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05 Issue e-Navigation News

Commissioners of Irish Lights

November 2015
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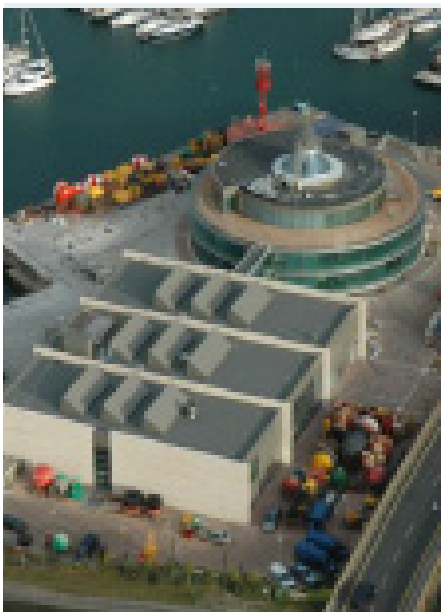

Welcome to issue 5 of Irish Lights e-Navigation News. As the Dublin Bay Digital Diamond (DBDD) Project draws to a close we can reflect on the objectives of this e-Navigation demonstrator and how they were achieved:

- Improving safety & efficiency of maritime transport was achieved by the Automatic Identification System (AIS) to Text tool, the traffic reporting tool and the spar buoy sensors
- Stakeholder value was delivered by the Dublin Bay Buoy- Met/ Hydro facility and the water quality sonde
- Effective communication of the potential of e-Navigation to the maritime community and public was accomplished by the publication of e-Nav News and bridge surveys.

We welcome any feedback that you may have: navigation@cil.ie

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The global e-Navigation community met again for the fifth time on the Pearl Seaways Ferry on passage from Copenhagen to Oslo and back to Copenhagen

> A clear and compelling need to equip the master of a vessel and those ashore responsible for the safety of shipping with modern, proven tools to make maritime navigation and communications more reliable and user friendly and thereby reducing errors

BRIDGE SURVEYS

UPDATES

In order to ensure that we always had the end user in mind, we conducted a number of bridge surveys to establish the mariner's opinion on e-Navigation and the current status of electronic bridge equipment. It was found that there still is a misconception that if you have Electronic Chart Display and Information System (ECDIS) on-board you have e-Navigation. While ECDIS is a component of e-Navigation, the concept is far more extensive, it is essentially about having the right amount of information at the right point in time and operating with a more coherent bridge to enhance safety at sea. The International Maritime Organisation defines it as "harmonisation of marine navigation systems and supporting shore services driven by user needs"; in short it is how the Mariner will navigate in the future.

It was heartening to observe that even with advancements in technology Radar is still very important to the Navigator in terms of priority of equipment used during watch and Radar skillsets. It was also found that the mariner themselves felt they have just the right amount of information, however earlier stakeholder engagement indicated an appetite for much more data. We need to ensure that the balance of information for the mariner in the e-Navigation era is just right and that e-Nav requirements continue to be "user led".

GLA e-Navigation Strategy:

The General Lighthouse Authorities (GLA) e-Navigation Strategy was approved by the Chief Executives in October 2015, the purpose of this strategy is to ensure that the GLAs will continue to provide an appropriate mix of visual and radio aids to navigation (AtoN) as a significant component of e-Navigation and that e-Navigation remains user-driven.

The GLAs' vision for e-Navigation is that it will enable innovative solutions for the:

- Cost effective integration and validation of the diverse information, available from multiple sources, needed for safe, secure, efficient and environmentally friendly marine navigation
- Reliable transmission of that information to appropriate users in a timely manner using the optimum communications channels
- Coherent presentation of the information to the user, while avoiding information overload.

Irish Lights e-Navigation Policy

Irish Lights are in the process of preparing an e-Navigation Policy and Guiding Principles document that will shape our approach to testing and trialling practical e-Nav applications. The overall focus will be on the design and production of Maritime Services Portfolios and the media to transmit and receive information including the Maritime Cloud.

Technical Advisory Committee:

The DBDD Technical Advisory Committee (TAC) met for the last time on the 7 October in Irish Lights HQ. The TAC is made up of representatives from across the maritime and technology sector to explore the potential of e-Navigation services. The purpose of the TAC was to provide advice on the technical feasibility, resource requirements, environmental issues, project outputs, presentation of technical material, strategies and recommendations for action.

