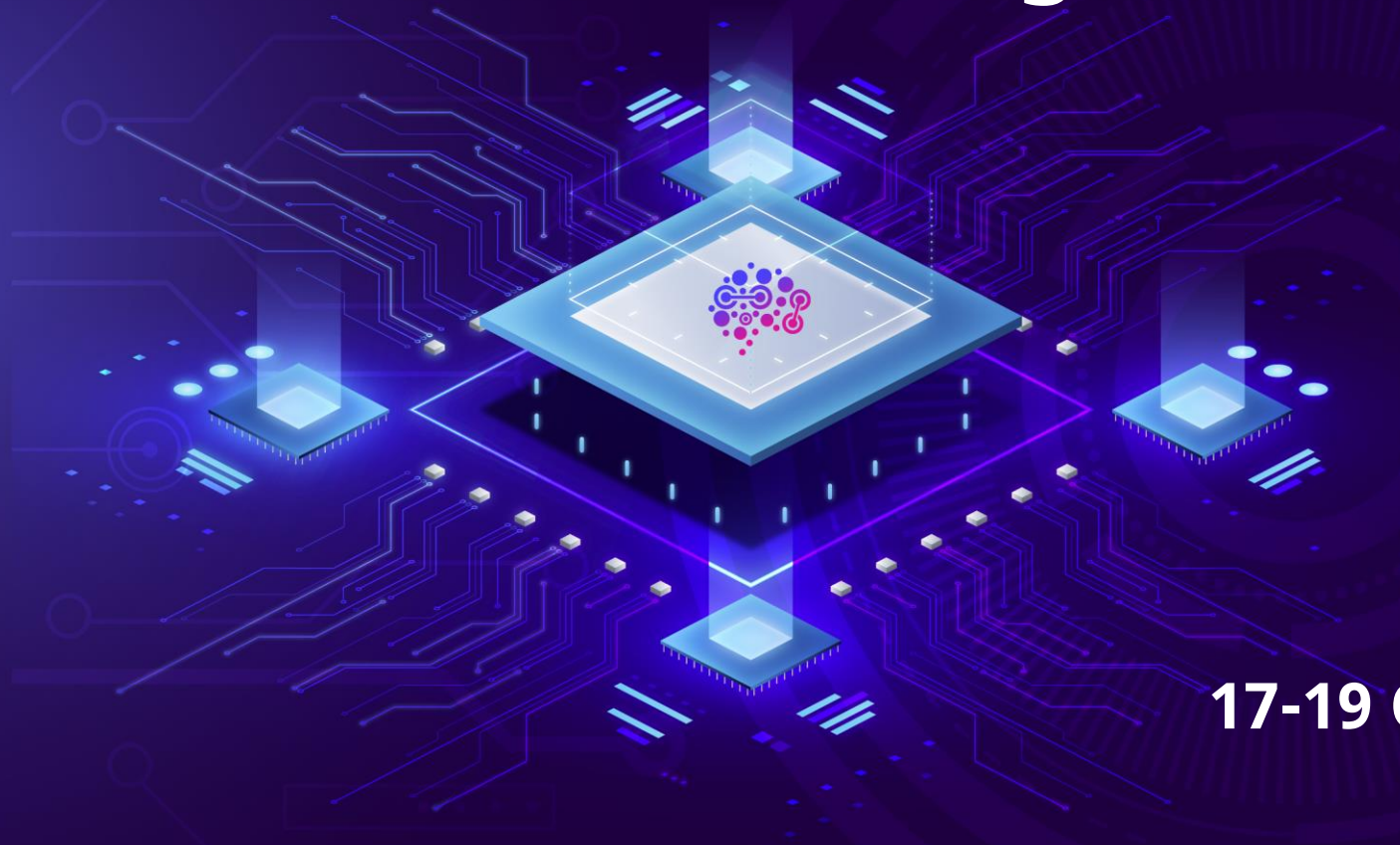
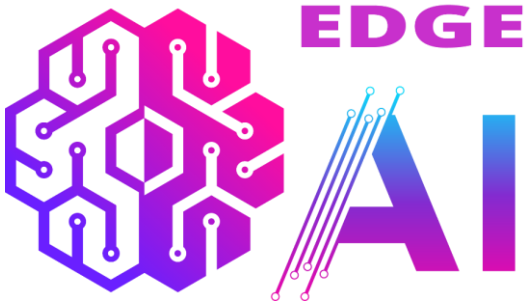
European Conference on EDGE AI Technologies and Applications - EEAI



Advancing emerging edge AI technologies and driving next generation intelligent applications.

