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Taking advantage of the MEMO orbiter to improve the determination of Mars' gravity field.

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In the context of future ESA's mission to Mars, it is proposed an orbiter named MEMO (Mars Escape and Magnetic Orbiter) to especially improve the measurement of the atmospheric escape and the magnetic field of the planet. Its orbit is planned to have an inclination of 77 degrees and periapsis and apoapsis altitude of 130 km and 1000 km, respectively. In addition, such an orbit is scheduled to be maintained during one Martian year. This differs from the usual near-polar, near-circular orbit with a periapsis altitude of at least 200 km, such as for Mars Reconnaissance Orbiter (MRO). Even if the MEMO orbiter is not dedicated to Mars' gravity field investigation, we propose to take this opportunity to improve our knowledge of Mars' gravity field. Indeed, the sensitivity of an orbiter to the gravity field strongly depends on the semi-major axis, inclination and eccentricity of its orbit. In this study, we quantitatively estimate the improvement on the determination of local gravity anomalies, of seasonal variations of the first zonal harmonics and of the k_2 Love number of Mars. We base our work on both analytical and numerical approaches in order to simulate the Mars' gravity field determination from spacecraft tracking data from the Earth. We also add in our simulations the possibility to have an accelerometer onboard the MEMO spacecraft. Indeed, if it is placed at the center of mass of the spacecraft, it could provide measurements of the non-gravitational forces acting on it, especially the atmospheric drag. A good determination of the contribution of this force to the spacecraft motion would bring information about the atmospheric density at altitude between 100 and 200 km, and would improve the gravity field determination from tracking data of the spacecraft.