The group were given presentations by the various project leaders on the outcomes of the projects that have been completed as well as an update on those that are near completion. Highlights from the GLA e-Navigation Strategy were introduced to the group along with updates on the various Research & Radio Navigation (R&RNav) projects that are relevant to the DBDD. The group were also given a demo of the Irish Lights Bosch camera that is mounted on the Dun Laoghaire East Pier. It is planned to give the RNLI, Dun Laoghaire Harbour and Dublin Port access to this camera when required in order to enhance safety at sea.

Traffic Reporting Tool:

The purpose of this project was to assess the feasibility of monitoring traffic entering and exiting the Port of Dublin using AIS to register each vessel for light dues.

The data was obtained using the ICAN portal hosting the MAESTRO AIS service manager where the necessary AIS data was obtained. A rectangle was defined around the Poolbeg and North Bull Lighthouses as the passing line at the entrance to Dublin Port in order to set the Geo Area. There were numerous resulting datasets from which the data had to be extracted from.

The project proved that it was possible to determine the movements of vessels across the passing line and export the data in a format familiar with most financial software packages that may provide a billing facility or verification tool.

WI-FI TRIAL

SHORT ARTICLE

You may remember from previous issues of e-Nav News that the plan for DBDD Wi-Fi was for data transfer between the four nodes at Irish Lights, Kish, Baily, and Dublin Port, all feeding data back to Irish Lights HQ. Initial surveys to establish the range of the Wi-Fi were conducted using the Dublin Port Pilot Boat and followed up by a survey using the RV Keary, the results of which were not as favourable as the first survey. The mounting conditions were different on both occasions and the sea conditions were poor during the second survey.

The results of these surveys indicated that the receiver had good signal strength, however the access point signal strength was 10dBm less than at the stations. Dun Laoghaire itself picked up 17 access points however there was a lot of noise from external access points. To counteract noise interference the access point on the Irish Lights roof was subsequently moved to Dun Laoghaire East Pier Lighthouse and a stainless steel shielding was fitted behind it.

A third survey was recently completed using the passenger vessel St. Bridget and found that the signal strength at Kish lighthouse was excellent but at 5km from Kish it was found at -70db, the limit of accessing the network. The shielding helped somewhat, however there are still issues with getting a connection back to the network that need to be addressed further.

DUBLIN BAY BUOY

FEATURE

The Dublin Bay Buoy was fitted with met/ hydro sensors in January 2014. The sensors measure wind speed/ direction, wave height, wave period and water temperature, the data is brought back to Irish Lights via an AIS message.

> The time is right now, to move to practical e-Navigation
> - Director General Danish Maritime Authority

Met/ Hydro data from the Buoy can be accessed from the Irish Lights homepage (www.cil.ie) or via twitter @DublinBayBuoy. Oxygen, salinity and temperature sensors were subsequently retrofitted to the Dublin Bay Buoy in collaboration with the Marine & Environmental Sensing Technology Hub of Dublin City University (DCU) as part of their Dublin Bay Smart City project to demonstrate the potential role of continuous data acquisition in decision support as part of a smart city project in Dublin.

Irish Lights engineers welded a 12mm flange at the side of the buoy and attached a stainless tube to the flange, where they then fabricated a stainless steel plunger bracket to lower and raise the sonde into the tube. The open area is to enable free movement of water allowing the sonde to take samples. The idea of the tube is to allow retrieval and cleaning of the sonde via local boat.

Access to the sonde in high fouling season is required twice a month and this proved difficult as a vessel had to be hired to access the sensor for cleaning.
Poor weather and removal of the sonde for cleaning were also found to be difficult. The salinity sensor gave good quality

data indicating change relating to rainfall and changes in salinity in the bay which are useful for flood warning. The test proved that with clever engineering, sensors can work on Aids to Navigation but that the future challenge is ease of access for maintenance.

Spar Buoy Sensors

Finish Company Meritaito provided two Spar Buoys that were deployed 300 metres East of the West Blackwater Buoy and 300 metres to the North of the Bennet Bank Buoy in January 2015. These types of Buoys can be used in an e-Navigation context for the use of sensors in particular on constant tension mooring buoys in order to provide the mariner with real time data. In this trial the West Blackwater Buoy was placed on pre-tensioned moorings.

