

DOCKING SYSTEMS FOR PILOTS

Benefit versus Cost

A comparison of shore-based and portable docking systems



DGPS Portable Pilot Unit

Differential GPS is achieved by applying a secondary source of correction data to raw GPS signals. This enhances the accuracy of the position from a typical PPU by about three to four metres. Navicom Dynamics' newest GPS receivers are accurate to 2.5m in raw GPS, and with DGPS applied they give an accuracy of 60cm, often better than this.

DGPS corrections are freely available through the WAAS and EGNOS systems (part of northern hemisphere only), or via free-to-air MF beacons operating in the 300kHz band in many countries. Where neither is available, it is possible to set up a dedicated DGPS base station at a port.

Level of accuracy:

Less than 60cm, often better. (Higher accuracy is often not noticeable on PPU software or laptop screens)
± 2cm/sec for velocity

Equipment needed:

PPU (with dual antennas for heading calculation)
Where free-to-air DGPS is not available, 1 DGPS base station (range 30 – 40km)

Disadvantages:

Free DGPS corrections are not available in some areas of the world

Advantages:

A DGPS PPU can be used at every berth in the port
Can be used for the entire pilotage
Real-time heading whether DGPS corrections are available or not
Data is consistently available
Lowest cost solution

Approximate cost:

Full-function PPU from approx USD 30,000
Where needed, a DGPS base station is approx USD 10,000 plus one receiver for each PPU (approx USD 4,000).
TOTAL SOLUTION PRICE: From USD 30,000



Summary:

DGPS-based PPUs have proved accurate enough for all pilotage situations, including docking. In most cases, no shore-based infrastructure is required. The technology is consistent, stable and can be operated anywhere there is an available chart and GPS satellite visibility. Where DGPS is unavailable, the PPU is very often accurate enough working from raw GPS - even for docking.

Thus DGPS systems are the most flexible, as well as the cheapest, option and will capably perform all pilotage requirements.

Nav-Dif Portable Pilot Unit

Nav-Dif is a Navicom Dynamics DGPS PPU with additional software and sensors able to recreate RTK float in the docking area. It brings the level of accuracy down to 20cm, while giving a more reliable and smoother heading than RTK. Nav-Dif gives the pilot far more security in a tight situation, because if for any reason it loses signal from the base station, the unit falls back on DGPS, maintaining 50cm of accuracy or better. If RTK lock is lost, the accuracy immediately drops to 2.5m.

One base station is required in the docking area. Outside this zone, DGPS accuracy is more than enough for navigation. As the Nav-Dif station is half the cost of an RTK one, this is a big financial saving.

Level of accuracy:

20cm accuracy.
± 2cm/sec for velocity

Equipment needed:

PPU (with dual antennas for heading calculation)
1 Nav-Dif base station (range 5km – enough for the port environs)

Disadvantages:

One-off cost of base station and the additional software makes this a little more expensive than a DGPS unit, but still significantly cheaper than RTK.

Advantages:

Very good accuracy
Extremely smooth and reliable real-time heading
Can be used on any berth in the port
If signal lost, will fall back on DGPS accuracy of 50cm
Reliable signal in busy port environments
Lowest cost solution available for an accuracy of less than 50cm
Can be incorporated into both lightweight and ruggedised units

Approximate cost:

Full-function PPU from approx USD 33,000
Where needed, a DGPS base station is approx USD 11,000 plus
TOTAL SOLUTION PRICE: From USD 44,000

Summary:

Nav-Dif gives you all the benefits of a DGPS PPU with greater accuracy and smoother headings when you need them most. It reverts to DGPS on loss of signal, which is still high enough accuracy to complete the berthing manoeuvre. The base station is half the cost of an RTK base station. For many ports where space is tight, Nav-Dif is the best of both the DGPS and RTK worlds.



RTK Portable Pilot Unit

PPUs based on RTK technology need an RTK base station, which has a reliable radius of 5-10km. RTK is known to give 'centimetre accuracy'. However this is achieved in 'Lock' status only. In 'Float' status, the level of accuracy achieved is about 20cm. There are many factors that can make it difficult for a PPU to achieve and/or maintain 'Lock' status (eg distance from the base station) and the receivers are sensitive to outside interference.

Level of accuracy:

1-20cm depending on whether RTK Lock is achieved
± 1cm/sec for velocity

Equipment needed:

PPU (with dual antennas for heading calculation)
One RTK base station. (Extra stations for use beyond approx 10km radius)

Advantages:

Very accurate distances and velocities
Can be used at every berth in the port and for channel navigation
Real-time heading



Disadvantages:

RTK Lock status difficult to achieve/maintain
 Laptop resolution limits ability to view centimetre accuracy
 Use limited by range of base station

Approximate cost:

Full-function PPU from about USD 45,000
 At least one RTK base station at approx USD 15,000
 TOTAL SOLUTION PRICE: USD 60,000 for passages up to 10km. USD 80,000+ for longer pilotages

Summary:

RTK is the most accurate PPU technology – 40-60cm better than DGPS-based PPUs. However that extra 40-60cm comes at a significant cost in terms of the PPU itself and the shore-based infrastructure (which will incur ongoing servicing costs). It is unlikely the enhanced accuracy will even show on the pilot's display computer, given that one pixel = 60-80cm on the typical pilot's laptop.

Laser Docking System

This consists of two laser sensors, with monitoring units located in a control room ashore. Vessel movement data can be displayed on a jetty-mounted monitor, and/or transmitted wirelessly to the ship's display, or a laptop on board the ship.

Laser docking is the most accurate docking solution, but only works for the last 300 or so metres of the docking procedure, and then only when the vessel is immediately opposite the lasers. It only gives data for the points opposite the lasers, not the ends of the vessels. It does not perform any other functions, such as channel navigation or swinging assistance, and it only operates on a single berth.

Level of accuracy:

1cm
 ± 1cm/sec for velocity

Equipment needed:

Two laser sensors with monitoring units, a control PC and jetty interface
 A large jetty display and/or wireless link to on-board display
 Speed warning lights

Disadvantages:

Does nothing but aid in final docking manoeuvre on a single berth
 May not work on dark-hulled, non-reflective ships
 Jetty display may be hard to see in some conditions

Advantages:

Very accurate and stable

Approximate cost:

Upwards of USD 250,000
 TOTAL SOLUTION PRICE: More than USD 0.25 million

**Summary:**

Unless used in conjunction with other purposes such as mooring load monitoring, the choice of this option is difficult to understand. A major premium is being paid for a minor increase in accuracy that is unlikely to give any actual operational advantage over a PPU, and the system cannot be used for navigation outside the immediate vicinity of a single berth.