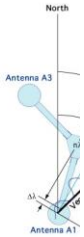
How Does a Satellite Compass Work?

The technology explained



How a satellite compass works

Magnetic compasses are twitchy things at the best of times - any metallic or magnetic objects in close proximity and local variation affects the accuracy and the higher the latitude, the worse it becomes. Magnetic/fluxgate compasses are almost unusable in the polar regions.

The solution is to fit a Gyrocompass, but these are bulky and expensive to buy and maintain. However, satellite compass technology is a solution, which uses GPS to calculate an accurate heading. It doesn't rely on the earth's magnetic field at all, isn't affected by metallic objects and there are no moving parts to maintain. They are also extremely accurate. So how do they work?

This is the technical explanation -
"Own ship's heading is determined by decoding the phase data in the GPS carrier frequency. In principle, a pair of antennas A1(ref) and A2(fore), each connected with an associated GPS engine and processor, are installed along the ship's fore-aft line. The GPS systems at A1 and A2 calculate the range and azimuth to the satellite.

The difference in range between A1 and A2 is Dl + nl where l is 19 cm and n is automatically found during the initialization stage. A fraction of a carrier wavelength, Dl, is processed by Furuno's advanced kinematic technology in geographical survey, thus determining a vector (range and orientation) A1 to A2, i.e., heading of own ship relative to north.*

In reality, a third antenna is added to reduce the influence of pitch, roll and yaw, and five satellites are used to process 3D data (by 3rd sat), to reduce clock derived error (by 4th sat), and to calculate n in initial stage (by 5th sat).

If GPS signal is blocked by a tall building or under a bridge, the 3-axis vibrating-gyro rate sensors, in the processor unit, take place of the satellite until all five satellites are in view. The rate sensors also contribute to regulating the heading data against pitch, roll and yaw together with the third antenna (A3 in the illustration).

**Ambiguity "n" is resolved by LAMBDA algorithm developed by Prof. Teussen, Delft University of Technology, The Netherlands."*

Well, thanks for clearing that up for us, chaps! If that leaves you none the wiser, a technical explanation follows -

"There are two GPS antennas inside the transducer. By measuring the difference between the positions recorded by both antennas it can work out what direction the boat is pointing in."