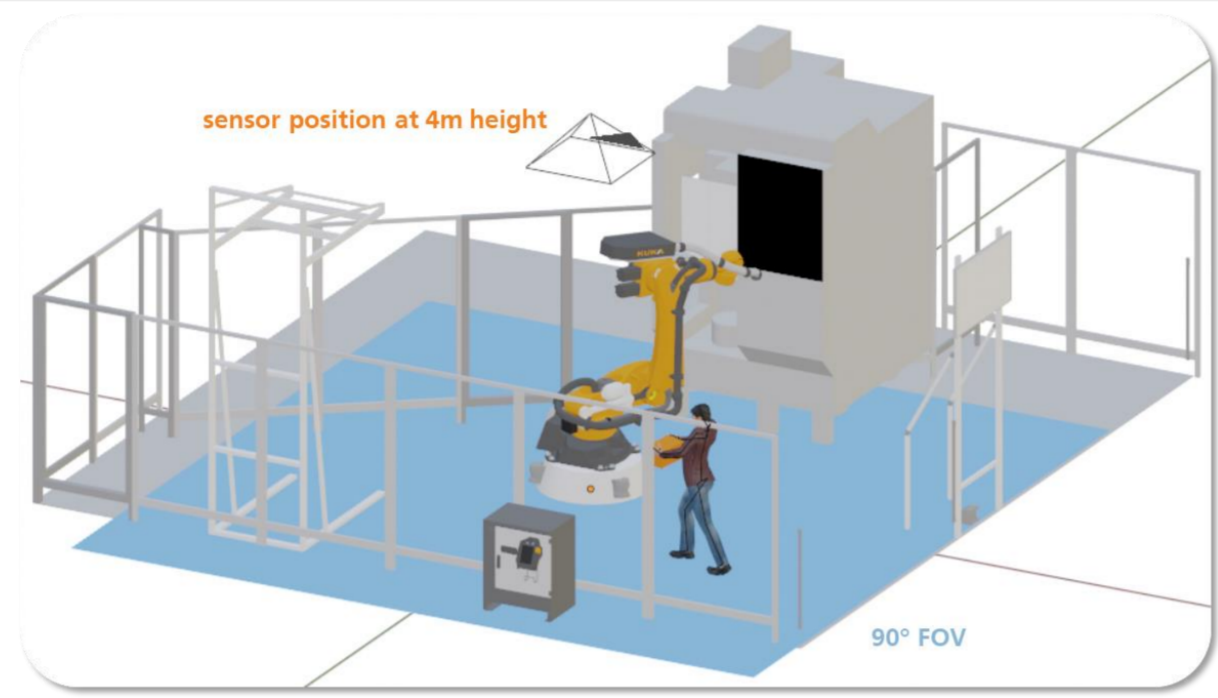


Conceptualization of hybrid neuromorphic sensor systems in practice

1 Problem and potential

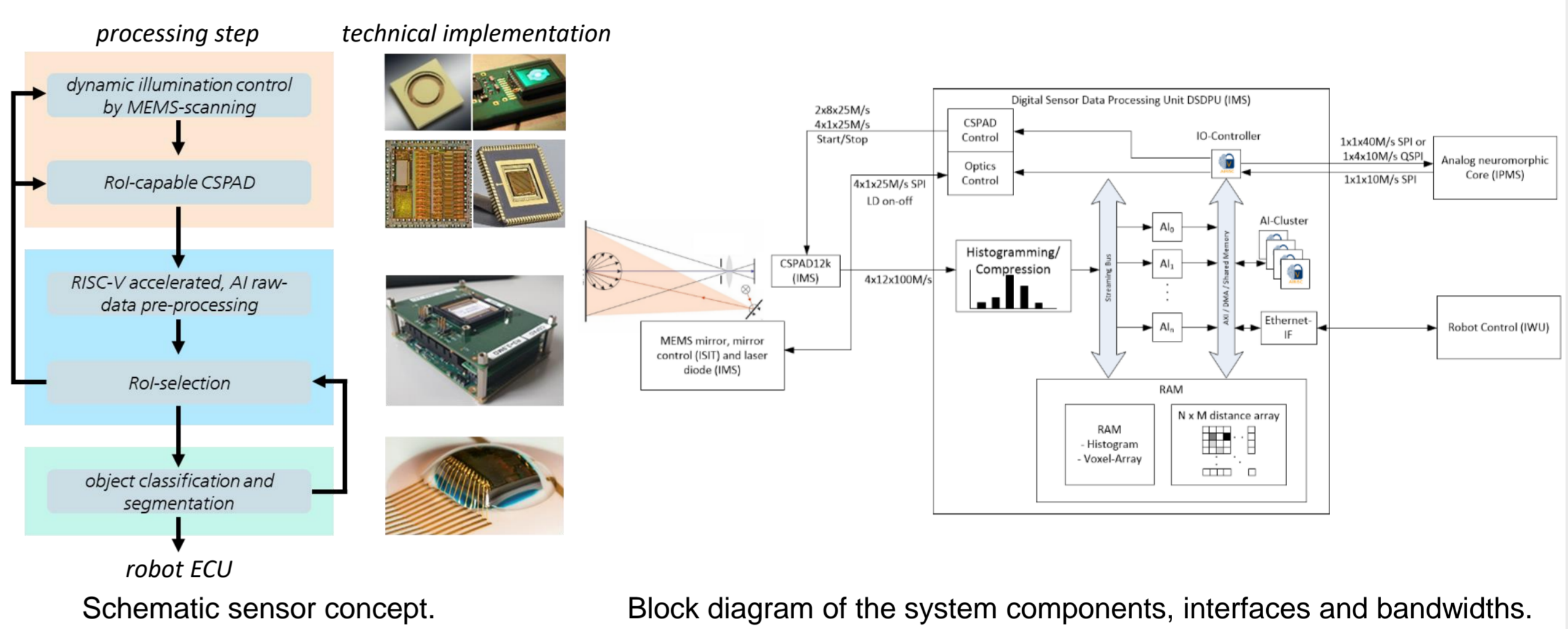
Application: Dynamic safety zones in human-robot collaboration for manufacturing environments.
Challenge: Simultaneous demand for reliability, latency and energy efficiency.



Objective: Basic system design for the use of neuromorphic accelerators and critical evaluation of user benefits in a LiDAR safety system.
Potential and synergies: In-memory compute (IMC) accelerators are very energy efficient. Digital (neuromorphic) solutions enable the scaling of bandwidth and precision.

2 Codesign and interfaces

Early focus on **data rate reduction and quantization**. **Application requirements** dominate design decisions. **Raw data access** is essential in order to make optimum use of IMC accelerators. Restriction to CNNs.

