Return to Session Menu

DYNAMIC POSITIONING CONFERENCE
October 15-16, 2013

SENSORS SESSION II

Ten Years of Experience from Acoustic Aided Inertial

Are B. Willumsen

Kongsberg

10 Years of Experience from Acoustic Aided Inertial

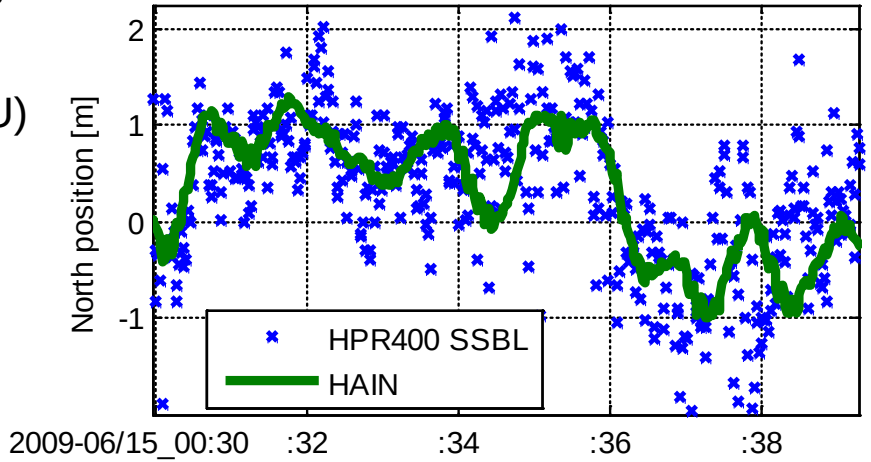
Are B. Willumsen, Product Manager HAIN, Kongsberg Maritime

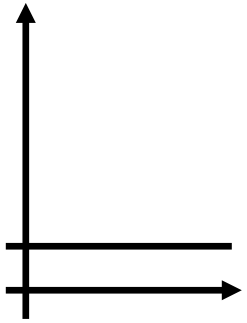
KONGSBERG

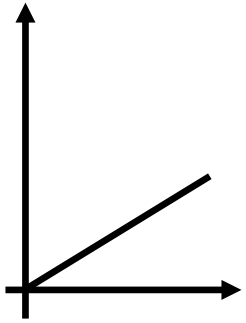
KONGSBERG PROPRIETARY: This document contains KONGSBERG information which is proprietary and confidential. Any disclosure, copying, distribution or use is prohibited if not otherwise explicitly agreed with KONGSBERG in writing. Any authorised reproduction in whole or in part, must include this legend. © 2012 KONGSBERG – All rights reserved.

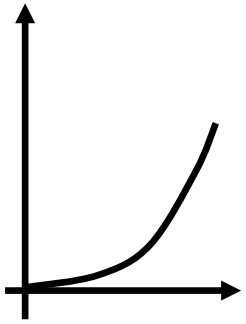
Inertial Navigation System (INS)

- Inertial measurements
  - +Accelerations – accelerometers
  - +Angular rates – gyroscopes
  - = Inertial Measurement Unit (IMU)
- Integration
  - Orientation
  - Velocity
  - Position (integrate twice)
- Independent
  - Of external systems
  - Of vehicle dynamics
- Integration without correction inherently instable









