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ESA's GOCE gravity gradiometer mission[1]

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In the present decade, three space gravity missions, CHAMP, GRACE and GOCE provide unique information about mass and mass redistribution in the Earth system with a wide range of scientific returns like global ocean circulation, ice mass balance, glacial isostatic adjustment, continental ground water storage. On board the four satellites of these missions, similar electrostatic space inertial sensors deliver continuously, during quite nine years for the older, the accurate acceleration data needed for the missions. The sensor operation remains on the six axes electrostatic suspension of one solid metallic mass, which is servo-controlled motionless at the centre of the highly stable set of gold coated silica electrode plates. All degrees of freedom are measured with very sensitive capacitive sensors down to a few pico-m and the applied electrostatic forces to pico-N. With similar sensor design and technologies, full scale range and resolution can be adjusted according to the satellite environment and the mission requirements. The CHAMP and GRACE accelerometers have demonstrated their in orbit performance. They provides measurements of the satellite non gravitational surface forces like the atmospheric drag and radiation pressures in order to extract from the satellite measured orbital position and velocity fluctuations, the effects of gravity anomalies. The six GOCE accelerometers compose the three axes gradiometer, combined to the SST-high-low GPS tracking to provide higher precision and resolution of the Earth static field. They contribute also to the satellite attitude control and drag compensation system, allowing the heliosynchronous orbit at the very low 260 km altitude. So, the accelerometers are designed to exhibit a full range of 6.5 10^{-6} ms^{-2} and a resolution of 2 10^{-12} ms^{-2} $Hz^{-1/2}$. Since the gradiometer switch on in April 09, they deliver data leading to the components of the gravity gradient tensor. The main characteristics of the GOCE accelerometers and the mission are depicted in comparison to the previous ones, exhibiting the increase of performance and the limits. First in orbit results are mentioned like in particular the satellite drag free fly. The future gravity mission configuration is envisaged as well as other fundamental physics applications of such sensors.

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