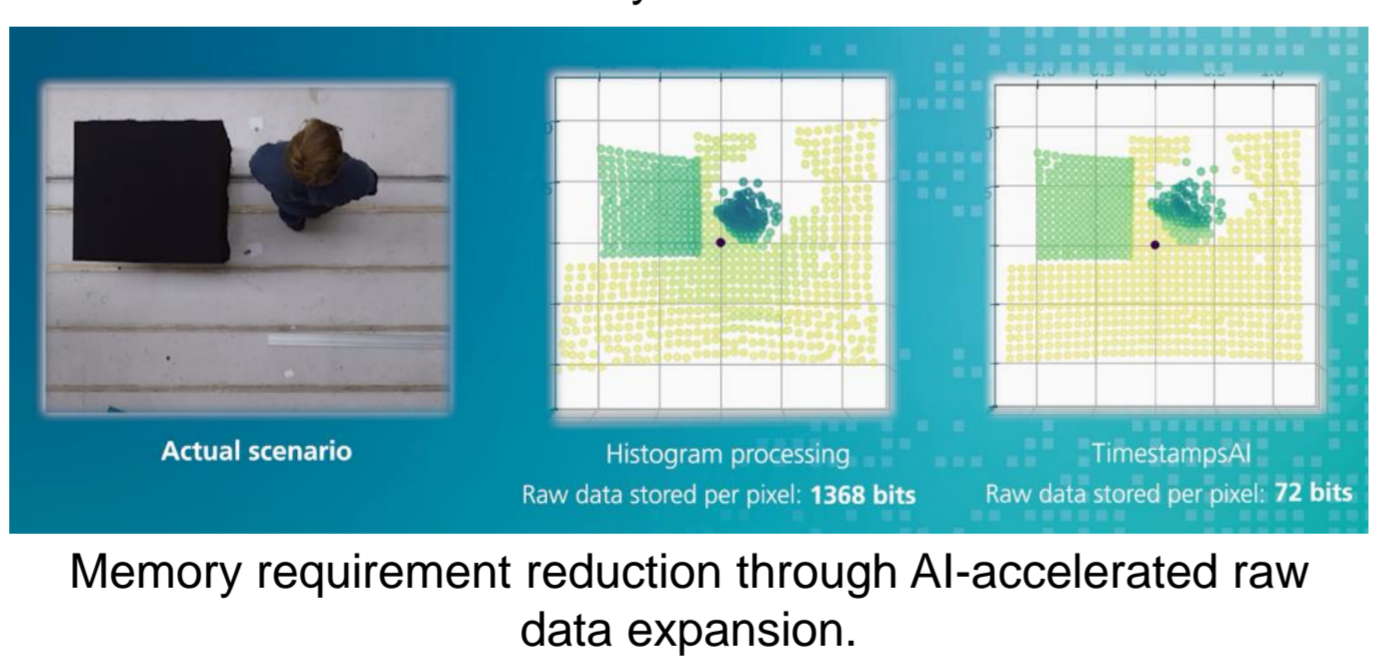
