# Perspectives and limits on the use of commercial low-cost digital MEMS accelerometers in gravimetry

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# Perspectives and limits on the use of commercial low-cost digital MEMS accelerometers in gravimetry

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The value of the acceleration due to gravity is of interest in a wide range of fields, from geophysics, geodesy, water-floor monitoring, and hazard forecasting to oil, gas and mineral exploration. For this purpose, relative or absolute gravimeters have been developed and used for decades. While absolute gravimeters are mainly used in monitoring stations or as reference, relative gravimeters are those actually used to determine the relative variations of the local gravitational field given their smaller dimension, lighter weight, and better reading resolution, despite the high costs and the difficulty in being used under severe environmental conditions. In the last years, the advent of micro-electromechanical-systems (MEMS), in particular MEMS accelerometers, has opened up the doors to new measuring possibilities at very low-costs. As a consequence, different international research groups focused their efforts to develop relative MEMS gravimeters and showed that this technology might be really useful for monitoring the gravitational field. However, their current production is limited to a few specimens and prototypes that cannot be exploited on a large scale at the present day. For this reason, this work investigates the possibilities and the limits in the use of commercial digital MEMS accelerometers as relative gravimeters. The digital MEMS accelerometers investigated in this work are two commercial low-cost digital MEMS accelerometers (STM, model LSM6DSR, and Sequoia, model GEA). The first is composed of an accelerometer sensor, a charge amplifier, and an analog-to-digital converter and is connected by a serial cable to a separated external microcontroller (ST, model 32F769IDISCOVERY), in which other electronic components are integrated. The second is composed of the sensing element and the analog-to-digital converter. Both are connected to the computer via USB cable. The two devices are included in a thermally insulated case, in which a resistive heater and a resistance thermometer (PT1000), connected in loop, are placed in order to guarantee temperature stability during use. The system, installed on a tilting table to ensure higher accuracy in the evaluation of local $g$, is calibrated in static conditions by comparison to the absolute gravimeter IMGC-02 at a specific measurement location at INRIM. Calibration is repeated several times over a period of a few weeks in order to evaluate repeatability, reproducibility and stability over time. Despite the promising future prospects of this technology, at present, the levels of precisions are low compared to the ones required by most of geodynamics applications.