Safe navigation systems

Robust compass heading in case of jamming and spoofing

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Products for newbuild and refit

Multifunctional Workstations

Flexible navigation toolbox

Radar and Naval Radar

High performance collision avoidance

ECDIS and WECDIS

Safe and efficient navigation

Electronic Logbook

Trust in data quality

Autopilot & Track Control System

Precise steering performance

Steering Gear Control System

Precise steering performance

Gyro Compasses

Long time secure investment

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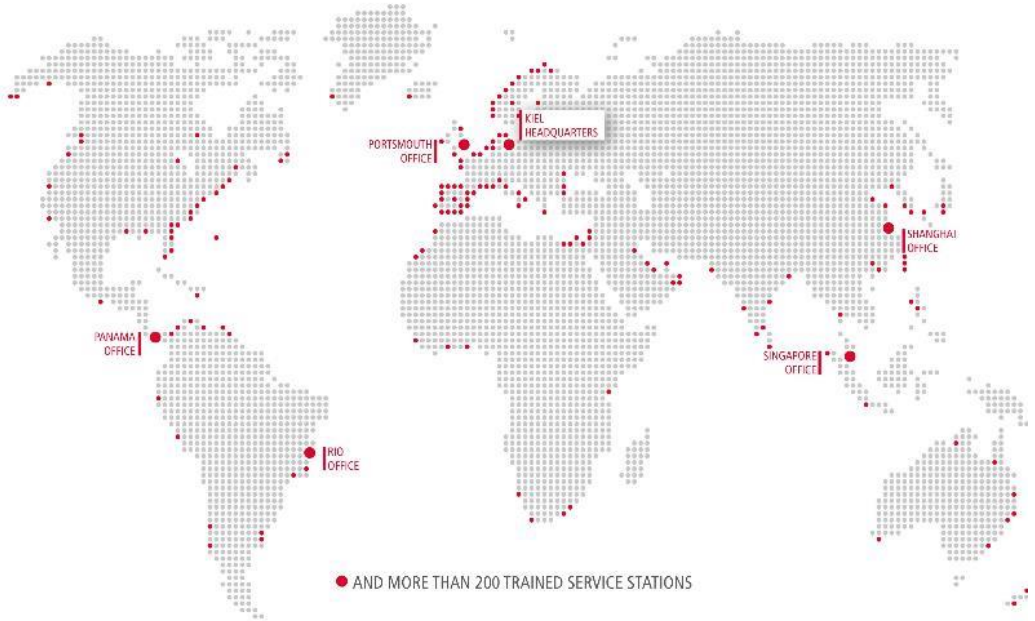

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Master‘s Report 28-05-2024

When approaching Ashdod all was fine until approx. 15 nm off the coast.

The GPS was suddenly spoofed and we lost GPS position.

When approx. 3 nm from Ashdod pilot the GPS signal came back.

During Ashdod port stay, there was first minor spoofing, but the all hell broke loose → GPS going all over the place – primarily to Beirut.

After departure Ashdod for Haifa we found our GPS spoofed and positions not usable.

GPS 1 was the most unstable. It was in Beirut during most of our stay in Israel. Glonass – did a lot better, but still very far away very frequently – and constantly when in Haifa.

→ Jamming and spoofing caused a heading failure

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What is Jamming and Spoofing?

- **Jamming** results in the **unavailability** of a GNSS satellite signal.

  → **No** Latitude, Longitude, SOG, COG

- **Spoofing** results in an available but **false** GNSS signal.

  → **False** Latitude, Longitude, SOG, COG

Effect on mechanical gyro compasses

- Mechanical gyro compasses determine true north by fast spinning masses, which align with the rotational axis of the earth.
- A mechanical gyro compass can work **without any** external information.
- The **accuracy** of a mechanical gyro compass is subject to a so-called speed error.
- The speed-error depends on the **latitude**, on the **speed** and on the **heading**.
- Example for speed error values:
  - Latitude = 30°, speed = 20kn, heading = 180°; speed error = 1,5°
  - Latitude = 60°, speed = 20kn, heading = 180°; speed error = 2,5°
  - Latitude = 30°, speed = 20kn, heading = 90°; speed error = 0°

Standard 22 NX

- Jamming & spoofing **reduces the accuracy** caused by the missing calculation of the speed error

- To get accuracy back on high level of accuracy the following should be done:
  - **Input latitude manually** – steps of a few degrees are sufficient
  - Connect a **speed log** (not GNSS based) to the compass system or **input speed value manually** – changes of a few knots are sufficient

Effect on strapdown gyro compasses

- Strapdown gyrocompasses: Firmly mounted angular rate sensors and accelerometers in gyro compass housing
- Angular rate sensors technologies:
  - Hemispherical Resonant Gyro (HRG)
  - Fiber Optical Gyro (FOG)
  - Ring Laser Gyro (RLG)
- Based on the angular rates and accelerations **heading** is **calculated**.
- Speed and position are required in order to differentiate between earth rotation and vessel movements – higher importance compared to mechanical gyro compasses.

