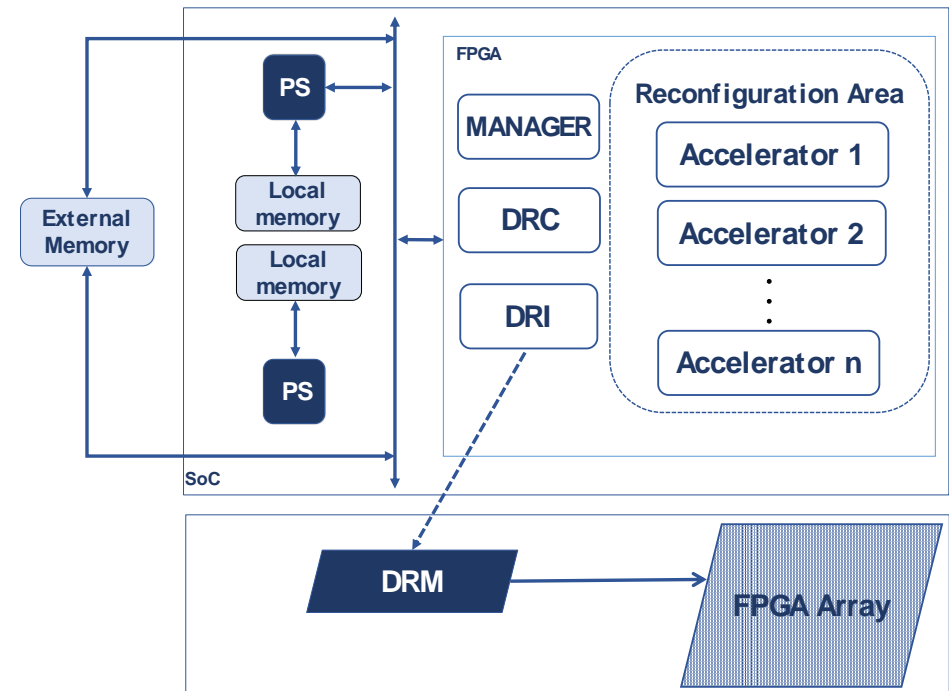
2. Embedded Systems Monitoring

- **Distributed HW Monitoring System**
 - Support for offline/online monitoring and reconfigurability
 - Library
 - AIPHS
 - Platforms
 - 4-LOOP, A-LOOP, F-OMP



