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Portable piloting units, models and hardware performance

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The Portable Piloting Unit (PPU) will be used in nearly all pilot assisted operations within a few years. Technology has brought the weight down, electronic charts are becoming more accurate, and software has become more powerful and user friendly. Global Navigation Satellite Systems (GNSS) such as GPS, GLONASS and GALLIEO are working hand in hand offering unique reliability and accuracy and lest not forget pilots are becoming more IT minded in adopting this new tool.

Several types of systems are available. It is important, before purchasing, to acquaint oneself with the performance of the large spectrum of choices, in order to ensure that the system selected will do the job needed.

The environment

Cargo turn-around time has increased far beyond expectations, ships are bigger and the world's top ports are proving difficult (almost impossible) to enlarge. As traffic increases in the evermore confined waters, a calling for tools to maintain high safety standards becomes paramount. Timing is vital so as not to go over capacity and traffic limitations caused by poor weather conditions is almost no longer an unacceptable excuse.

If one of the new breed of very large ships were to go aground in the harbour approach channel, it could end up causing environmental damages to a scale never before seen. If a harbour were to be closed for a long time, it would result in massive economical losses. The latest PPU is just one important tool in the puzzle to increase safety.

Figure 1. E-Sea Fix CAT III in operation.

The way to safety

The way to safety is a cocktail of several elements. A level of precise communication between ships on par with that of aircraft communication sounds simple. But in practice, connected to the many problems associated with a lack of understanding between pilot and ships officers, is a well-known problem linked to poor phraseology. AIS has become a fantastic tool which is getting better and better as it is adapted by the user. But pilots have become aware of its limitations and so its danger. Through the implementation of AIS, VTS seems to play a less important role, but in reality the opposite is proving true as traffic continues to increase and more importantly, the vessels grow larger.

The latest range of PPUs now being launched offer unique advantages due to their extremely high reliability and accuracy. Had it been built a few years earlier, the new PPU, with all that it packs inside, would have weighed over 25 kg. The new PPU also has a prediction accuracy which is essential for operating with extreme precision in confined areas for safe and efficient berthing.

Precise GNSS receivers combined with dual frequency receivers, along with real-time Heave, Roll and Pitch and squad corrections offer the pilot a tool of unknown precision and reliability. Figure 1 shows the new E-Sea Fix CAT III in operation.

How to select the right PPU

Choosing the most accurate PPU, which includes any and all features you could dream of, could prove too expensive and maybe too complex. Therefore it is important to have a general idea about the classification of each system on offer. In order to keep it simple, these have been divided into three categories. There are some options within these three categories which lie somewhere in the middle.

General overview

E-Sea Fix CAT I

CAT I is the category where the standard GPS single frequency (L_1) is used. It covers GPS technology similar to what a car receives. Most maritime GPS receivers are in this category and several systems installed on ships have differential receivers taking advantage of maritime GPS corrections from governmental DGPS services. To take advantage of the DGPS receiver it is of course important that the operator knows how to use its various functions.

Most of the new GPS receivers available today have integrated differential corrections based on different geostationary satellites (designed from precise aircraft landing systems) such as EGNOS, WAAS, MSAS and several others. They are fully automatic and it is important to know where in the world they are available and the accuracy on the location of interest. In most cases, this new technology offers more accuracy than government DGPS services, for which reason most users will veer towards this type of differential correction. Typically a new GPS receiver with EGNOS type technology integrated will provide position accuracy better than ± two metres which is the accuracy needed for aircraft landing systems (ILS). Figure 2a shows the E-Sea Fix Cat I.

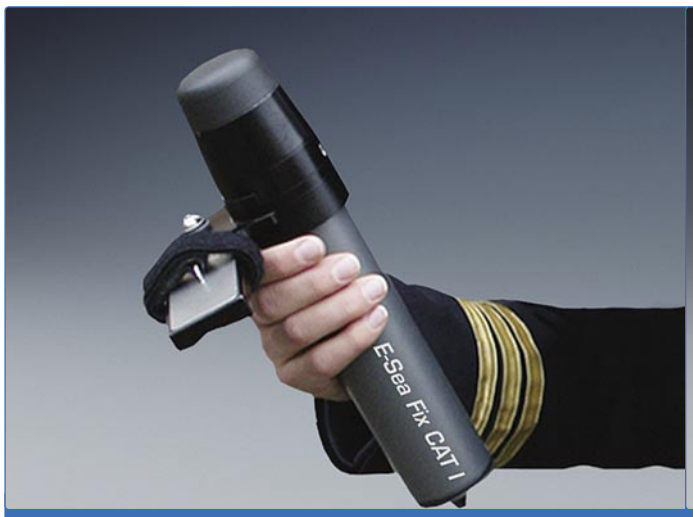

Figure 2a. E-Sea Fix CAT I.

