Better docking for both pilots and terminals

Peter Selwyn, *Chief Executive,*
Navicom Dynamics, Auckland, New Zealand

When it comes to technology that can help to increase safety and efficiency in ports, one of the most significant areas to focus on is ship movements within ports. This article provides suggestions on the best practices to meet the increasing demands on port infrastructure. Recommendations are given for providing the safest, most efficient manner for moving ever increasing sizes of ships in and out of their berths.

Factors to consider

Part of the problem is in the infrastructure of a port itself and how wharves have been constructed. Other considerations must account for what kind of fenders are fitted at a wharf and how bigger ships are affecting them.

The British Standard on the subject, BS6349 Part 4, recently updated its 2014 edition to read:

A means of significant risk reduction is the installation of equipment on board the ship or on the berth to monitor the vessel's berthing velocities, both normal to the berth and rotational as well as berthing angles to ensure that they are maintained within permissible operating limits. Such equipment could be either fixed jetty-based systems with display units visible from the ship's bridge, or portable piloting units carried by the pilot.

This states that lower safety factors can be justified in the design of a wharf if suitable equipment is selected that will reduce risk. This constitutes clear guidance towards cost saving to structural designers so long as there is appropriate investment in risk mitigation technology.

So, the big question is – what risk reduction measures are available and how do they measure berthing velocities and angles?

Methods commonly employed include laser docking systems, though these have disadvantages in that each system only works at the berth on which it is fitted (not during the approaches), the points at which lasers are directed onto a ship are rarely the ends of the ship; there are hull reflectivity issues on some vessels.

Portable Pilot Units

The primary alternative that is being used worldwide, including in terminals which have very stringent requirements for accuracy, is the Portable Pilot Unit (PPU). Over the last dozen or so years, PPUs have come on in leaps and bounds in terms of reliability and accuracy. There is a plethora of such products offering varying levels of performance, so it can sometimes be a bit of a minefield sorting through the specifications to separate them. The following is intended to be a quick guide to the most important features to look out for:

System accuracy

Firstly, we need to understand what is meant by the word accuracy. When referring to accuracy, most people are referring to the precision with which the position of an antenna is known. In broad terms, for high quality receivers, this could be expressed as follows:

GPS: 2.0-2.5m (95%)
DGPS: 50cm (95%)
RTK: 2cm (95%)

But any receiver can only output data for where its main antenna is. It doesn't directly tell you anything about where a ship is. The position of the rest of the ship (in particular the other end of a ship) is determined by the navigation software in the laptop/tablet, using the following key information:

- Vessel dimensions
- Where the antenna is placed on the ship (the offsets)
- How accurate the heading data is (from the sensor)

Noting that items 1 and 2 above are relatively easily known, the most important factor in calculating the position and movement of the other end of the ship is to accurately know the heading of a vessel.

So the real question when determining the optimum PPU for any scenario, in addition to knowing how accurate you want the position to be, is to decide which system is going to offer the most accurate heading data. So how do we calculate heading?

Dual-antenna systems

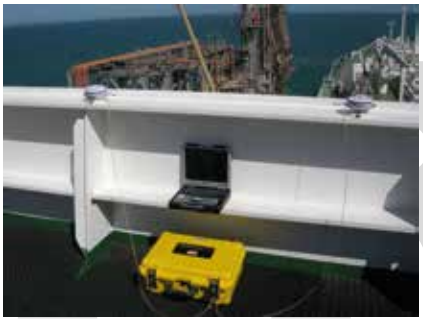
Dual antenna systems such as Navicom Dynamics' HarbourPilot range (HarbourPilot Lightweight and HarbourPilot Ruggedised) are at the top end of the PPU range. The primary reason for this is because they are able, independently of ship input, to work out a vessel's heading.

By employing complicated mathematical techniques on the received raw signals by the two antennas, these systems very accurately calculate the relative bearing of one antenna from another. Once the system is lined up with a vessel, this easily translates to the true heading of a vessel.

Since HarbourPilot is capable of calculating heading to an accuracy of approx 0.02 degrees, this means the error of the bow will be in the order of 7-10cm (3-4"), based on a 200 metre antenna to bow distance. With this level of accuracy, particularly when combined with the highest levels of positioning accuracy, the software can generate athwartships velocities as accurate as 0.02 kts (or 1 cm/sec); as good as most laser docking systems.

Other advantages of a PPU include

HarbourPilot Lightweight in use at Ponta da Maderia terminal in Maranhão, Brazil



HarbourPilot Ruggedised in use on LNGC at Withnell Bay terminal in Western Australia

the ability to record all of the data for later review, and the ability to relay data between ship and shore.

Single antenna systems

Other smaller and lighter PPUs may have only one GPS antenna. While none of these can directly measure the heading of a vessel, like any GPS they can work out the direction in which they are moving over time, but this is not the same as heading. While some, for example, Navicom Dynamics' ChannelPilot, can use external input to calibrate their own internal gyro in order to give a very good approximation to the heading of a vessel, these systems are not really suited to the absolute heading accuracy required for the most delicate berthing operations.

ChannelPilot has other benefits however, particularly during river or channel navigation, or even approaches to ports where challenging turns are to be made. Here, it's independent GPS receiver, combined with the smoothed heading and independent Rate-of-Turn data from its internal gyro, make an excellent combination for pilotage use.

AIS based systems

Other PPUs operate on the basis of tapping into a ship's automatic identification system (AIS) to extract data. For a variety of reasons, these systems are not recommended for the kind of important manoeuvres being discussed in this article. Two of the most significant drawbacks of AIS-based systems are:

- Heading data from AIS is only ever output to whole degrees, so there will be big jumps in heading, leading to big swings in calculated athwartships speed
- Data supplied to the 'pilot plug' is often updated at the same periodicity at which data is updated in external transmissions – commonly 4 seconds or 12 seconds under pilotage conditions – again giving rise to big jumps at the next update

Conclusion

There are big advantages to using products like high-end PPUs as an alternative to laser docking systems in ports and terminals. Probably the biggest of these is that the system is available throughout the approach, not just in the last 50-100 metres, giving full navigational support to the pilot once setup.

During any swing it will give clearing distance ahead and astern, something that a wharf-based laser system can never offer; plus it gives clear graphical imagery on where a vessel is predicted to be in the next minute or two, assuming the existing dynamics persist.

About the author

Peter Selwyn, BSc MIEE, is a former Royal Navy Engineering Officer. Having served for 18 years in submarines in the Royal Navy; he has in-depth experience of gyro and electronic-based navigation technology. For the last 11 years, he has been leading the sales and training aspects of Navicom Dynamics' business and is currently serving as the CEO of the company.

About the organisation

Navicom Dynamics is based in Auckland New Zealand and is a global specialist in precision orientation and monitoring systems primarily used in the commercial maritime sector. Navicom is the largest global supplier of PPUs, whether for harbour pilots looking for the types described in this article, or the offshore industry looking for customised berthing aids. Navicom prides itself in being able to respond to all requests for bespoke GNSS positioning systems on land and at sea.

Enquiries

www.navicomdynamics.com