Hull-to-Hull
Leveraging EGNSS for safer maritime navigation
Requirements and operations

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Hull-to-Hull (H2H) Project

• Funding from the European GNSS Agency (GSA) under the European Union's Horizon 2020 R&I programme grant agreement No. 775998

• 3.5 years project started 01.11.2017

• 5 Partners
Hull to hull Objective

The overall objective of the project is to address the need of the maritime community to safely navigate in close proximity of other vessels and objects.
Basic Concept

- Hull-to-hull positioning based on 3D models and position measurements
- Vessel to vessel data exchange:
  - 3D vessel models
  - Sensor measurement, e.g. position, orientation, distance.
- Open concept with standardized data exchange
- Uncertainty zones for own vessel as well as neighbouring objects indicate position accuracy
Technology

- European GNSS: Galileo and EGNOS
- Other GNSS: GPS, GLONASS and Beidou
- Relative GNSS, RTCM3 corrections and RTK
- Attitude from inertial measurement, combined with dual antenna GNSS
- Maritime broadband radio
- Vessel models in Wavefront .obj format
Uncertainty zone shall encompass actual hull, typically with a probability of 95%.

Position error
Orientation (heading) error
3D model error
The H2H engine
Use cases

• Inland waterways:
  • Straight sailing
  • Docking
  • Auto-mooring

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<th>Local control, captain on board</th>
<th>Remote control, captain on shore</th>
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• Open sea:
  • Simultaneous operation: two vessels in close proximity

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Pilot demonstrations

- Straight sailing and docking, Leuven, Belgium
- Auto-mooring, Mol, Belgium
- Simultaneous operation, Trondheim, Norway
Demonstration straight sailing and docking (KU Leuven)

• Cogge – a scale model of Inland waterways barge (Watertruck+)
• Remotely controlled from shore control centre
• Cameras and Hull to hull visualization
Demonstration auto-mooring (Mampaey)
Demonstration auto-mooring (Mampaey)

- Captain navigates to quay within half a meter with Hull to hull support
- Mooring arm sensors then engage and bring vessel to final position
Demonstration simultaneous operation (KONGSBERG)
Demonstration simultaneous operation (KONGSBERG)

Perspective 3D View

Ortographic 2D View
Position sensors

**GNSS position sensors**
- GPS, GLONASS, Galileo, Beidou, QZSS.
- Augmentation systems, like DGNSS and SBAS.
- In H2H, focus will be on use of EGNSS (Galileo and EGNOS).
- Absolute and relative positioning
  - Attitude determination using dual antenna systems

**Range and direction finding**
- R-mode
- Microwave
  - Radar
- Optical
- Image processing

**Proximity sensors**
- Infrared
- Ultrasonic

**Inertial sensors**
Requirements

• 3D model with known accuracy
• GNSS high accuracy and high integrity
  • Required performance highly dependent on the operation taking place
  • Typical RTK/PPP
  • Reference data from other vessel or satellite service (SBAS or high accuracy Galileo)
  • Dual frequency and multiple constellations
  • Authentication
  • Ability to calculate integrity risk, e.g. ARAIM like service
• Alternative means under bridges and other structures, e.g. inertial systems
• Vessel to vessel safe and secure communications
• Standardized exchange between vessels
Public information

https://www.sintef.no/projectweb/hull-to-hull/