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Fine analysis of lever arm effects in moving gravimetry

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A moving inertial gravimetric system is now being developed, consisting of 3 high precision accelerometers measuring accelerations along 3 non parallel axes. The system has been designed to perform high resolution gravity measurements from motor vehicles, ships or aircrafts as well at some milligals precision. Position, velocity and attitude of the vehicle, needed for computing acceleration corrections, are provided by a 4 antenna GPS system rigidly mounted in the vehicle with a sampling rate at 0.5 Hz.

Because acceleration and GPS measurements are not located at the same point, the signals coming from accelerometers have to be corrected for lever arm effects. To this end, we derived the complete equation connecting accelerometer and GPS measurements, which indicates that the correction of level arm effects requires the computation of exactly 8 acceleration terms. The amplitude of level arm effects depends not only on lever arm length, but also on vehicle movement parameters. Our own findings based on both simulations and real measurements suggest that some of the 8 level arm effects have to be considered to fulfill some milligals precision on gravity.

We discuss the various suitable methods for processing gravity with the system with respect to the type of vehicle used to carry out gravity.