

# How reliable is the tactical-grade GNSS+INS for bathymetric surveys?

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This paper explores the tactical grade inertial navigation system (INS) coupled with Global Navigation Sattelite System (GNSS) modules for ocean mapping operations aboard a survey vessel. The motivation stems from the recent proliferation of autonomous and uncrewed vehicles for ocean mapping, which often requires power and payload optimization to operate sensors successfully while a mission lasts. That is particularly so for small-sized, medium-sized, and battery-operated vehicles, which often require the deployment of small-size and power-efficient sensors such as the industrial or tactical grade INS and low-cost GNSS modules. While the performance of survey-grade GNSS+INS is well known to the hydrographic and marine science community, the performance and limitations of the compact GNSS+INS require in-depth exploitation to answer the following questions. (1) How close or far is the tactical-grade GNSS+INS performance from the survey-grade systems? (2) Can we use them for bathymetric surveys? (3) For what survey order can a user deploy them? We attempt to answer those questions by deploying two units of tactical-grade GNSS+INS (a micro-electro-mechanical system (MEMS) and a fiber-optic INS) and a survey-grade GNSS+INS on a survey boat. With the lever-arm offsets accurately determined using a robotic total station, all systems collected data while operating a multi-beam system. The tactical-grade GNSS+INSs shared one pair of antennas for heading, while the survey-grade system used independent antenna pair. We analyze the GNSS+INS results in sequence and the respective SBET-integrated bathymetric surfaces as metrics for determining the tactical-grade GNSS+INSs' reliability and absolute accuracy.