17-19 October 2023, Athens, Greece

European Conference on EDGE AI Technologies and Applications - EEAI



ANDANTE

AI for New Devices And Technologies at the Edge

Mario Diaz Nava, STMicroelectronics, France

17-19 October 2023 Athens, Greece

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Project Overview

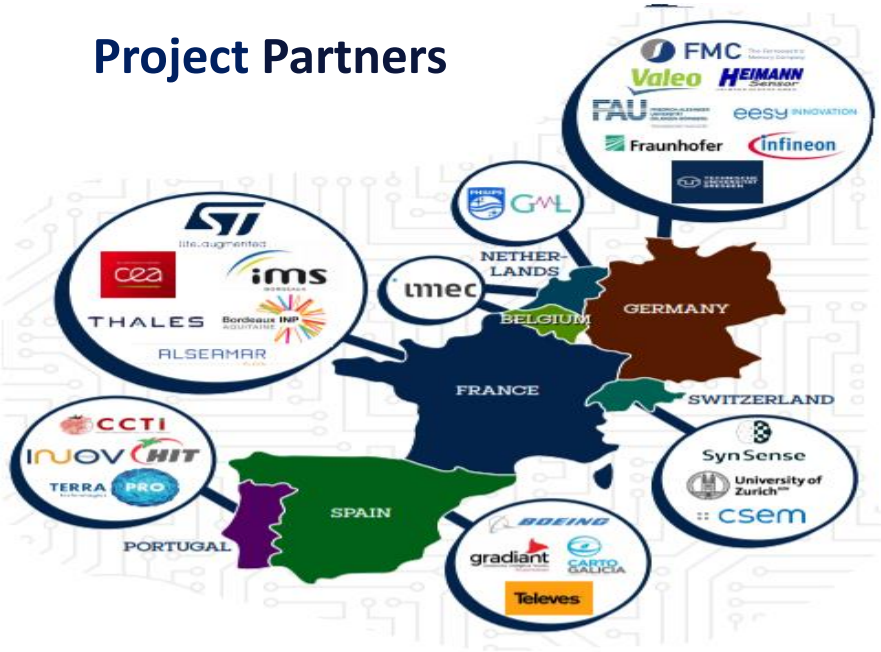
ANDANTE

ANDANTE aims to leverage innovative IC designs to build powerful **HW&SW platforms** for artificial and spiking neural networks (**ANN/SNN**) as a basis for future products in the **Edge IoT domain**, combining extreme power efficiency with robust neuromorphic computing capabilities and demonstrate them in key application areas.

Main focus

Emerging eNVM memories	Tools & Methodologies	Neuromorphic ASICs & FPGAs	AI Platforms & Applications
• OxRAM, • PCM • FeFET, • SOT-MRAM	• SW-HW co-design • Training, profiling and mapping a neural network on a HW target	• SNN and ANN architectures • Digital, mixed-signal design strategies	• Validate, and evaluate performance • Solutions pertinence

Project Partners



ANDANTE targets innovative solutions in the Edge with strong market impact

Digital Industry · Digital Farming · Transport & Smart Mobility · Healthcare · Digital Life

Project facts and figures

Start	End	Duration	Budget	Partners	Countries
June 2020	Feb 2024	45 Months	40 €M	30	7

https://andante-ai.eu
www.linkedin.com/company/andante-ai
mario.diaznava@st.com (coordinator)

