

"Boot" Issues

The INS does several calibration routines when it boots. Upon boot, it checks the integrity of the software to ensure the basic software system is intact and checks the aiding sensors to be sure they are communicating. To check each aiding sensor, it waits for each sensor to come online and provide enough data for it to validate communications. Additionally, in many configurations the INS has to calibrate several sensor inputs.

When the INS boots, it assumes it is stable. This is very important to understand. During the boot sequence, the INS assumes it is stable and computes the bias on the gyros and accelerometers. This process is commonly referred to as "spin up". The INS uses this bias calculation to perform an initial Zero Velocity Correction (ZVC) on the states computed from the accelerations and gyroscopic rates. The amount of time spent in this state depends on the IMU and the system configuration, but usually ranges from 20 seconds to a minute or more for non True north seeking technologies. True north seeking technologies typically require a much longer spin up time.

During the spin up time, the INS also calculates biases for any other attached sensors requiring compensation. INS units with integrated pressure sensors will calculate bias and noise characteristics on the pressure sensor to compensate the depth estimate. During this process, the INS usually checks to see that the system is on the surface and stable prior to gathering and applying these metrics. Should the system not be stable during boot, the INS will use stored parameters for bias and compensation.

Some INS configurations calculate true north based on the gyro data during the boot period. During this time, it is best if the system is stable and reasonably free of high dynamics. Moderate ship motion is usually fine. During a true north calculation, the INS requires anywhere from one minute to 20 minutes of stability. The more stability allowed, the better the calculation.

Typical boot issues and their causes consist of the following.

- **A perceived "long" boot time.** Customers often complain about the time it takes to boot an INS or receive data from an INS. It is important to explain the spin up process and the calibration process taking place during boot.
- **The INS never releases from boot and never reports a "ready" state.** This usually happens if the INS software cannot communicate with the IMU. It can also happen if the IMU is reporting an invalid state. Check the *_IMU_STAT message to determine the health and status of the IMU.
- **The INS boots but never provides a navigation solution.** This may be due to a faulty communications channel, a faulty communications configuration, or a faulty INS unit. Double check all wiring and verify proper connections. If the connections are valid, it is often useful to check raw data between the topside software and the INS. To check for basic data, use Wireshark, Hyperterminal, or CuteCom to validate communications. After checking communications and verifying all wiring is correct, the INS may be faulty.
- **Jumps in data about a minute after boot.** After the INS acquires bias and noise data from the sensors it applies corrections to the Kalman filter and sensor prefilters. This correction may make the solution of the INS "jump". Often this will be unnoticeable, but for many states, especially magnetically aided or pressure aided, operators will see a change in the data. As long as the data stabilizes, this is normal.

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