



Sonardyne DP-INS is a new, inertial navigation-based Position Measuring Equipment (PME) source for dynamically positioned (DP) rigs and vessels. The independence and redundancy provided through inertial augmentation of Sonardyne's Marksman and Ranger 2 acoustic positioning systems delivers improved performance and safety whilst reducing operational cost. DP-INS combines the complementary characteristics of the latest Sonardyne Wideband[®] 2 acoustic signal technology with high integrity inertial measurements. The resulting output is resilient to acoustic disruptions and completely independent from GPS.

Acoustically Aided INS

The seamless integration of acoustics and inertial technologies exploits the long term accuracy and precision characteristics of acoustic positioning with the continuous availability and fast update rate from high grade inertial sensors. A single navigation solution is computed and output to a display with intuitive status and quality metrics. Standard output telegrams are available for Converteam, L3 or Kongsberg DP systems.

The independence offered by Sonardyne DP-INS significantly reduces operational delays during periods of challenging subsea acoustic conditions such as aeration and noise. In addition, the high update rate and independence from GPS will allow the vessel to continue operating in periods of GPS instability or outage caused by effects such as GPS signal scintillation.

DP-INS does not need a full seabed Long Baseline (LBL) array and can be used with a single transponder deployed below the vessel. This significantly reduces the set up time following arrival on location. The need for only occasional acoustic aiding provides additional operational cost saving benefits by extending transponder life and thereby reducing maintenance operations.

DP-INS at a glance



- Provides an independent DP reference
- Ride through capability – resilient to effects such as aeration and noise
- LUSBL accuracy from a single transponder
- Independence from GPS disruptions
- Update rates to match DP model
- Three fold improvement over standard USBL repeatability
- Potential for fuel and operational savings

Dynamically positioned vessels operating in deep water have traditionally relied exclusively on GPS and subsea acoustics (LUSBL or USBL) as their two primary types of position reference. There has always been a recognised need amongst operators for an independent DP reference that would allow safe rejection of a positioning error in one of the other two reference types. An example of the need for an independent reference exists in Brazil where scintillation can degrade GPS positions leaving the LUSBL system as the sole reference.

Sonardyne's DP-INS system addresses this need by offering an acoustically aided inertial navigation solution.

System Configuration

Lodestar Hardware Platform

The core of the system is the Lodestar platform. Lodestar was released to the market in 2007 as a premium quality, survey grade Attitude and Heading Reference System (AHRS) for surface and subsea applications. Using the same hardware platform, Lodestar is now configurable for acoustically aided INS operations for tightly integrated DP vessel applications.

Lodestar makes use of three ring laser gyroscopes that measure the angular rate and three accelerometers that measure the specific force of a moving platform. The highest quality dual use (commercial and military) field proven sensors have been selected for use due to their performance, low mean time between failure (MTBF) and ease of export. These sensors have highly stable error characteristics and are compensated for temperature variation making them ideally suited to DP applications.

The INS sensor outputs are combined mathematically to compute the position, velocity and attitude of the vessel. The output is extremely low noise and very accurate in the short term but slowly degrades over time. Therefore it is necessary to seamlessly aid the INS with complimentary acoustic positioning observations.

Acoustic Aiding Input

DP-INS system uses a tightly coupled integration of range and bearing from at least one transponder to aid the INS and control integration drift. This approach makes optimum use of Sonardyne Wideband acoustics to exploit and enhance the positive characteristics of the inertial sensors.

Sonardyne's latest Sixth Generation (6G[®]) vessel-based transceivers and subsea transponders maximise the benefits of the system by providing the most precise and reliable acoustic aiding input. Whilst only one transponder is needed to aid navigation, two are typically deployed if equipment redundancy is required. Before the system is used operationally, the vessel's GPS receiver is used to calibrate the real world position of the transponders. Once this is complete, the system no longer requires GPS as an input. Previous generation Sonardyne transceivers and transponders are also compatible with DP-INS.

Bridge Installation

The Lodestar INS unit and acoustic transceiver are interfaced to, and powered from, the bridge using the Navigation Sensor Hub (NSH), itself connected to a dedicated Navigation PC running the Marksman LUSBL or Ranger 2 USBL software applications.