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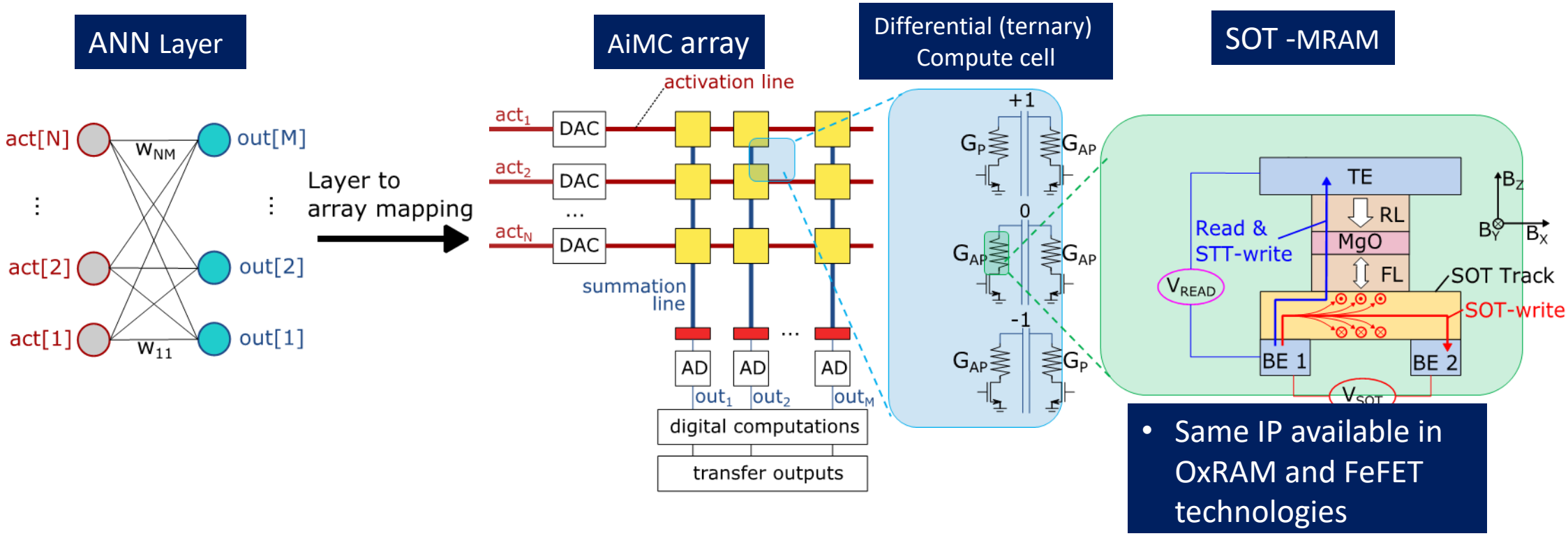
State-of-the-art: embedded non-Volatile Memories

Fundamental IP for aiMC in OxRAM, FeFET and SoT-MRAM

- Matrix vector multiplications (MVMs)
- Minimizing the data movement between through IMC (In Memory Computing techniques) and the high storage density of eNVM.