HAIN

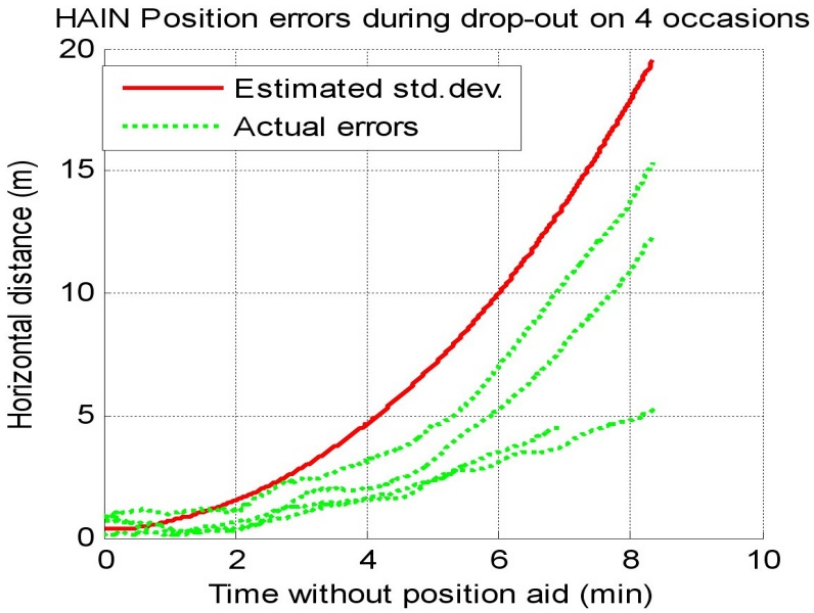
- Hydroacoustic Aided Inertial Navigation
  - HAIN Subsea
  - HAIN Reference
- HUGIN Navigation System
- 2003
  - First HAIN Reference trial on Seaway Osprey
  - First commercial use of HAIN Subsea
- 2013
  - 50+ HAIN Reference sold

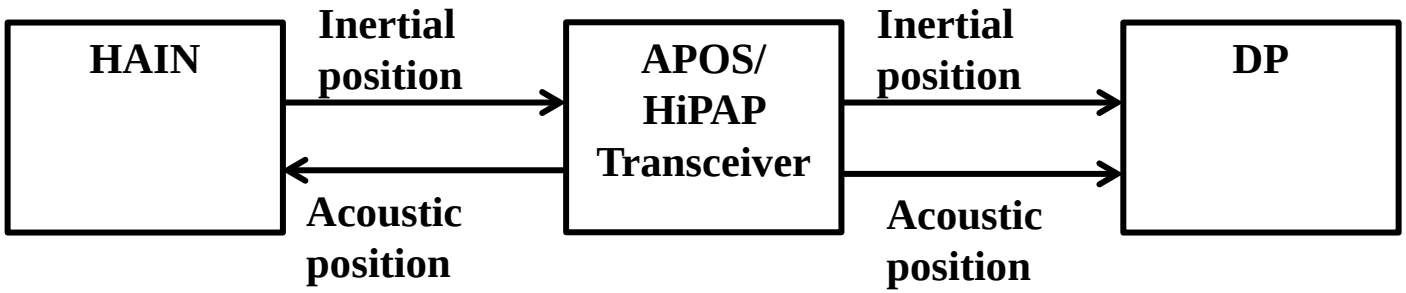
KONGSBERG PROPRIETARY - See Statement of Proprietary Information

(Pictures in courtesy of respective owners)

