Gravity field determination using post-Newtonian energy integral

Mr. Joseph O'leary[1,3], Dr. James C. Bennett[2,3], Prof. James M. Hill[1]
[1]University Of South Australia, , Australia, [2]EOS Space Systems Pty. Ltd., , Australia, [3]SERC Limitied, , Australia

It was not until the launch of gravity field determination missions such as CHAMP was it possible for direct applications of Jacobi's integral when determining the gravity field of the Earth [1,2]. Gravity field determination using Jacobi or energy integral methods [3] requires precise orbit information and knowledge of the non-gravitational forces acting on the satellite which is provided by on-board GPS receivers and accelerometers respectfully. However, the literature restricts attention to energy conservation arising from Newton's second law of motion. In a recent article [4], the present authors derive a new energy integral associated with near-Earth objects in the first post-Newtonian regime for general relativity. In this paper, we investigate if the post-Newtonian Jacobi-like integral can provide more accurate gravity field determination using ESA's Swarm mission.

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[4] O'Leary, J., Hill, J.M. and Bennett, J.C., 2018. On the energy integral for first post-Newtonian approximation. Celestial Mechanics and Dynamical Astronomy, 130(7), p.44.