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Architecture concepts for a next generation gravity mission

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The current generation of missions, culminating in GOCE, has established gravity as a new probe of the whole Earth system, including the water cycle. Preparatory studies, notably those promoted by ESA since 2003, have concluded that a future gravity mission focused on gravity variations, ought to be based on low-low Satellite-to-Satellite Tracking (SST) and possess improved instrument sensitivity/accuracy, 100 to 1000 times better than GRACE, such as can be provided by laser metrology. Further desired characteristics include higher time resolution than GRACE, high spatial resolution, comparable to GOCE, and mission duration of the order of 10 years.

An affordable mission concept is being defined by trade-off of scientific mission requirements and implementation constraints, including cost constraints. Designing for time resolution (e.g., a repeat orbit with a short repeat rate) automatically leads to poor spatial resolution. Optimizing for spatial resolution, as GOCE does, leads to poor time sampling. High resolution in both space and time may be achieved by a multiple satellite configuration such as a number of SST pairs in different orbits. Such a concept, however, will at some point exceed the available level of resources. Payload costs, in turn, are driven by the sensitivity and accuracy requirements and mission operations costs are driven by mission duration.

Establishing the design requirements and the optimal implementation concept of a new generation gravity mission and its measurement instruments is the objective of a new study, performed for ESA by a team led by Thales Alenia Space Italia (TAS-I). The paper will describe the methodological approach and the current results of the new study.