The Navigation PC is a powerful, purpose-built unit that has been specifically designed to run Sonardyne's family of acoustic and inertial navigation software applications. The operator interface consists of a rack mountable TFT colour monitor and keyboard. This facilitates system initialisation, whereby job specific parameters can be changed and positioning tasks monitored. Dual screen and touch screen options are possible. Alternatively, the software display can be integrated within a customer's own DP console.

Lodestar INS Platform

Lodestar, the core of DP-INS, uses the highest grade inertial sensors with proven reliability.



Seabed Reference Transponder

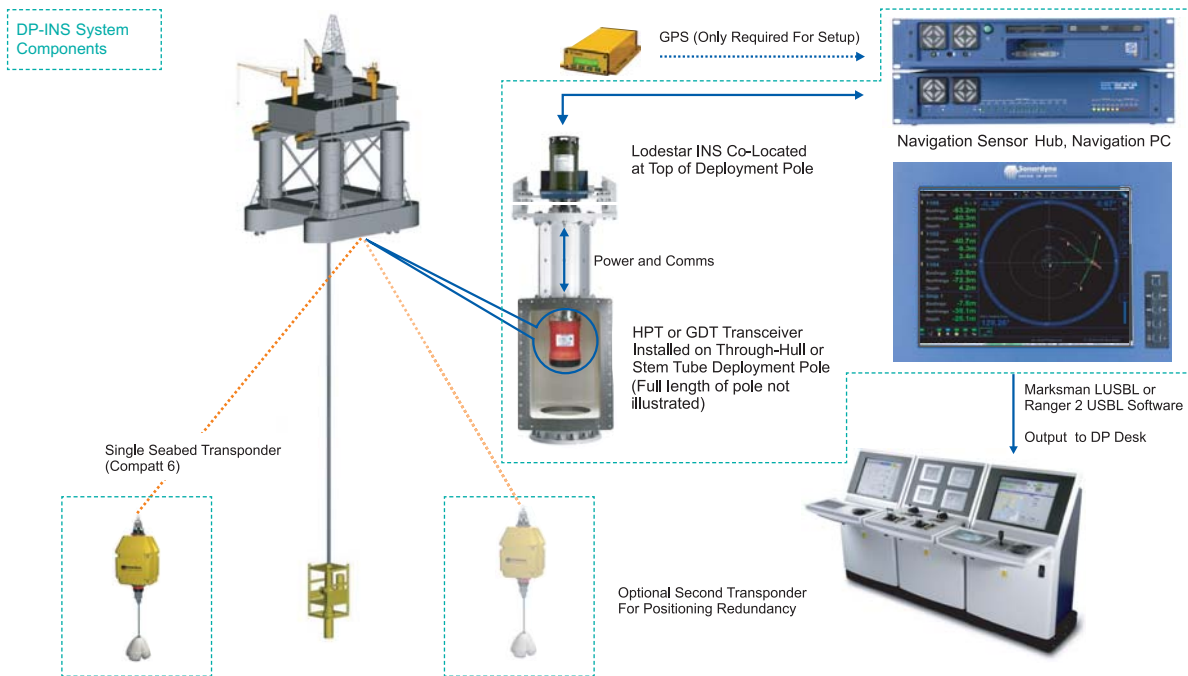
DP-INS can be used with a single transponder (two for redundancy) instead of a full seabed array. This reduces set up time and extends transponder life.



Independent DP Reference

Sonardyne's acoustically aided DP-INS meet industry's need for an independent DP vessel reference.





The vessel's Marksman and Ranger 2 software displays both the vessel's LUSBL or USBL position and the INS position in an intuitive format alongside essential status information. The display gives the system operator access to all the information required to monitor DP-INS performance without significantly increasing their workload.