- Same IP available in OxRAM and FeFET technologies

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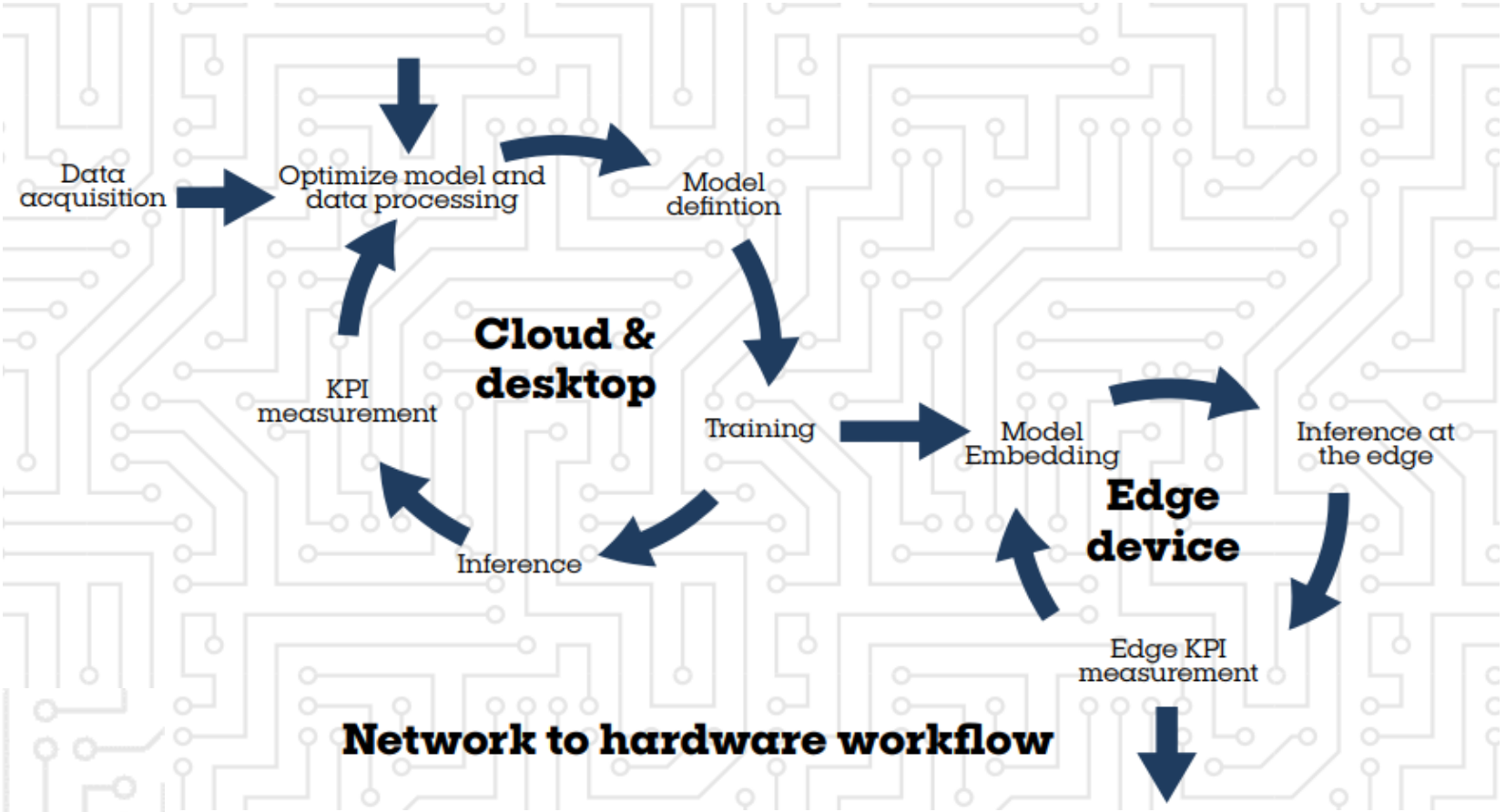
State-of-the-art: Tools and Methods for training, profiling and mapping NN on a HW target

- Establish a SW-HW co-design methodology
- Tools for
  - Training :
    - Spiking and classical coding,
    - HW aware training for mixed-signal implementations of ANN ASICs.
  - Generation, Mapping and Simulation.