Standard 30 MF

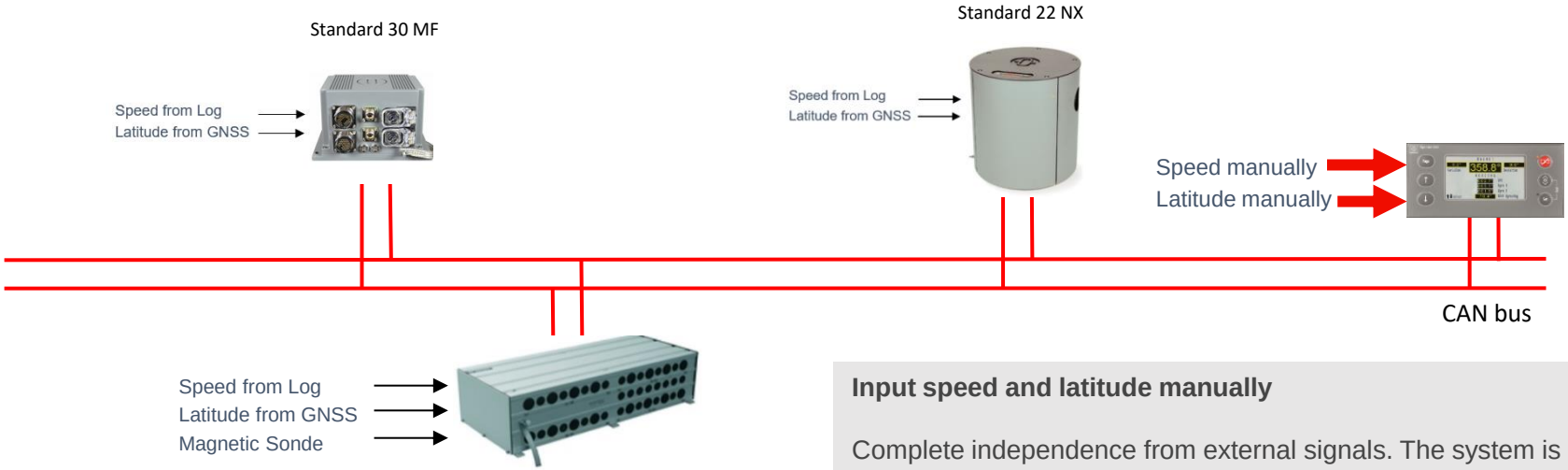
- Standard 30 MF was already tested for **28 days** in 2018 without GNSS input. The result was a maximum heading **deviation of 2°.**
- The test has been repeated in July 2024 on a ferry sailing from Germany to Lithuania. **Results have been confirmed.**

→ **Standard 30 MF works without latitude**

- In case of spoofing Standard 30 MF **filters large position jumps**
- **Small position errors** may cause a slight heading deviation over long time.

Anschütz heading management system

Avoiding or minimizing effects of jamming and spoofing



Input speed and latitude manually

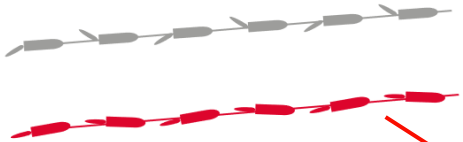
Complete independence from external signals. The system is **not affected** by jamming and spoofing. **Gyro compass heading is available permanently**.

Summary

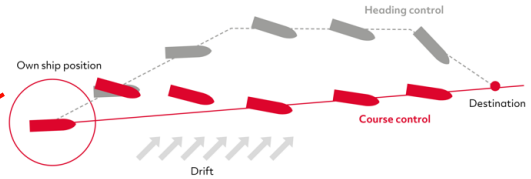
- Robust against jamming and spoofing
  - Standard 30 MF tested for 28 days without latitude, provides still high accuracy in heading
  - Standard 30 MF settles without latitude
  - **Anschütz heading management system** combines Standard 22 NX and Standard 30 MF for redundancy in technology.
  - **Anschütz heading management system** provides safe heading by monitoring features.
  - Standard 22 NX and Standard 30 MF features **manual speed and latitude input,** which makes the system **completely resistant** against jamming and spoofing.
- By the way: Standard 30 MF was recently used on an expedition cruise up to 89° latitude north!

NautoPilot 5400 NX - Four fuel-saving features

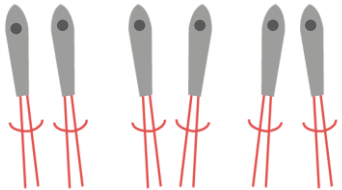
Economy mode



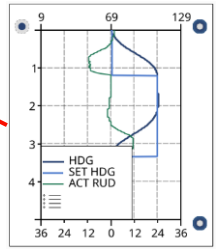
Course Control



Toe angle function



Heading & Rudder Plot



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Thank you very much for your attention!

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