The following sensors were fitted on the West Blackwater Buoy:

- GPS location
- Battery Voltage
- Water Level
- Wave height
- Water Temperature

The Bennet Bank was fitted with:

- GPS location
- Battery Voltage

The data collected was accessed using Sea How's web portal with a user name and password. This project proved that we can use water sensors on a buoy with pre-tension moorings. This mooring method also opens up options for sea floor sensor connectivity.

Resilient Navigation is an important element of e-Navigation and it was important that the DBDD tested other positioning alternatives..

STEREOSCOPIC POSITIONING

Stereoscopic Positioning is where two photos of the same object/view are taken a few meters apart to be compared with real-time on board camera images and processed for a match at a particular bearing. Images were sent to National University of Ireland Maynooth (NUIM) for processing, however quality of imagery was found to be a constraint.

Localisation using stereo imagery has been of growing interest for a number of years and the challenges in using multiple images (or a composite of such images) to obtain ones location is known and can be overcome.

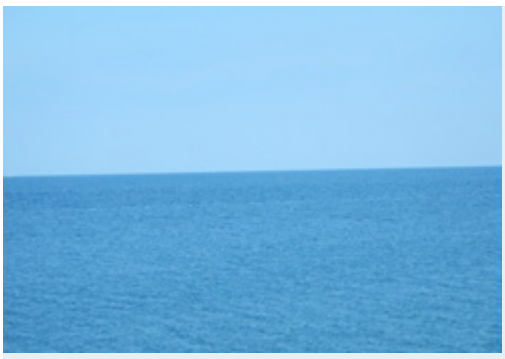
There is a substantial body of work in simultaneous localization and mapping (SLAM). Existing SLAM systems can yield very acute results (e.g. google cars). The accuracy of SLAM systems can be degraded by the unexpected motion of the vehicle and in the presence of other moving objects. High performance SLAM systems now typically use dense networks of landmarks (near and far and on all sides), however this is problematic for Dublin Bay as the bay is inherently featureless at sea and the landmarks are all at the boundaries. At that boundary, there are a number of useful visual landmarks. Away from these, performance will degrade as we move to sea.

It was found that:

- Image based techniques have the potential to be used in Dublin Bay as a complement to GNSS systems
- With off-the-shelf technology, 100 metre accuracy is possible with improvements closer to shore
- Modern localisation techniques can use images on their own and we would expect 25 – 200 metre accuracy
- Performance degradation will occur at night and in poor visibility

A GOOD POSITION ANGLE

A POOR POSITION ANGLE



ELORAN

WORK PLACE

The purpose of this project was to determine whether eLoran is a potential back-up candidate for Global Navigation Satellite Systems (GNSS) in the Dublin Bay area. eLoran is a high-power, low-frequency terrestrial radio-navigation system that has been developed out of Loran-C. eLoran makes use of the legacy Loran-C transmitters, but includes a number of enhancements to improve accuracy, availability and also to provide integrity. Loran-C inaccuracy is due in part to the varying speed of propagation of the signal, which depends on the type of land surface the signal passes over. Delay Factors include Additional Secondary Factor (ASF).

To get the best accuracy out of eLoran, ASF must be known precisely. The best way to do this is to conduct a survey of an area to measure, and map the ASF. Correction tables of ASF can then be loaded into an eLoran receiver and used automatically to improve positioning accuracy. A local Differential-Loran service is used to keep the surveyed map up-to-date as ASF will change slowly over time due to changes in land-conductivity, weather and seasonal changes.