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State-of-the-art: Design of Neuromorphic SoCs, ASICs and FPGAs, and Platforms

Design of Edge AI processors (1/2)

8 ASIC Designs

Designs

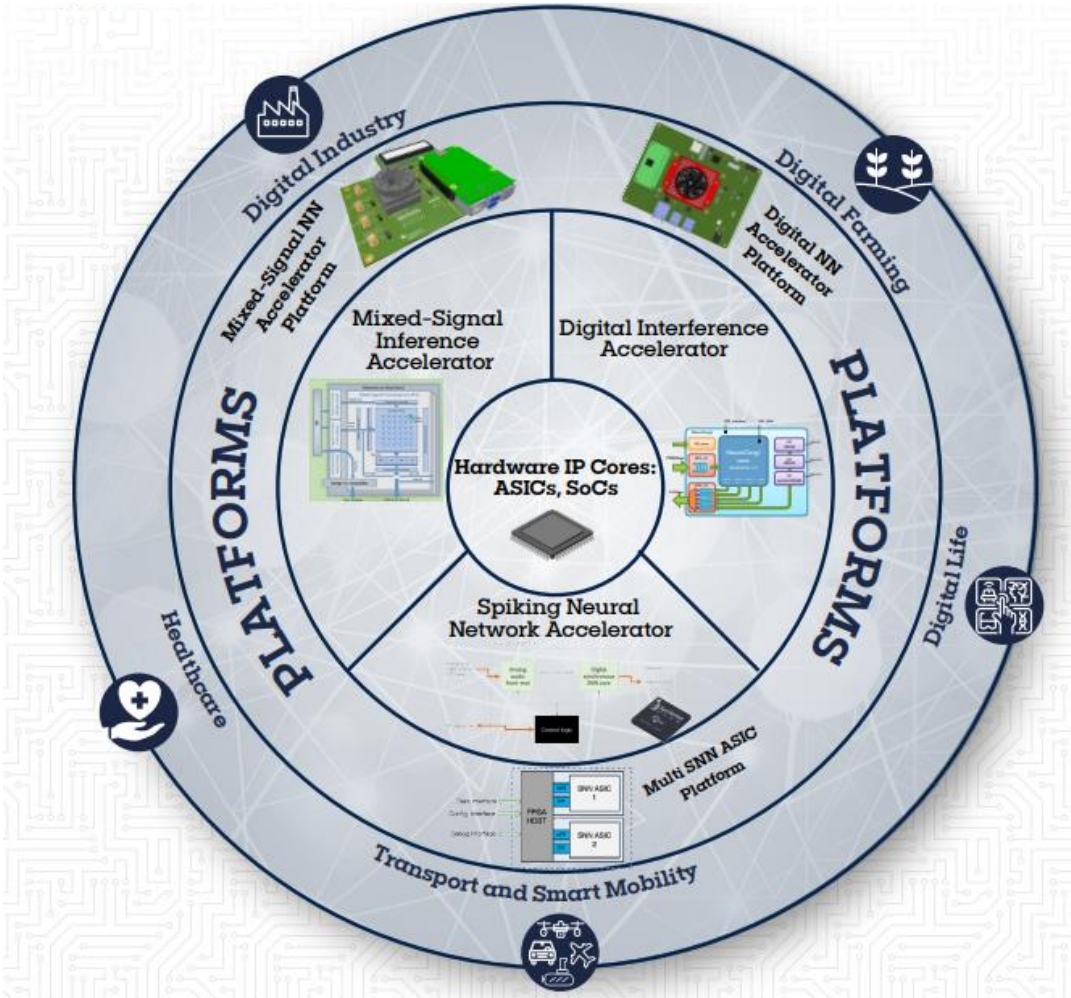
- 2 Mixed-signal SNN
- 1 Digital ANN (inference accelerator)
- 1 Digital CNN (smart vision)
- 3 Mixed-signal inference accelerators with in-memory computing
- 1 SoC (MCU + NPU (AI accelerator)

Benefits

- High energy efficiency
- Low latency
- High integration

6 Platforms

- 14 Applications in 5 Application areas
- Validation
- KPIs measurement
- Evaluation



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State-of-the-art: Design of Neuromorphic SoCs, ASICs and FPGAs, and Platforms

Design of Edge AI processors (2/2)

6 FPGA Designs

Designs

- Hybrid accelerator for Detection, Classification and Segmentation of high altitude Images
- 16 SpiNNaker2 processing element