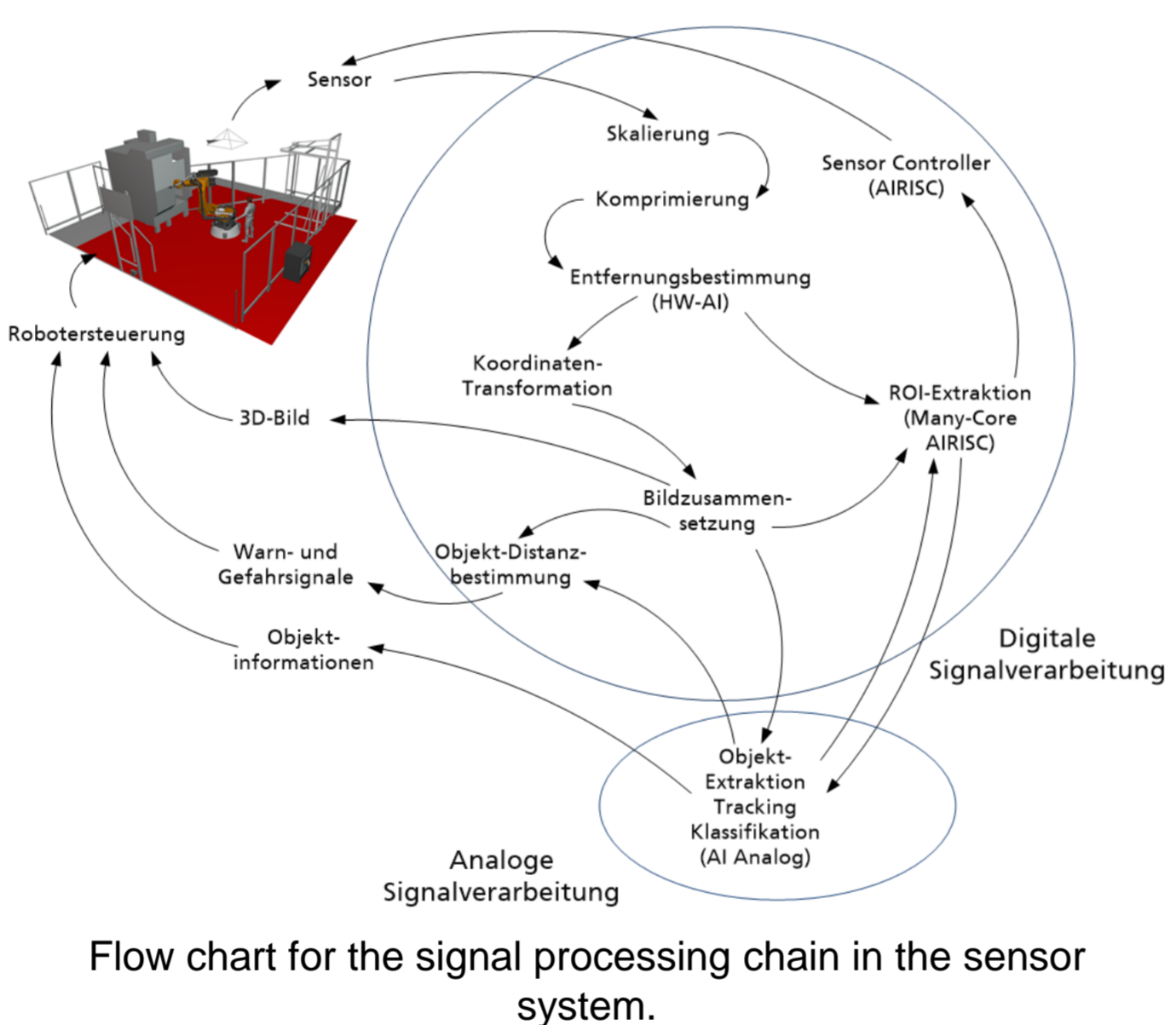