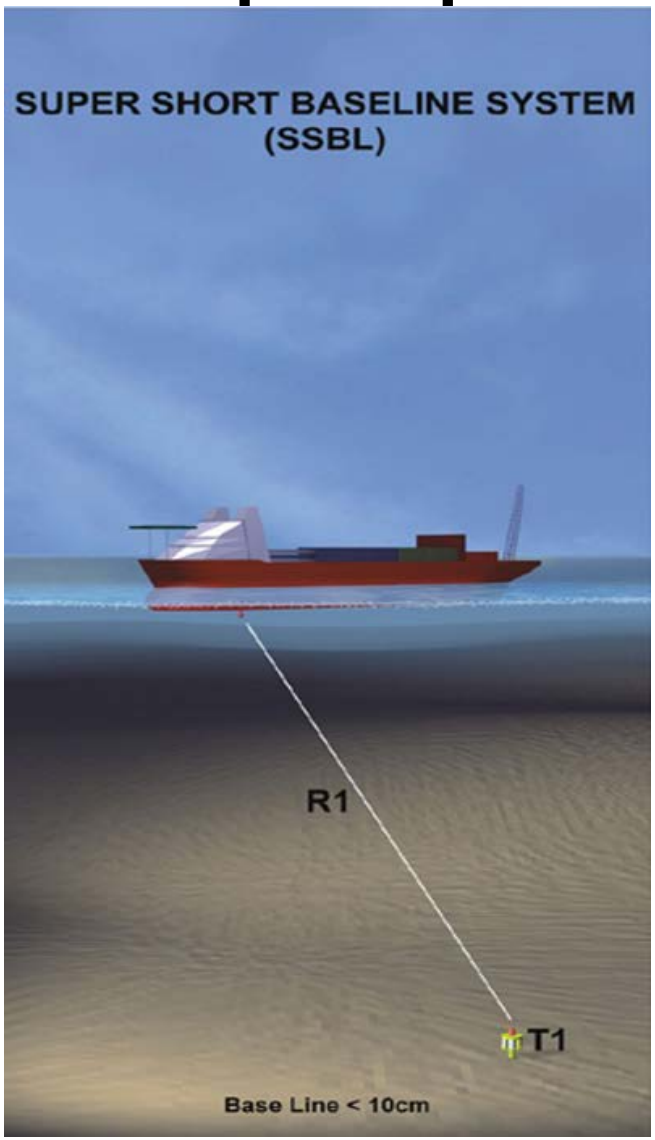
System integrity

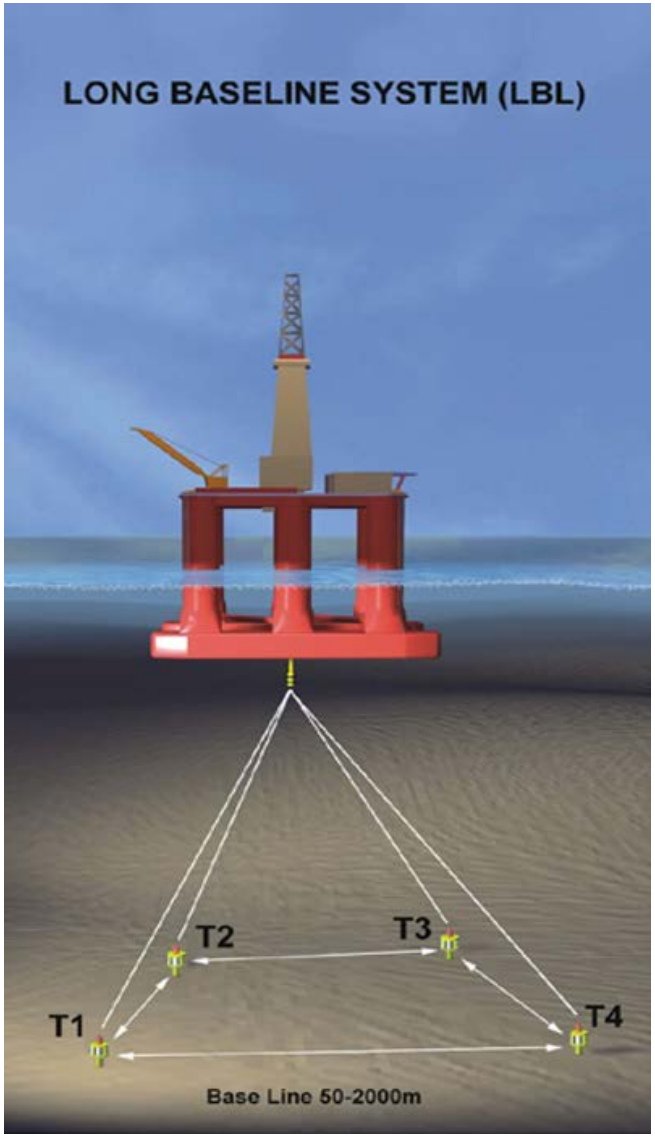
- INS never independent of aid.
  - Never use both as references simultaneously.
- Unaided increasingly inaccurate.
  - Safety measure: exclude inertial position if unaided 3-5 mins.
- DP receive acoustics if INS fails.
- INS must be GNSS independent.