  Hybrid inference accelerator
- Neuromorphic accelerator, SENeCA
- Accelerated inference of DNN for runway detection, Yolo v4
- Accelerated inference of DNN for object detection and image registration, RetinaNet and VGG19
- Accelerated inference of DNN for process communication parameters MobilNet V1

Benefits

- High level of (HW/SW) programmability
- Design Flexibility
- Easy to update and Optimize

Xilinx Platforms

Applications

- Smart Mobility and Healthcare application areas
- Validation
- KPIs measurement

VCU118

ZCU102

ZCU11

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State-of-the-art: 14 Use cases in 5 Domains

Use Case 1.1: Indoor Positioning Recognition and People Counting

Digital Industry

Use Case 2.1: Autonomous Weeding System

Digital Farming

Use Case 2.2: Tomato pests and diseases forecast

Digital Farming

Use Case 3.1: Drones/USV

Transport and Smart Mobility

Use Case 4.1: Multi-modal image processing and device tracking in medical X-ray and ultrasound images

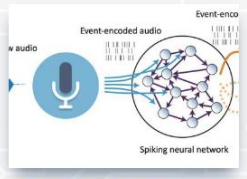
Healthcare

Use Case 4.2: Ultrasound acquisition or processing

Healthcare

Use Case 4.3: Glucose Monitoring

Healthcare



Use Case 5.1: Consumer Auditory Processing

Digital Life

Use Case 3.2: Underwater Acoustic Signal Classification

Transport and Smart Mobility

Use Case 3.3: 3D Object Detection and Classification of Road Users based on LiDAR and camera

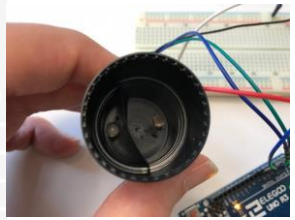
Transport and Smart Mobility

Use Case 3.4: Robust Autonomous Landing

Transport and Smart Mobility

Use Case 3.5: Path planning for autonomous steering

Transport and Smart Mobility



Use Case 1.2 :Color detection

Digital Industry

Application Domains:

- Digital Industry
- Digital Farming
- Transport and Smart Mobility
- Healthcare
- Digital Life

