

# GRAIN

## RADIATION-TOLERANT EDGE AI

### Authors



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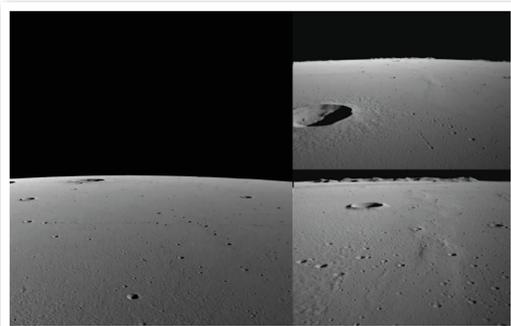
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### Introduction

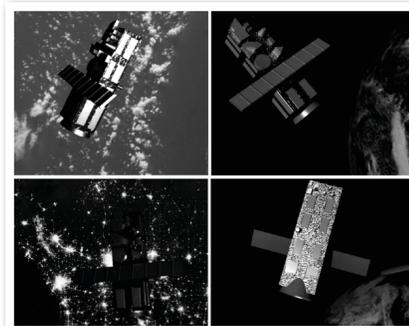
- Neuromorphic technology in space
- Motivation
  - Neuromorphic technology has the potential to provide more autonomy and lower latency while minimising power consumption in space missions.
  - Use cases are being explored in a running ESA TDE activity NEURAVIS - Neuromorphic Evaluation of Ultra-low power Rad-hard Acceleration for Vision Inferences in Space.

- Use cases
  - Moon landing
  - Debris detection/collect
  - Docking
  - Object classification

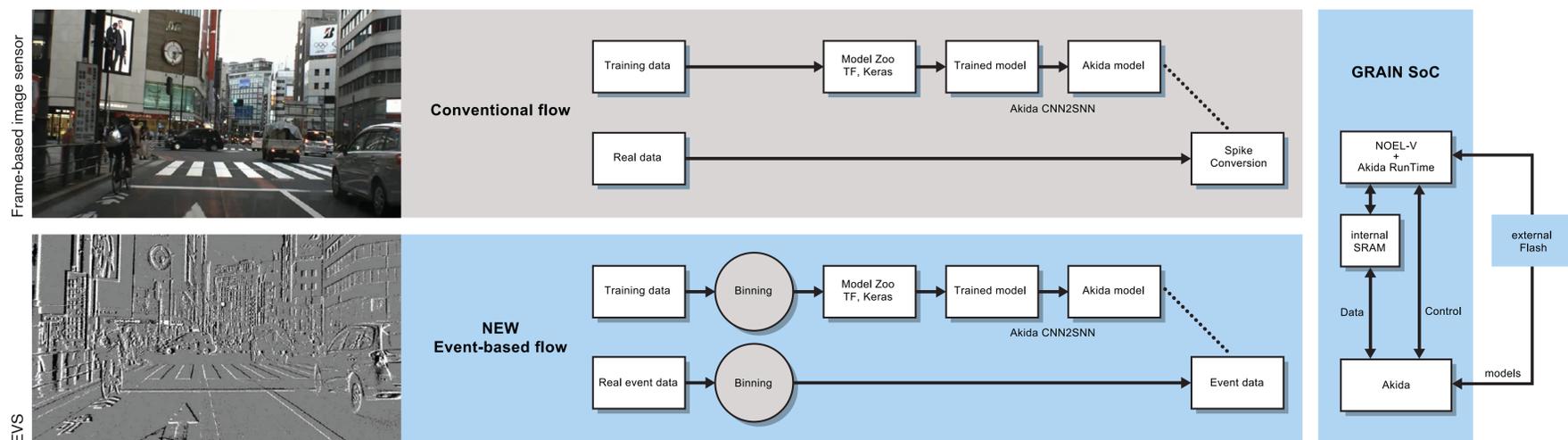
Use Case #1: Vision-Based Navigation for Lunar Lander



Use case #2: Monitoring building block for in-orbit rendezvous

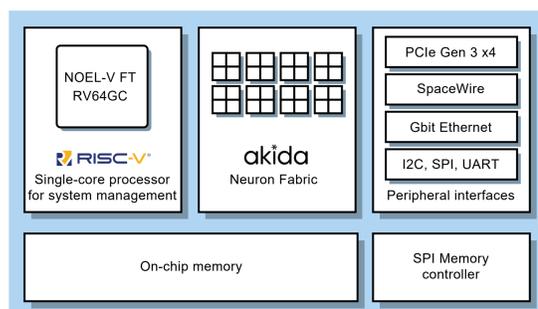


### Conventional vs event-based inference flow



### Features

- RISC-V CPU (NOEL-V)
- Akida 1.0 neuromorphic engine
- Fault-tolerant
- Rich set of interfaces
- On-chip RAM
- Small footprint



### Application scenarios

#### Remote Terminal Unit

- Collection analog and digital telemetry from sensors and units (Temperature, Pressure, Digital Status)
- Setup and conditioning of analogue sensors
- Control AOCS actuators and sensors
- Control the Propulsion, control Solar Array Drive Equipment
- Distribute power to heaters, distribute power to active loads

#### Stand-alone Controller

- Efficient system partitioning (main processor vs MCU)
- Robotics
- Embedded system
- Data logging
- Monitoring system

#### Near-edge-processing unit

- Self-contained and autonomous system
- Close integration with sensors for data processing
- AI-driven control/monitoring
- Efficient partitioning of a low complexity vs a high complexity AI engine

#### Auxiliary data processing module

- Add-on module with AI engine to an existing CPU system
- Off-loading computation effort to a dedicated module
- Efficient partitioning of a low complexity vs a high complexity AI engine