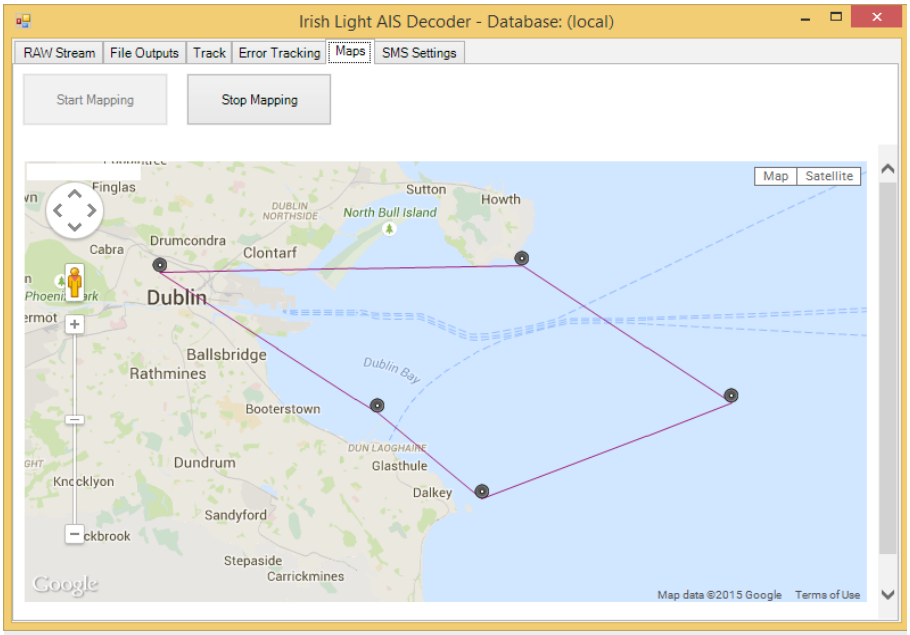
Prior to conducting the survey, the modelled eLoran accuracy for Dublin was computed and it was found that 15m accuracy is the theoretical best eLoran accuracy available in the DBDD area.

The ASF Survey was carried out by our colleagues in the GLA R&RNAV directorate, using the RV Keary. This survey was done at the same time as other signal measurements.

The Anthorn station is the closest to the DBDD area and has been upgraded to an eLoran station. It can be shown that delays in the signal from the Lessay station are far greater than the delays from Anthorn due to the distance and the terrain that the signal passes over.

The provision of eLoran for Positioning and Navigation in the Dublin Bay area is limited by the present geography of the transmitters. Essentially the transmitters are all in a line to the East of Dublin Bay (Ejde, Anthorn and Lessay) or even further to the East (Sylt and Vaerlandet).

Because of this, eLoran cannot be used in the Dublin Bay Digital Diamond area. The provision of a DLoran station to provide ASF variation data does little to enhance the positional accuracy. However, eLoran can provide timing signals in the DBDD which could be used as a back-up system for GNSS timing.



AIS to Text

The user requirement here was to test if a VHF voice reporting point could be replaced using AIS to send an automated SMS text message. Burkes Shipping Agency kindly assisted with this test and allowed us to correlate vessel arrivals using AIS with what they had for the vessels time of arrival. The system works by sending a text message to the Burkes Shipping Agent as a monitored vessel enters a predefined polygon in the DBDD area. When a ship enters the polygon, a text message is sent to the agent alerting the agent that a monitored vessel is approaching.

Besides monitoring vessels the system also provides simple map tracking of monitored vessels in the area, and also allows basic trouble shooting of the GMS modem as well as the ability to send ad-hoc text messages.

The AIS to text tool has passed its proof of concept stage. Elements of this project could be expanded in the future including:

Monitoring System

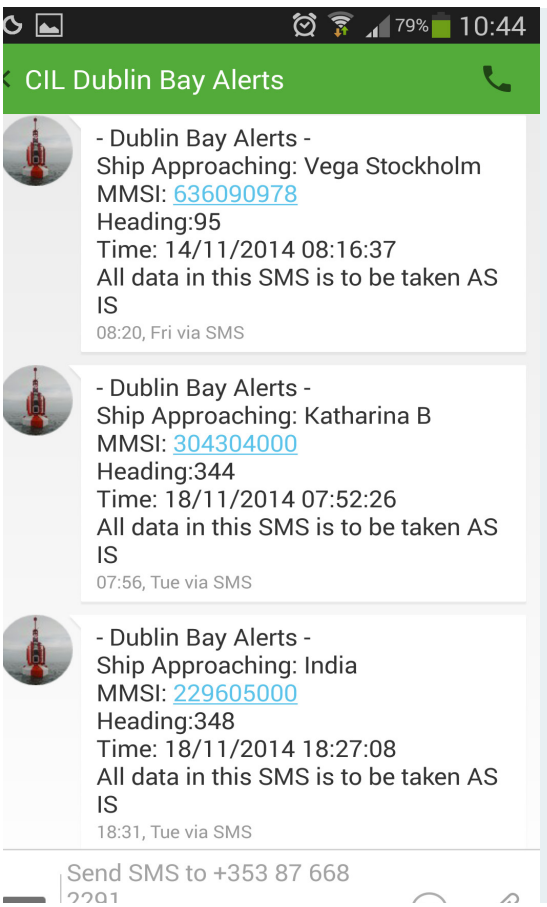
We could expand the monitoring system for more actions (Entered / Exited / Anchored in area / Awaiting Pilot Vessel / Distance monitor / Race monitor etc...) for the polygon or list of vessels, we can also expand the AIS properties on all messages for visual interpretation.

