# VERGER : Early Timing Verification of GERICOS multicore critical software


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**Context and objectives.**

For several years, LESIA (UMR CNRS 8109) has been developing the GERICOS software platform. The GERICOS platform is a middleware dedicated to the development of embedded software for space systems. It was, for example, used to implement the PLATO satellite payload. GERICOS offers to the software developers a set of reusable and layered components to facilitate the development of real-time critical software. The platform is also used as part of a model-driven engineering approach to automate software production.

Since 2002, the Lab-STICC (UMR CNRS 6285), has been developing methods and tools to ensure the verification of the timing constraints of critical real-time systems in the early design phase of the system design. It has been shown that this early verification phase is a key step to guarantee the quality of the produced system while controlling its production cost. These methods and tools are based on the AADL language and a model-driven approach. In collaboration with the company Ellidiss Technologies, these methods and tools are integrated into various open-source and commercial platforms, such as the AADLInspector product or the open-source platform TASTE from the ESA.

Given the targeted applications, LESIA is now facing with the need to automatically produce timing constraint verifications of software built with GERICOS. However, today, the GERICOS engineering process does not include such verification, which can be a difficult task to achieve given the specificities of GERICOS components. For example, GERICOS assumes the use of an execution platform based on multi-core processor.

The objective of the thesis is therefore to combine the skills of the three teams: LESIA, Lab-STICC, and the CNES in order to increase the verification capabilities of the GERICOS platform. Automating the verification of timing constraints imposed on GERICOS applications raises several challenges. The thesis proposes to study 3 of them:

1. We plan to investigate the compatibility of the semantics of the GERICOS components with the analysis methods of the literature in real-time scheduling analysis.
2. In case literature does not fully support GERICOS features, we also plan to extend scheduling analysis methods to make them applicable to GERICOS-compliant software architectures.
3. We finally expect to integrate the thesis contributions into a software design process based on the GERICOS language.

**Complementary of the team and potential outcomes.**

LESIA has developed expertise recognized by space agencies (CNES, ESA, DLR) in the field of flight software. All LESIA flight software developments are carried out using the GERICOS platform, itself designed and developed by LESIA. With regard to space projects, LESIA has been responsible for the development of the software embedded in the on-board computer of the RPW instrument on Solar Orbiter, a sun observation satellite in operation since February 2020. LESIA is currently responsible for the development of the flight software for the on-board processing units driving the cameras of the PLATO payload, which is scheduled for launch in 2027.

The partners recently collaborated on the PLATO satellite. The timing analysis of the PLATO flight software was made possible thanks to a collaboration with CNES, LESIA, Lab-STICC and Ellidiss technologies. It is also within the framework of the PLATO project that the GERICOS platform was extended to support AMP (Asymmetric Multi-Processing) multi-core architectures.

A first outcome of the thesis is a new version of the GERICOS platform. The GERICOS platform used for the development of flight software of the Solar Orbiter and PLATO missions

must be improved and extended to make possible and automatable their timing verification. The thesis will allow this improvement by making GERICOS compatible with the analysis tools designed by the Lab-STICC.

Regarding the impacts for the Lab-STICC, this thesis should allow the laboratory to consolidate its activities in the field of space software. Recently, the Lab -STICC contributed with Ellidiss to the H2020 MOSAR which aimed to study and design technologies allowing the modular construction of satellites in order to improve their maintenance, both corrective and evolutionary. In this context, the Lab-STICC participated in the extension of the TASTE tools of ESA and Cheddar in order to allow the timing analysis of the software distributed on the SpaceWire network of the satellite.