3. Dynamic Partial Reconfiguration

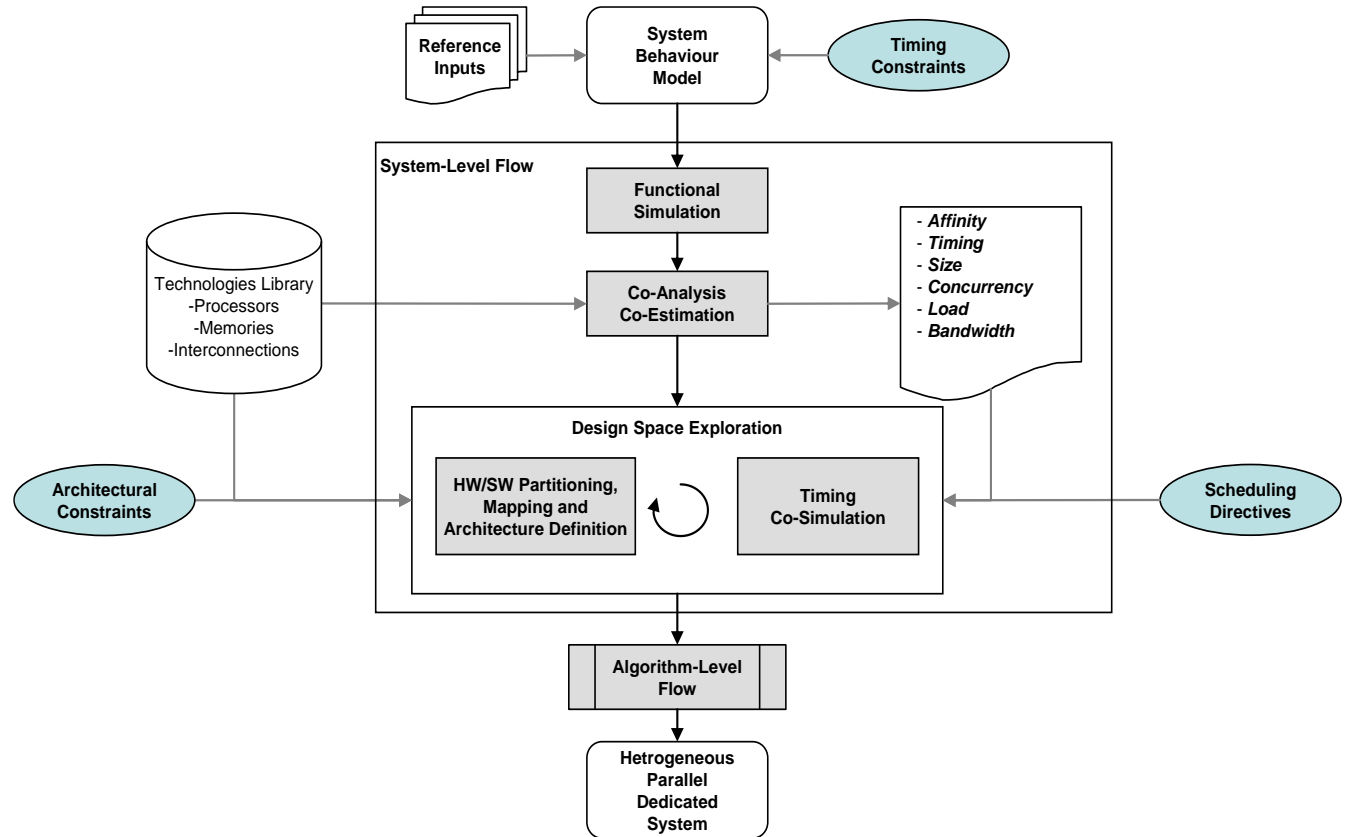
- **DPR Profitability**
 - Accurate evaluation on Xilinx SoCs
 - Reconfiguration Time
 - Run-Time Reconfiguration Manager
 - Real-time Systems



4. ESL HW/SW Co-Design

Hepsycode

HW/SW Co-Design of
Heterogeneous Parallel
Dedicated/Embedded
Systems



<http://www.hepsycode.com>

5. Wireless Sensor Networks

- **Basic Technologies**
 - **HW:** CrossBow/Memsic, Advanticsys, Texas Instruments, Atmel
 - **SW:** C/HAL, TinyOS, Contiki
 - **Communication protocols:** IEEE 802.15.4 (802.15.4e), OpenZB
 - **LabSMILING** - *Remote Lab and Testbed*

- **Middleware for WSN**
 - Heterogeneous HW/SW/radio platforms
 - Mobile-agents based Virtual Machines
 - Services
 - Indoor Localization, Security, GIS

6. Neural Networks

- **AI at the Edge**
 - Embedded AI
 - HW: FPGA
 - SW: uC, GPU, dedicated cores (e.g., Xilinx VERSAL)
 - Applications
 - Age&Gender Estimation
 - CNN

7. Assistive Technologies

- **The CrazySquare Project**
 - ICT-Game based system for music education learning
- **IVR-based Serious Game for ASD People**
 - Serious games for the treatment of autistic people using immersive virtual reality technologies

8. eICT for New Arts

- **RF Sounding**
 - Awareness of surrounding electromagnetic fields due to both base stations and users mobile terminals
- **Augmented Musical Instruments**
 - eTrumpet