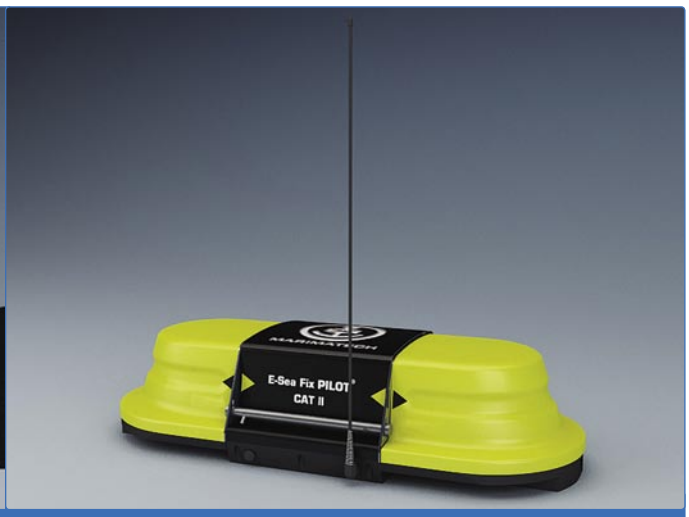

Figure 2b. E-Sea Fix CAT II.

Therefore the new CAT I PPU will as standard offer:

- Position based on GPS < 10 metres
- Differential correction based on EGNOS, MSAS etc. < four metres
- Heading based on past track calculation
- Speed over ground < one kts.
- WI-FI (wireless) connection to the pilot display
- Can be used as a WI-FI connection to pilot plug on AIS
- Optional: Integrated dual frequency AIS receiver
- Total weight of the E-Sea Fix CAT I (exclusive computer) 0.25 kg

The application of the CAT I is:

- General navigation
- Independent AIS receiver (option)
- WI-FI (wireless) connection to pilot AIS plug

E-Sea Fix CAT II

CAT II is in the category where two GPS receivers and two antennas are combined to be able to measure heading. The technology is single frequency (L_1), GPS, phase measurements and RTK (Real-Time Kinematic). Apart from the heading added this principle offers better position stability and better speed accuracy compared to CAT I. A built-in rate sensor makes the system robust in its overall performance. Differential corrections from EGNOS, WAAS and MSAS are standard and corrections from shore beacons are a feature that can be added. Figure 2b shows the E-Sea Fix CAT II hardware.

The new CAT II PPU will as standard offer:

- Position based on DGPS < one metre (system dependant)
- Position based on DGPS L_1/RTK < two metres
- Heading (dual antenna DGPS) < 0.25 degree
- Rate of Turn (ROT) < two degree/minute
- Speed (DGPS L_1/RTK) < four cm/second (0.08 kts)
- Integrated inertial gyro to be able to maintain heading and position in over 1 minute in case of loss of GPS signals
- WI-FI connection to PPU
- Integrated dual frequency AIS (option)
- Reception of environmental data in real-time
- Weight total (exclusive computer) inclusive carrying case, 5.8 kg

The application of CAT II is:

- General navigation
- Accurate channel navigation (positioning)
- Precise heading and ROT information
- Precise speed information
- Berthing tool (if an error of up to ± two cm/second can be tolerated)

E-Sea Fix CAT III

CAT III is the highest level in satellite positioning. Similar to CAT II it operates with two receivers to provide heading. CAT III is a dual frequency (L_1 + L_2) receiver, phase measurements and RTK. Accuracy is position jumps to centimetre and heading accuracy to 1/50 of a degree. These extreme accuracies allow us to make reliable prediction calculations. The E-Sea Fix CAT III also has motion sensors integrated that compensates for Heave, Pitch and Roll and keep track of ROT (Rate Of Turn). These 4 parameters are also essential for the prediction of accuracy end-result. The CAT III satellite receiver gets signal from not only GPS but also GLONASS and in future also GALLIEO. With this increase of available satellites the E-Sea Fix CAT III can operate under the most critical situation like obstructions from cranes, bridges and ships own masts, antenna etc. Figure 3 shows the E-Sea Fix CAT III hardware in deployed operation.

The new CAT III PPU will as standard offer:

- Position accuracy based on DGPS L_1 + L_2/RTK, Glonass, Galileo. < ± 1.5 cm
- Heading accuracy (duel antenna) < 0.02 degree (even with differential signal lost)
- Rate Of Turn (ROT) < 1 degree/minute
- Speed (DGPS L_1 + L_2/RTK < 1 cm/second (0,02 kts)
- Elevation measurement = 4.5 cm (to be used for DUKC, Dynamic Under Keel Clearance)
- Compensation for heave, roll and pitch
- Inertial gyro to be able to maintain heading and position accuracy several minutes in case of loss of satellites
- Integrated dual frequency AIS
- Reception of environmental data (options)
- Weight total (exclusive computer) inclusive carrying case, 6.1 kg

The application of CAT III is:

- Extreme position accuracy under all conditions
- Ultra precise heading and ROT at any time
- Precise speed information at any time
- Berthing tool (two to four times more accurate than CAT II) Accuracy equal to laser system
- Full berthing accuracy for VLCCs.