Acoustic principles

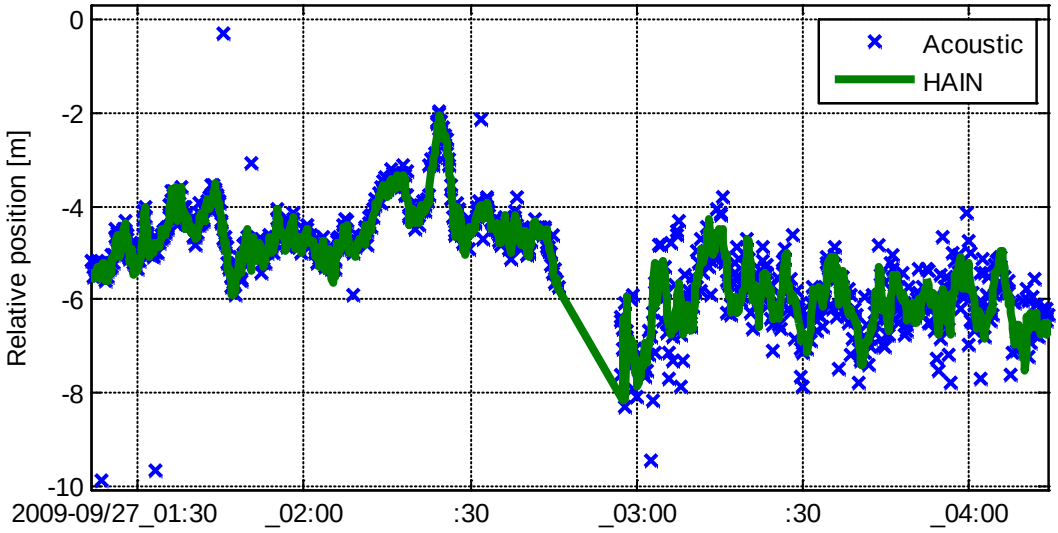


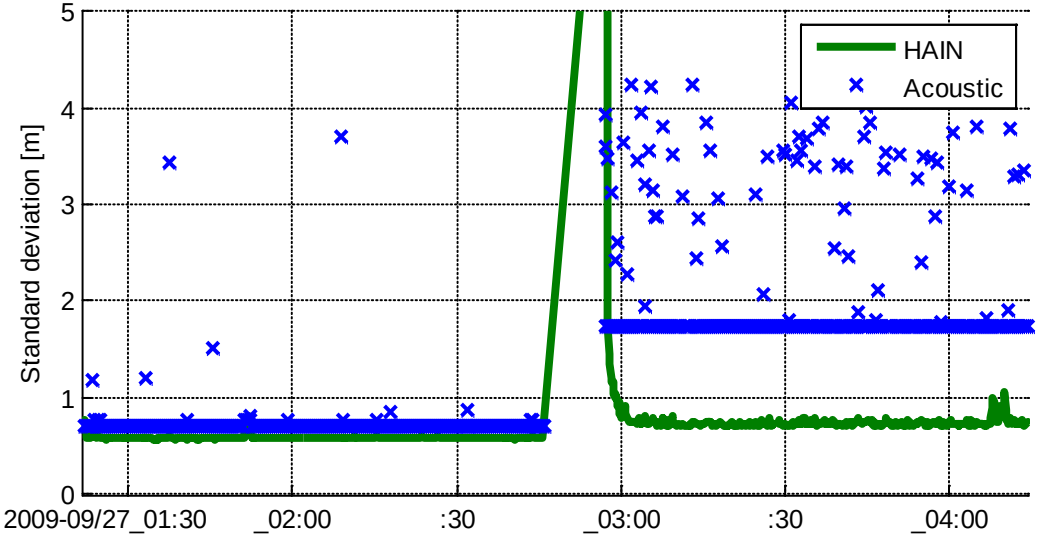


KONGSBERG PROPRIETARY - See Statement of Proprietary Information

Acoustic principals and inertial

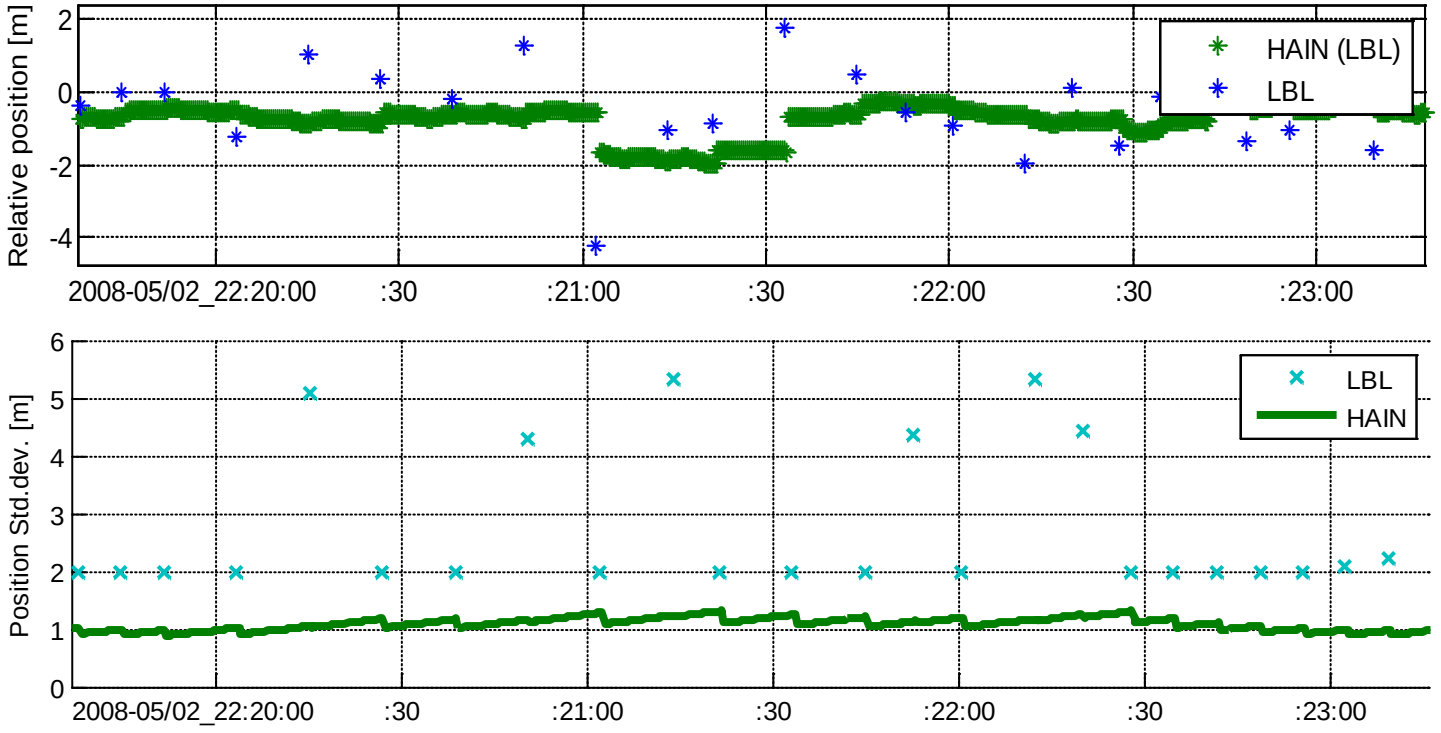
- SSBL
  - High standard deviation
  - Almost never drift
  - Rapidly varying errors
- LBL
  - Often slow rate
  - Low standard deviation
  - Occasional drift/
  - Slowly varying errors
- AINS
  - w/ SSBL or LBL
  - Less drift
  - Increased accuracy
  - Added integrity
  - Slowly varying errors





DP weighting

- DP weighting is a quadratic function of standard deviation.
  - 2 meters standard deviation gives only 1/4 weight.
- DP weighting is a linear function of update rate.
  - 2 seconds update period gives only 1/2 weight.



