Master Thesis Project: Neuromorphic Computing for Autonomous Space Systems
Hosting Organization

Supervisors:

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The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt e.V.; DLR) is Germany's leading research institution for aerospace, energy, transportation, and security. At the Institute of Software Technology (SC), over 200 researchers develop cutting-edge software solutions, including safety-critical systems, artificial intelligence, and advanced computational platforms. DLR offers a vibrant, international, and innovative environment, ideal for tackling some of the world's most pressing technological challenges.

Project Motivation

Modern satellite systems, such as large-scale constellations, require unprecedented levels of autonomy and resilience due to their complexity and scale. Neuromorphic Computing Hardware (NMHW) offers a promising alternative, combining energy efficiency, responsiveness, and robust learning capabilities. This thesis aims to investigate the application of NMHW in space systems, enhancing resilience against both short-term faults (like soft errors) and long-term hardware degradation.

Research Objectives

Your mission will be to explore how NMHW can be integrated into autonomous space systems effectively and efficiently. Specifically, you will:

* Understand the capabilities and limitations of Neuromorphic Computing.
* Identify the specific requirements of on-board space computers suitable for NMHW integration.
* Develop a resilient, energy-efficient concept leveraging NMHW.
* Implement your design on actual neuromorphic hardware platforms.
* Validate your solution through simulated testing environments.

Methodology & Tasks

The project will involve:

* Literature survey on current Neuromorphic Computing approaches and space system autonomy.

* Requirement analysis and concept definition.

* Hardware selection and integration into test environments.

* Implementation and rigorous testing on selected NMHW.

* Result analysis and comprehensive documentation of findings.

Expected Outcomes

* A thorough evaluation of Neuromorphic Computing in enhancing autonomy and resilience of space systems.

* Practical demonstration of your proposed solution on actual NMHW platforms.

* Detailed performance evaluation in terms of energy efficiency, resilience, and system responsiveness.

Required Skills

* Pursuing a master's degree in Computer Science, Embedded Systems, Electrical Engineering, or a related field.

* Strong programming skills in Python and C/C++ (or Rust).

* Familiarity with FPGA design and integration.

* Solid understanding of AI and machine learning principles.

* Analytical mindset and strong problem-solving capabilities.

* Proficiency in English (written and oral).

Location & Supervision

The thesis will be supervised at the DLR location in Oberpfaffenhofen (near Munich), with direct guidance from local researchers. An alternative location in Braunschweig is also possible, but Oberpfaffenhofen is preferred due to on-site supervision.

Financial Support

DLR will offer a student assistant (HiWi) position to partially cover expenses. Additionally, students are encouraged to apply for Erasmus(+) funding for extra financial support.

Duration & Credits

This project can be scoped as either:

* A combined master's thesis and internship, or

* A stand-alone master thesis project.