Sending Texts

We now have a programmable GSM modem whereby we can expand on the alerts people would like to receive. Registered users could be made aware of maritime alerts via text message:

- You are entering a tidal cut off zone, High tide 40mins.
- Met/Ocean / Sonde data alerts to clients
- You are in a SAR area please report suspicious objects in the water
- Alert Oil Spill, 3 Nautical Miles East of your location

This was found to be a successful test with numerous applications that can be expanded on in the future.



R&RNAV UPDATE

FEATURE

> Facilitate safe and secure navigation of vessels
> - International Maritime Organisation

The R&RNAV department is based in Harwich in England, and has a staff of 12 people, and facilities on the same site as the East Coast Operations HQ of the Trinity House Lighthouse Service. It was set up many years ago as a separate entity to give advice to the General Lighthouse Authorities on emerging technologies that could be applied to the Lighthouse Service and also to provide independent testing of AtoN manufacturer's products to guide GLA selection.

Every year a number of mandates or requests for work are collated from each of the GLAs, and a decision on the work to be done taken by a steering group comprising the CEOs and directors of the GLAs. Projects selected vary over a wide range of technologies and subjects and are carried out either by the internal R&RNAV experts or by letting the work out to academic institutions or consultants. Projects tend to be focussed on tangible deliverables that provide solutions to improve the cost effectiveness of running the lighthouse services, or push the boundaries of new work such as e-Navigation.

Below is a brief overview of some of the current projects that are of interest in the context of the DBDD and e-Navigation.

NavDat

A system called NAVDAT has been developed, transmitting on 518kHz with a data throughput of 10kB/s. Following on from successful Chinese tests on NAVDAT which proved that the system could work, there is still a need to identify user applications. Navtext has been included as part of the GMDSS review and it is hoped that NavDat will be put forward as its successor during these deliberations.

GPS Jamming detection units

Several small logging devices have been purchased that measure the received signal strength of GPS and can therefore detect presence of GPS jamming devices. One of the units was on test at R&RNAV in Harwich and when the log was examined dips in received GPS signal were noted. The effect of small GPS jammers on vessels navigation systems has been assessed through previous trials. It is planned to extend the project next year to develop a cheap jammer detector which will be fitted to vessels and ports and will be able to detect type of modulation used as well as jamming frequencies as an indication of how much of a problem this is.

DGPS Antenna measurements

This project is modelling the large antenna systems that we have at our DGPS sites and will help our maintenance teams to identify which parts of the aerial or earthing systems are deteriorating and in need of replacement during annual maintenance to maintain system performance. In parallel with this project R&RNAV are setting up a network of receiving stations to provide real time monitoring of all our DGPS sites to give advance warning of system degradation.

AIS VDL Loading map

The loading of the AIS VHF Data Link has often been cited as a compelling reason to provide more channels for AIS and for Application Specific Messages. A brief examination of the message loading around the English Channel did not support this assertion and this project is to monitor the VDL around the UK & Ireland and to produce a loading map, which will act as a guide when planning new AIS infrastructure projects.

R-Mode

This is a follow on project from the ACCSEAS EU funded e-Navigation project which concluded last year. ACCSEAS looked at R Mode using AIS Base stations for short range together with an extra carrier signal on DGPS sites for longer range navigation. This project is to fit R-Mode carrier equipment to two operating DGPS sites in Ireland, and carry out a range study and an interference study on its effect on the DGPS service.

Wi-Fi signals of opportunity

Results from DBDD Wi-Fi trials were compared with a model of expected signal strength from Wi-Fi nodes and some correlation was found. However due to the quantisation of the signal strength readings obtained from the mobile phone units it was not possible to carry out a detailed analysis. Model predicts multiple null points for signal strength, which can be mitigated by using a second antenna vertically separated from the first and using multiple channels. Practical tests will be carried out on a Trinity House vessel in Harwich this year together with further modelling and hardware development. Next year a full trial will be carried out in Dublin Bay.