

Title: **Acoustically Aided Inertial Navigation – Proven, Robust and Efficient Positioning Solutions**

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Abstract

Inertial navigation is based on the principals of dead reckoning. By knowing your start location and subsequent speed and direction you can work out where you will be at some time in the future. Of course, the accuracy of dead reckoning navigation is related to the accuracy of the information you have about your movements. Errors in dead reckoning navigation accumulate over time, and to make safe use of this form of navigation it is essential to understand how these errors grow and make subsequent decisions based on knowledge of that error.

Before the invention of accurate chronometers by John Harrison in the 1760's all longitude calculations were based on dead reckoning, including the discovery of America. In 1906 the first practical marine gyrocompass was patented in Germany by Herman Anschultz-Kaempfe, Elmer Sperry filed his own patent in America in 1908. Marine gyrocompasses were used extensively throughout the First World War, but it was during the Second World War and the German V2 rocket that brought together two gyroscopes and lateral accelerometers with an analogue computer to form the first recognizable inertial navigation system.

The team who developed the V2 guidance system during WW2 led by Von Braun surrendered at the end of the war and moved under Operation Paper clip to the US where they continued their work on inertial navigation. Building on the German technology, the USA introduced the Atlas ICBM's in the 1950's using inertial navigation. In 1958 the USS Nautilus transited under ice to the North Pole navigating primarily on INS. In the 1960s the Apollo program travelled to the moon and back using INS.

The first major civilian use of inertial navigation was with the Boeing 747. Right from the introduction of the aircraft in 1969 747s were equipped with multiple inertial navigation units.

In the 1980s practical ring laser gyroscopes were introduced. Ring laser gyroscopes were a big improvement on previous mechanical systems, reducing power consumption as well as weight and physical size.

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