Inertial Measurement Unit (IMU)

- Accelerometers are fairly cheap
- Gyroscopes are more costly

- FOG – Fiber Optic Gyro
  - Solid state may yield lower MTBF
  - OK Performance
- MEMS – Microelectromechanical systems
  - Cannot gyrocompass – yet
  - Cheaper
- RLG – Ring Laser Gyro
  - Hearable noise
  - Best performance

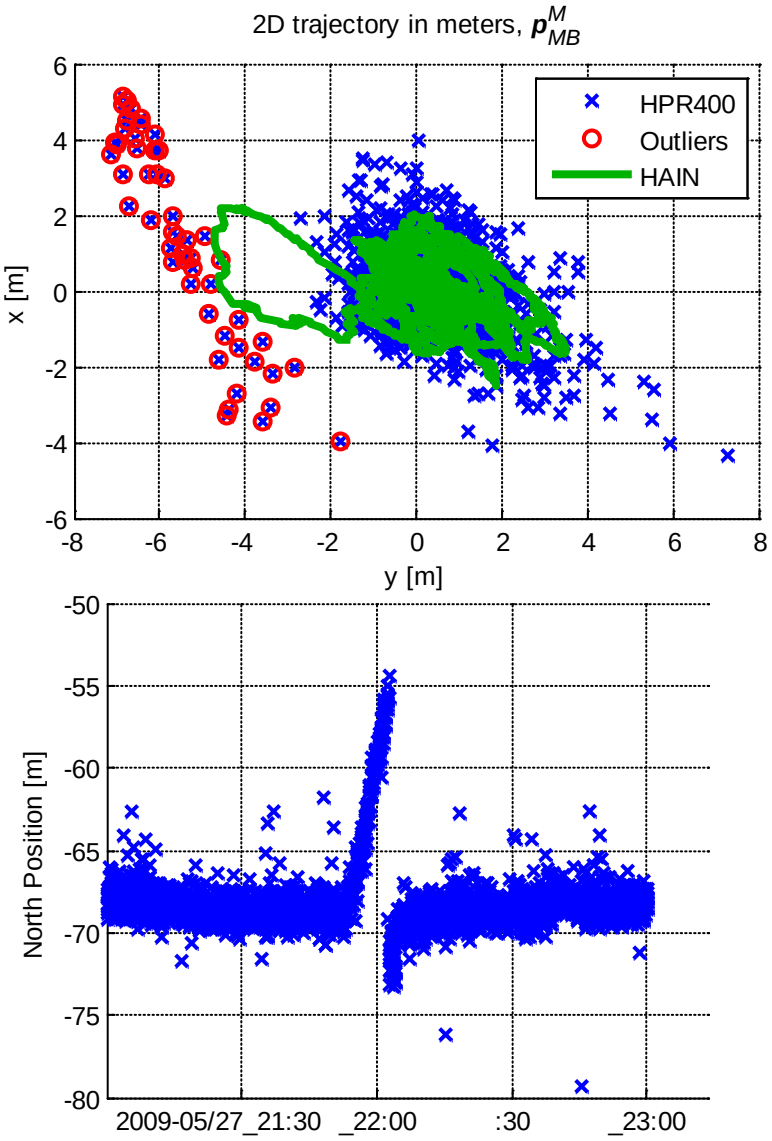
(Pictures in courtesy of respective owners)

Installation

- Anywhere on vessel
  - RLG noise annoying
  - Stable temperature and humidity is good
  - Cannot factory align
- Mounting
  - Coarsely aligned with Vehicle axes
  - UPS
  - Connection to ships acoustics
- Lever arm accuracy of 0.2 meters sufficient
  - 150+ m – OK
- 2-4 hours IMU alignment
- FMEA and performance testing

Problems

- IMUs are export restricted
- INS errors
  - Carries high DP weight
  - Drifts off and stays off
- HAIN Reference
  - Few problems and service
  - Little crew attention
- IMU
  - To spec or broken down
- Acoustics
  - Outliers and noise
  - Non-white errors
- Problems leads to improvement in both acoustics and INS



Conclusions

- Acoustic aided INS is well proven as DP Reference
  - 7+ years of HAIN
  - 50+ HAIN units
- INS will work on
  - any acoustics
  - any vessel (without tuning)
- INS is easy to use
- Technical problems are few
- It improves
  - update rate
  - precision (accuracy)
  - integrity
- Increased DP weighting

kongsberg.com

KONGSBERG

KONGSBERG PROPRIETARY - See Statement of Proprietary Information