An Inertial Navigation System (INS) estimates current position of the vessel through a sophisticated form of ‘dead reckoning’. Current position is calculated by measuring speed, direction, and time of travel from a known starting point. Within the system, a triad of accelerometers and gyros sense gravity and other forces that act on the INS in addition to all angular rates of rotation with respect to a fixed reference frame. The INS must sense the full range of motion parameters including: roll, pitch and yaw, heading, latitude, longitude, and altitude.

The INS is susceptible to a number of inherent errors, the two most important of which are uncertainty in determining the starting point and inaccuracies in speed and heading measurements. Speed and heading errors will increase with time, whereas, the errors in determining starting point are fixed and will not change with time.

The POS/MV INS uses a ‘strapdown’ arrangement, as opposed to the mechanically gimbaled platform found in older INS systems. The INS inertial reference frame is aligned with the primary axis of the ship: for/aft, port/starboard, and the surveyed vertical of the ship and geographic reference frames. This alignment allows sensed accelerations and rates of rotation to be mathematically translated to measurements of velocity, heading and track of the vessel.

A mathematical ‘heave filter’ is applied to the INS data to limit the appearance of noise in the vertical measurements that occurs as a result of the ship heaving over ocean swell or other sources such as Schuler oscillations and GPS noise. Parameters of the filter should be adjusted for varying conditions of the particular survey, dynamics of the vessel, and response of the vessel to sea state.

The POS/MV system is capable of heading measurements as accurate as 0.02° due to the blending of independent data from INS and GPS measurements. The POS/MV uses two methods to correct for errors in heading. The first is ‘Dynamic Heading Alignment’ by which the INS re-aligns with the down and north directions. The INS does this continuously by sensing gravity and the angular rate of the earth’s rotation to obtain a leveled and aligned platform. The second is the GAMS (GPS Azimuth Measurement Subsystem), which corrects for heading errors by aligning with two fixed GPS antennas on the vessel. The GAMS determines a geographic vector between the two antennas by measurement of the phase difference in the received GPS signals from the two antennas. The dynamic heading alignment suffers from drift on the order of nautical miles per hour but is relatively unaffected by noise in the short term. The GAMS system, like all GPS systems, is prone to noise in the short term. Thus, the measurements and corrections from these two systems are blended to offset the errors of each and improve the heading accuracy of the IMS.