

Julia
Van den Toren
DLR (German Aerospace Center) for Satellite Geodesy and Inertial Sensing, D-30167 Hannover, Germany
Alexander Koch, DLR (German Aerospace Center) for Satellite Geodesy and Inertial Sensing, D-30167 Hannover, Germany
Gerald Bergmann, DLR (German Aerospace Center) for Satellite Geodesy and Inertial Sensing, D-30167 Hannover, Germany
Kevin Grosse, DLR (German Aerospace Center) for Satellite Geodesy and Inertial Sensing, D-30167 Hannover, Germany
Thomas Schwarze, DLR (German Aerospace Center) for Satellite Geodesy and Inertial Sensing, D-30167 Hannover, Germany
Oral

Precise relative attitude control between two or more spacecraft is essential in satellite gravimetry missions. Missions such as GRACE-FO, or NGGM require a highly accurate initial alignment of their laser beams to establish an interferometric laser link. Current solutions, like those used on GRACE-FO, involve spatial acquisition scans lasting up to nine hours. To reduce this time to almost instantaneous operation, we propose MiniCAS, a compact optical system that enables attitude acquisition with microradian sensitivity.

MiniCAS (Miniaturized Constellation Acquisition System) comprises an optical receiver paired with a dedicated light source. Identical sensor systems are installed on both spacecraft. By detecting the light emitted by its counterpart, the receiver determines the misalignment relative to the connecting line between the two satellites, known as the Line of Sight (LOS). After on-ground calibration of the MiniCAS vs. LRI alignment, this measurement directly reflects the relative tilt of the LRI coordinate frame with respect to the LOS.

True to its name, MiniCAS focuses on a compact, lightweight and cost-efficient design, that increases MiniCAS's application areas. The receiver integrates a lens assembly with a suitable focal plane array. It is paired with a dedicated light source that emits a beacon beam, rendering spatial scanning sequences redundant. The current optical layout is optimized to provide a Field of View of approximately ± 5 mrad with additional margins, matching the needs of a mission like NGGM.

In this presentation, we introduce the main concept of MiniCAS. We outline system requirements and present current simulation results of the sensor data. In addition, we provide an overview of the current design status, including optical simulations of different lens configurations. The system is currently under active development and is expected to reach TRL 5 by the end of 2026.

Presentation file

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