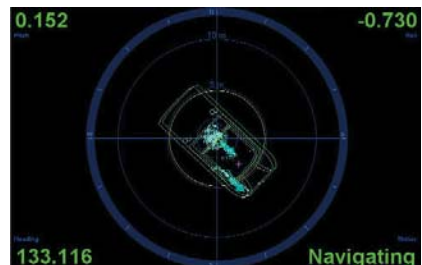
Wiring

The Lodestar and USBL transceiver are connected through to the bridge where they interface to a Navigation Sensor Hub (NSH). The NSH provides power and serial communications via a junction box at the deployment pole or machine. For the Lodestar, 1x CAT6 or better is needed for INS communications and 1x copper pair used for power. For the USBL transceiver, a second CAT6 is used for acoustic transceiver communications and a second copper pair used for power.

Transceiver and Lodestar Deployment

In order to provide optimum system performance, it is important that the inertial and acoustic systems experience the same dynamic motion. Therefore the Lodestar INS and vessel's acoustic transceiver should be co-located on the same deployment pole using a through-hull or stem tube arrangement.

Sonardyne's through-hull deployment machine has a stiff, one piece Inconel clad steel pole that hydraulically lowers and raises the transceiver through a gate valve. A sea chest with inspection hatch allows for ease of installation and cleaning of the transceiver. Sonardyne also offers a through-tube method of transceiver deployment for convenient retrofitting systems to older vessels. Refer to separate brochure for more details.



Vessel Position

The INS sensor outputs are combined mathematically to compute the position, velocity and attitude of the vessel.

6G® Technology

Sonardyne's latest 6G® vessel-based transceivers and subsea transponders maximise the benefits of DP-INS by providing the most precise and reliable acoustic aiding input. Previous generation Sonardyne transceivers and transponders are also compatible with the system.



Equal weighting in DP desk

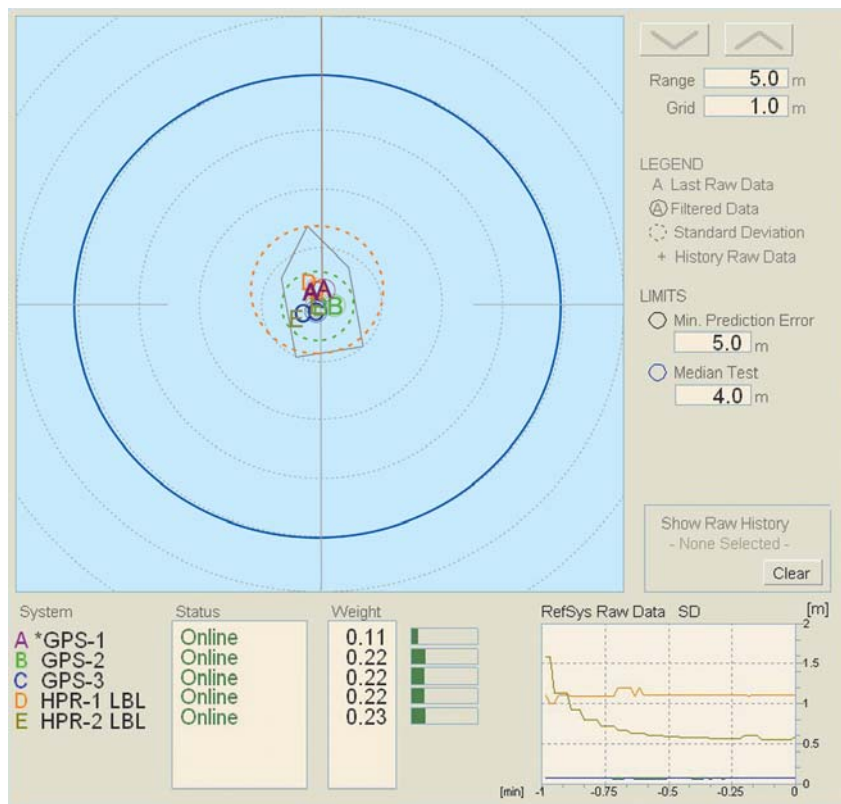


Figure 1

The real world performance indicates Sonardyne DP-INS is assigned an equal weighting to DGPS in a DP desk when operating in a 1,700 metres water depth. In the screen shot, Input D in yellow (labelled HPR1) is the DP-INS input.