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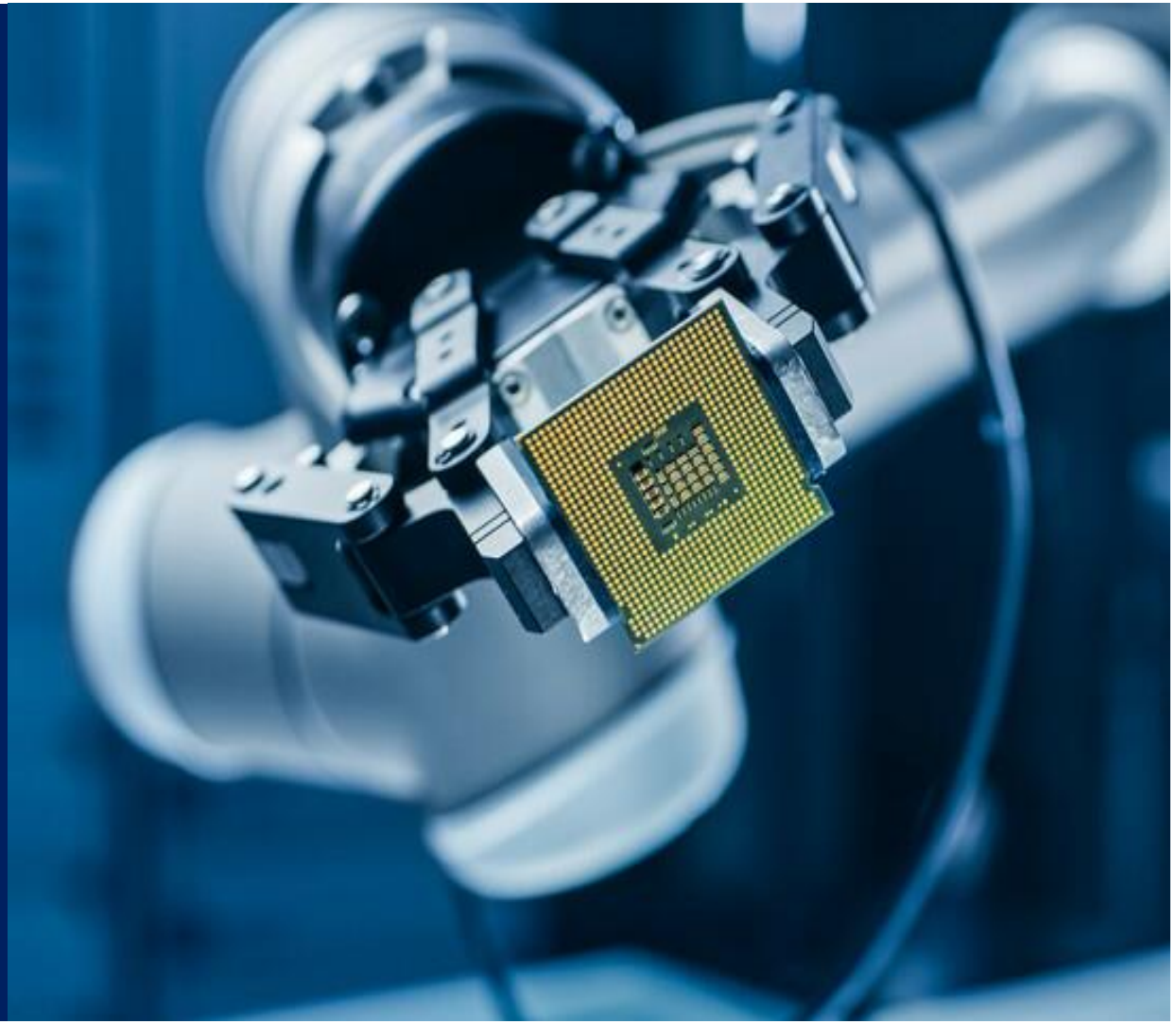
Highlights: Contributions for efficient AI HW solutions at the Edge

Brief Summary on October 17th, 2023:

- NVM technologies :
  - Prototypes available in OXRAM, FE-FET, SOT-RAM and PCM advanced technologies
- AI Methods and tools
  - HW: SW co-design methodology and 16 associated tools
- IC Designs
  - 14 designs: 6 ASICs/SOCs available, 2 under design, 6 FPGAs available
- Platforms
  - 6 platforms: 5 available, 1 under validation
- Applications
  - 14: 8 available and 6 under development.
- Dissemination
  - > 60 publications, exhibitions, workshops and videos



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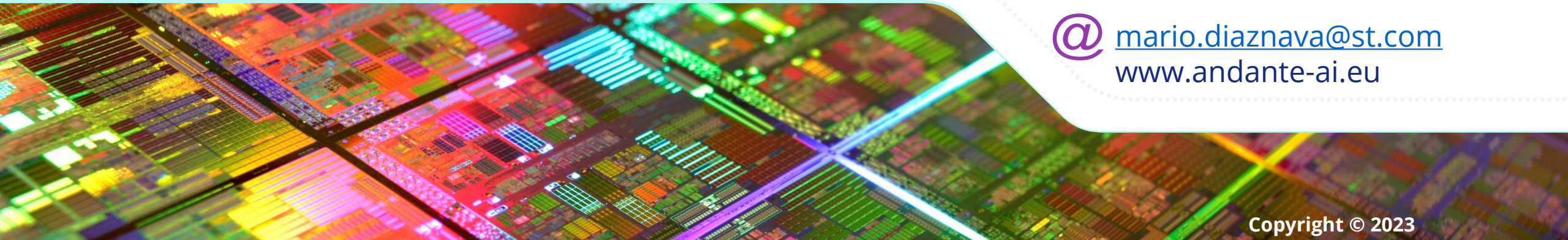
EDGE AI

Thank You

For your attention



@ mario.diaznava@st.com
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