3 Neuromorph ≠ Neuromorph

Application-specific **many-core RISC-V** processors with AI accelerators for efficient and low-latency raw data processing.

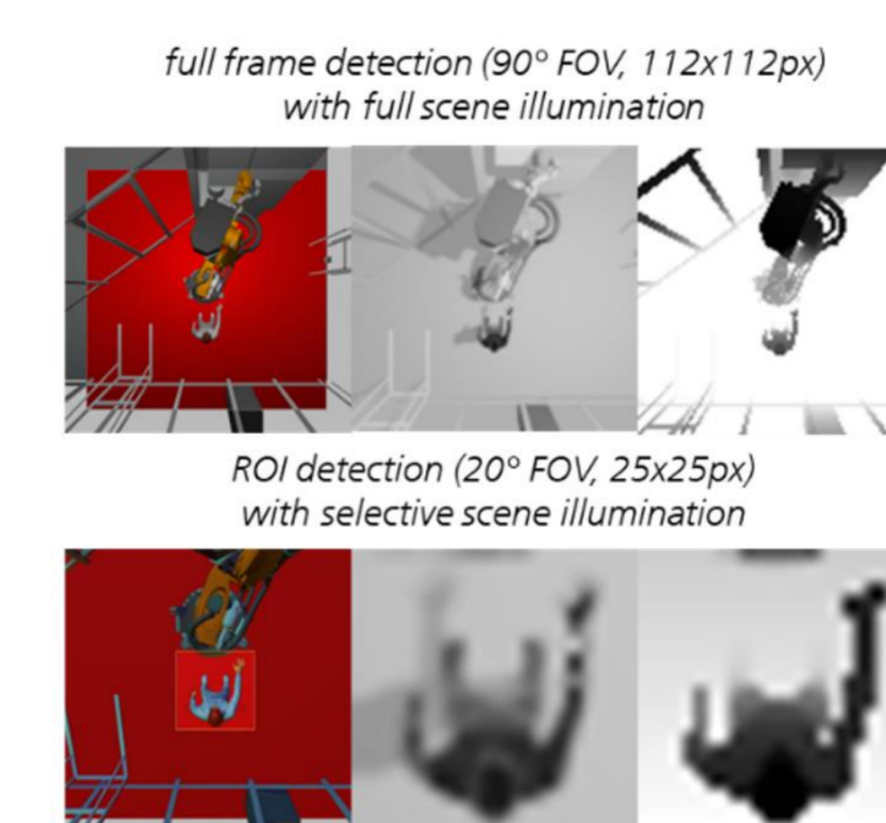
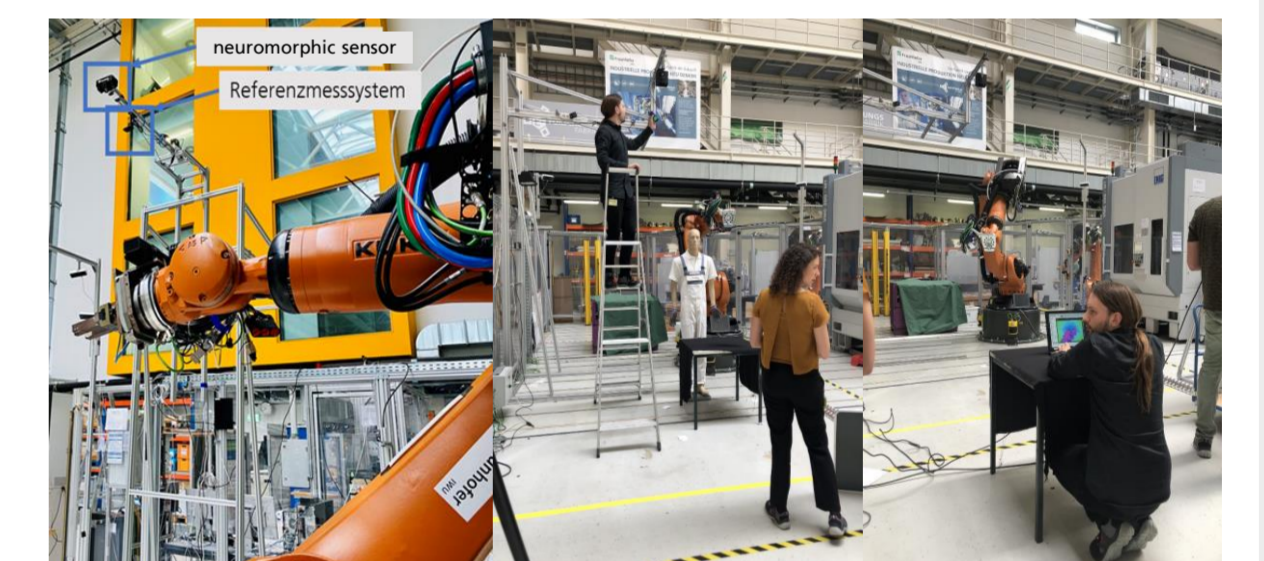
2-8-bit FeFET-based **mixed-signal IMC accelerator** for energy-efficient per-pixel segmentation of relevant image sections.

Reconfigurable (ROI-capable) **sensor system** reacts to scene content.



