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The Laser Ranging Interferometer on GRACE Follow-On

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The GRACE Follow-On satellites were launched on 22nd May 2018 to continue the measurement of Earth's gravity field from the GRACE satellites (2002-2017). A few weeks later, an inter-satellite laser link was established with the novel Laser Ranging Interferometer (LRI), which offers an additional measurement of the inter-satellite range next to the one provided by the conventional microwave ranging instrument. The LRI is the first optical interferometer in space between orbiters, designed to measure inter-satellite distance variations with a noise of less than 80 nm/$\sqrt{\text{Hz}}$ at high frequencies, which is approximately 15 times lower than is possible with microwaves. The actual in-flight noise of the LRI is even well below 1 nm/$\sqrt{\text{Hz}}$ at a Fourier frequency of 1 Hz.

Moreover, the LRI is capable of determining attitude variations of the satellites in two directions with a low noise, which can be used in post processing, for example, to correct for the so-called tilt-to-length coupling.

In this talk, we will provide an overview on the LRI and present some results of the instrument characterization during the commissioning phase. We will show that the LRI ranging data exhibits some glitches correlated with spacecraft thruster activations, however, these can be removed to a negligible level by using data streams solely from LRI.

The GRACE Follow-On mission offers the unique opportunity to operate and compare two different ranging instruments. The LRI aboard this mission demonstrated various advantages and the technological readiness of laser interferometry. This paves the way for instrument developments for future gravimetric missions, and it is an important milestone towards the future space-based gravitational wave observatory LISA.