EMBEDDED SYSTEMS DESIGN: FUNDED RESEARCH PROJECTS

- **VISION (ERC-2009-StG 240555) [CLOSED]**
 - Video-oriented UWB-based Intelligent Ubiquitous Sensing
- **SMILING (RIDITT 2009, national project) [CLOSED]**
 - SMart In home LiViNG
- **PRESTO (Artemis-JU ASP 2010-269362) [CLOSED]**
 - ImProvements of industrial Real Time Embedded SysTems develOpment process
- **CRAFTERS (Artemis-JU ASP 2011-295371) [CLOSED]**
 - ConstRaint and Application-driven Framework for Tailoring Embedded Real-time Systems
- **EMC2 (Artemis-JU AIPP 2013-621429) [CLOSED]**
 - Embedded Multi-Core systems for Mixed Criticality applications in dynamic and changeable real-time environments
- **CASPER (H2020-MSCA-RISE-2014) [CLOSED]**
 - User-centric MW Architecture for Advanced Service Provisioning in Future Networks
- **SAFECOP (ECSEL-JU RIA-2015) [CLOSED]**
 - Safe Cooperating Cyber-Physical Systems using Wireless Communication
- **MEGAM@RT2 (ECSEL-JU RIA-2016) [CLOSED]**
 - MegaModelling at Runtime - scalable model-based framework for continuous development and runtime validation of complex systems
- **AQUAS (ECSEL-JU RIA-2016) [CLOSED]**
 - Aggregated Quality Assurance for Systems

EMBEDDED SYSTEMS DESIGN: FUNDED RESEARCH PROJECTS

- **FITOPTIVIS (ECSEL-JU RIA-2017) [RUNNING]**
 - From the cloud to the edge - smart IntegraTion and OPTimization Technologies for highly efficient Image and Video processing Systems
- **AFARCLOUD (ECSEL-JU RIA-2017) [RUNNING]**
 - Aggregate Farming in the Cloud
- **COMP4DRONES (ECSEL-JU RIA-2018) [RUNNING]**
 - Framework of key enabling technologies for safe and autonomous drones' applications
- **OPTIMIST (H2020-MSCA-RISE-2019) [RUNNING]**
 - OPTIMised video content delivery chains leveraging data analysis over joint multi-access edge computing and 5G radio network infrasTructures
- **FRACTAL (ECSEL-JU RIA- 2019) [RUNNING]**
 - A Cognitive Fractal and Secure EDGE based on an unique Open-Safe-Reliable-Low Power Hardware Platform Node
- **IREL 4.0 (ECSEL-JU IA- 2019) [RUNNING]**
 - Intelligent Reliability 4.0

EMBEDDED SYSTEMS DESIGN: MAIN ACADEMIC PUBLICATIONS & EVENTS

- **2019/2020**
 - More than 10 publications on journals (Scopus)
 - More than 30 presentations at conferences (Scopus)
 - Tutorials/Summer Schools (>5), Exhibitions/Demos (>5)

EMBEDDED SYSTEMS DESIGN: INDUSTRIAL RESEARCH CONTRACTS

- **LE**
 - Thales Alenia Space Italy
 - Xtratum HPV Qualification
 - RTEMS over XtratuM HPV Qualification
 - CFDP over specific OBCwith PUS-C compliance
 - Satellite Simulation Framework
 - Thales Italy
 - Advanced multi-core platforms
 - Embedded profiling mechanisms for multi-core platforms

EMBEDDED SYSTEMS DESIGN: INDUSTRIAL RESEARCH CONTRACTS

- SME
 - Tekne (Italy)
 - Embedded profiling mechanisms
 - RoTechnology (Italy)
 - Wireless Sensor Networks Security
 - Embedded Systems Security
 - Kondor CS (Italy)
 - CNN for Age&Gender estimation
 - HIPPEROS (Belgium)
 - Experimentation of the HIPPEROS ARIA software stack

EMBEDDED SYSTEMS DESIGN: MEMBERSHIPS

- **ARTEMIS Industry Association (ARTEMIS-IA)**
 - Advanced Research & Technology for EMbedded Intelligent Systems
 - <https://artemis-ia.eu/>
- **HSA FOUNDATION**
 - Heterogeneous System Architecture
 - <http://www.hsafoundation.com/>
- **HiPEAC**
 - European Network on High Performance and Embedded Architecture and Compilation
 - <https://www.hipeac.net/>
- **TULIPP Advisory Board**
 - Towards Ubiquitous Low-Power Image Processing Platforms
 - <http://tulipp.eu/>
- **National Laboratories (CINI)**
 - Embedded Systems & Smart Manufacturing
 - Assistive Technologies (AsTech)

EMBEDDED SYSTEMS DESIGN: MAIN CONTACTS

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