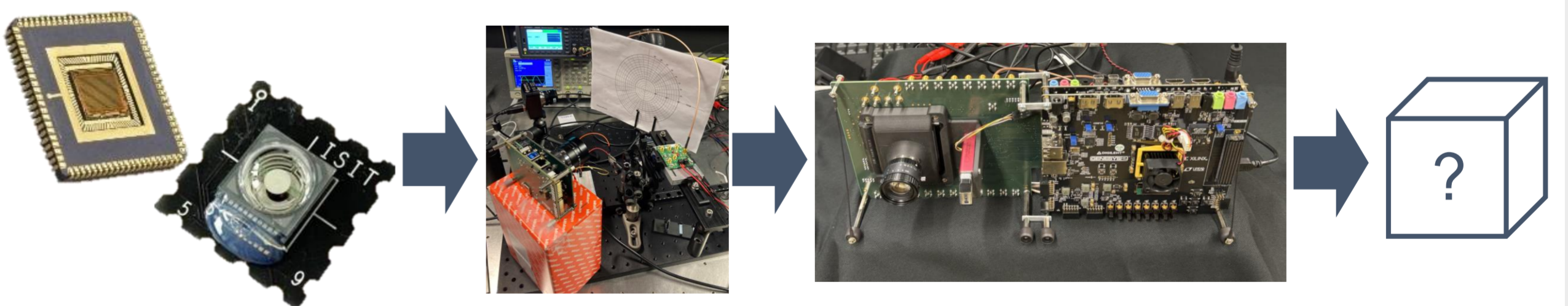
4 Iterative, application-centric development

Record **real data** as early as possible to validate the system design (even with low resolution, low FOV, ...).



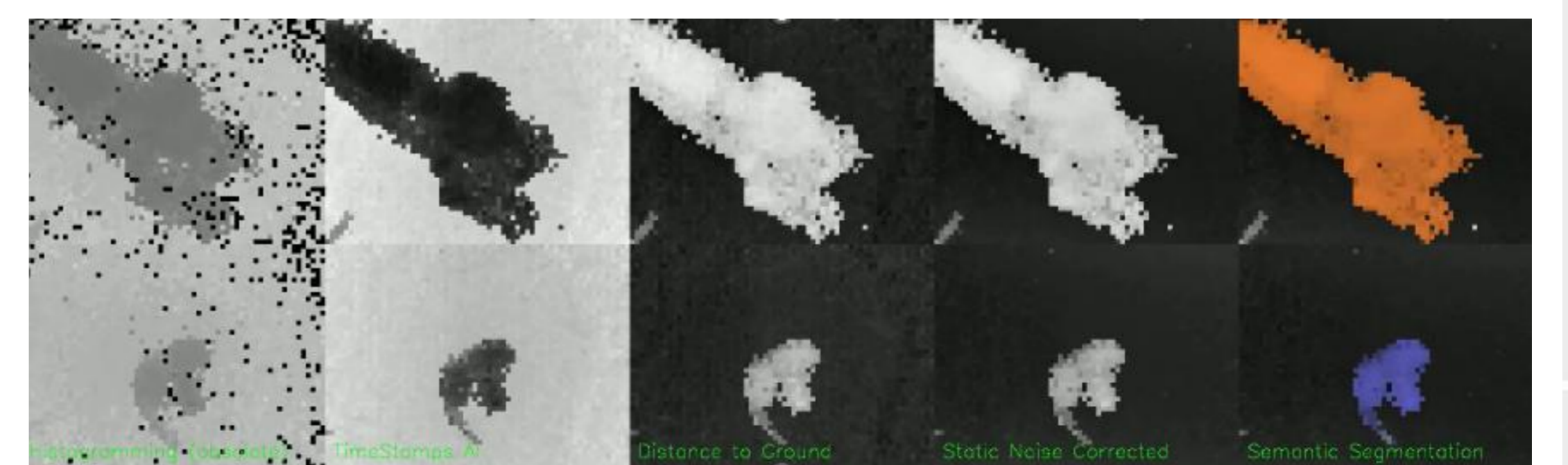
Synthetic training data generation to develop NNs and evaluate quantizations. Define scenes and extreme cases for real data acquisition.

System development from components to prototypes



5 Status of work and outlook

Development and production of the sensor components completed.
 Digital data pre-processing pipeline established. CNN IMC accelerator in processing.
 Prototype presentation in 2025.
 Numerous lessons learned along the system design and evaluation process.



Real data along the processing chain up to segmentation and object classification.