Sonardyne DP-INS comparison with DGPS

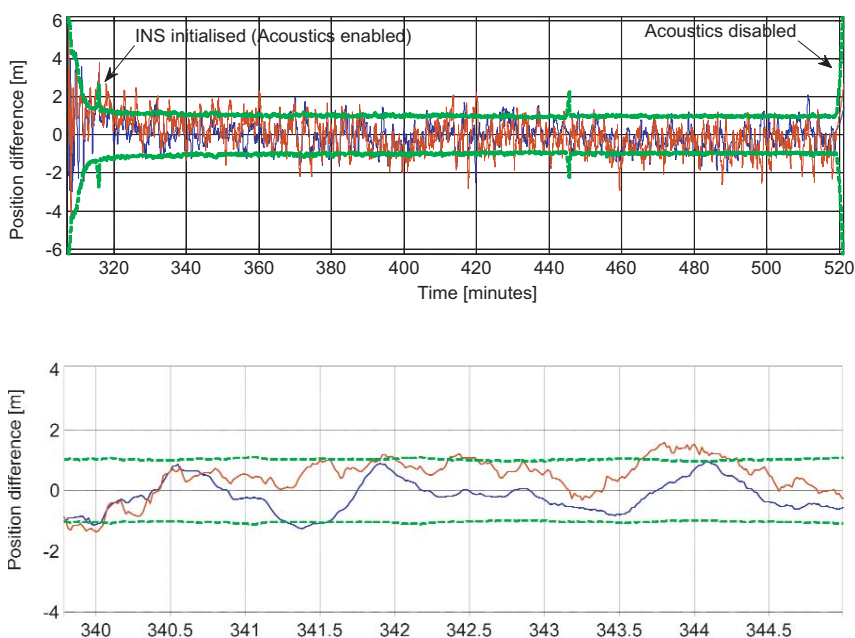


Figure 2

The real world performance indicates North and East position compared to a DGPS system of decimetric accuracy.

Position difference compared to decimetric DGPS over 3 hours (top) and 5 minutes (bottom) in a water depth of 1,700 metres.

Key:

- North
- East
- 1DRMS
- 1DRMS = 0.93m (Relative Veripos ULTRA DGPS)

DP-INS System Performance

The typical accuracy (excluding systematic error) of Sonardyne DPINS when compared to other PME's is shown in Table 1 below:

System	Accuracy (1DRMS)	Update rate
Marksman / Ranger 2	0.1 m – 0.5m	1 per 5 / 6 seconds
DP-INS (Acoustically aided)*	0.05 – 0.1% depth	1 to 5Hz
DGPS	0.1 m – 0.5m	1Hz

* Single transponder aiding. Actual performance is system and environment dependent.

DP-INS Equipment List Key: ● = Required ○ = Optional



● Software DP-INS User Interface



● Type 8026 Navigation Computer



● Type 8098 Navigation Sensor Hub



● Type 8024 Lodestar Subsea

Additional Requirements (At least one required)



○ System Marksman LUSBL



○ System Ranger 2 USBL

Other Wideband Systems from Sonardyne

- Marksman LUSBL
- Ranger 2 USBL
- SPRINT
- Wideband Emergency BOP Controller
- Wideband Acoustic Data Logger

DP-INS Key Technology



6G®

Sonardyne's new sixth generation (6G®) technology platform provides robust performance, ease of use, greater functionality, equipment flexibility and compatibility with aided inertial technologies. Its features reduce operational risk, deliver more efficient operations and lower the cost of ownership.



Acoustically Aided INS

Seamlessly integrates Sonardyne LBL, USBL and Lodestar INS technologies to offer a combined acoustic and inertial navigation solution suitable for the most demanding subsea tracking and vessel positioning applications.



Wideband 2®

Sonardyne Wideband® 2 is an ultra-wide bandwidth signal architecture exclusively developed for 6G® hardware. Delivering seamless acoustic navigation and telemetry of subsea data, the technology offers a host of benefits; fast and robust transmission of data, precise ranging, wide area coverage, mitigation from multipath signals and greater immunity to noise from vessels and other acoustic systems.



Dynamic Positioning

From deep water drilling rigs to construction support vessels, Sonardyne Wideband positioning systems are optimised to provide Dynamic Positioning systems with accurate and repeatable position referencing. Compatible with all leading makes of DP with options for system redundancy and inertial aiding.

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