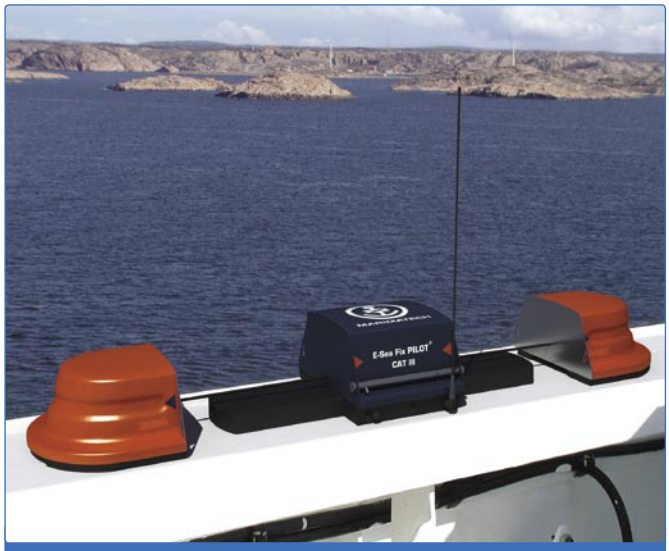

Figure 3. E-Sea Fix CAT III installed.

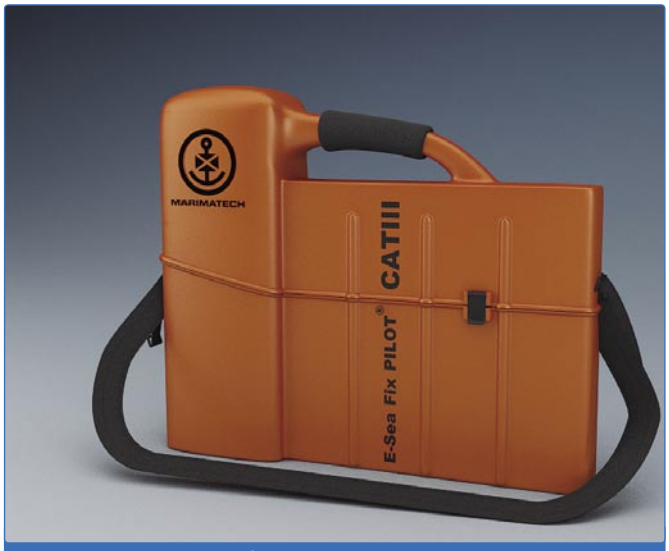

Figure 4. Pilot transport case for CAT I, II, and II.

Conclusion

The above information is provided in order to give user rough guide to the three basic categories. User entry to the PPU software is the same in all three. If you are familiar with CAT I there are only a few features added because of the extra advantages in CAT II and III.

Based on the information provided here, it could be difficult to justify the price difference doubling between CAT II to III. In practice the two categories look much the same. CAT III offers 25 times better heading accuracy along with extreme ROT accuracy and fourfold the speed accuracy, making CAT III a much more robust system in overall performance. Up to three times as many satellites are available (due to GPS, GLONASS, and GALLIEO). Therefore it is less critical for the pilot to find a suitable location on the ship to ensure full performance. The dual frequency receiver (L_1+L_2/RTK) offers a solid and fast lock-on to RTK and differential signals. Even without differential correction the CAT III will not lose its dynamic performance at all. Only the absolute position could be typically less than two metres off.

The three axis motion sensors in the CAT III compensate for Heave, Roll and Pitch along with the extreme heading and ROT accuracy. This provides pilots with the best achievable prediction accuracy which can be extremely important when operating large vessels in confined waters. In general, prediction accuracy is more than fives times better in a CAT III system.

Furthermore, the CAT III system opens up for accurate and reliable Dynamic Under Keel Clearance measurements.

Packaging

Just a simple thing but rather important is the carrying case. It will have to be able to swim and give the best protection to the equipment inside, the computer being the weakest component. The E-Sea Fix new transport case gives the protection for all three CAT systems and the add-on benefit is reduced weight. Figure 4 shows the new transport case.

I hope this article puts the end-user in a better position to justify and select the technology that meets their requirements.

Its decreased weight along with equipment robustness, improved performance and user friendly software, lends itself well to a much faster implementation of PPUs.

Future

So what does the future hold? The pilot laptop will be lighter and more powerful and the PPU will also be a key component towards better Port Information System. Finally, the new CAT III technology will offer complete tug management essentials for handling large vessels.

ABOUT THE AUTHOR

Erik Brinch Nielsen graduated as an Electronic Engineer B.Sc. E.E from Copenhagen in 1969, after which he was employed by the Royal Danish Navy in the field of hydrography. Educated as a navigator, he has been involved with the merchant marine for many years and has had 20 years experience in research and development in the marine industry.

ABOUT THE COMPANY

MARIMATECH is a private owned Danish company formed in 1988, located in Denmark. Their main activities are R&D, services, consultancy, manufacturing and sales within the maritime industry worldwide.

Innovation, technology and quality are important elements at MARIMATECH. The innovative use of the latest technologies – balancing state-of-the-art techniques and solid, well-proven quality – result in unique products and solutions for our customers.

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