TNA PROJECT REPORT

1. Project Information

Proposal reference number	JN_CALL_2_16
Project Acronym (ID)	ECSyrinx
Title of the project	Environmental Characterisation of Syrinx ADCP
Host Research Infrastructure	Galway Bay Cabled Observatory (CPO).
Starting date - End date	03/10/2017 - 09/04/2018
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User group members	Geraint West, Tom Bennetts, Matthew Thorne Sonardyne International Ltd.

2. Project objectives

The objective of this project is to undertake a long term deployment of Sonardyne's Syrinx Acoustic Doppler Current Profiler (ADCP) in order to evaluate its performance in a variety of environmental conditions. Syrinx is a relatively new product and has until now only been used as a Doppler Velocity Log (DVL) to aid underwater vehicle navigation, usually for reasonably short deployments of a few hours. This trial will involve bottom-mounting the ADCP in an upward looking orientation for at least two months for use as an in-situ current measuring instrument.

3. Main achievements and difficulties encountered

The deployment of the Syrinx ADCP prototype was well supported by the SmartBay team, who established a good working relationship with the Sonardyne technical team. Overall the trial was highly successful, achieving most of the targets set, with a comprehensive data set which will be used to guide further development of the instrument.

The only difficulties encountered were:

- Access to the SmartBay RDP server gave rise to an expected security risk raised by Sonardyne's IT department. This was resolved internally to the company.
- It had been hoped to compare data from the SmartBay waverider buoy with Syrinx, but this was unavailable for a variety of reasons; however, SmartBay did provide data from the Teledyne ADCP installed, which was useful.

Sonardyne are very grateful to Rogerio and the SmartBay team for their excellent support.

The activity described in this report has received funding
from European Commission's H2020 Framework Programme
under JERICO-NEXT project, grant agreement No. 654410.

4. Dissemination of the results

Syrinx is a commercially sensitive development and therefore only limited distribution of technical results is possible at this time. Notwithstanding this, a copy of the data in PD0 format has been deposited with SmartBay (contact rogerio.chumbinho@smartbay.ie), while several contributions to trade press have been published:

- Wave and Tidal Energy Magazine Issue 13 (**https://content.yudu.com/libraryHtml/A433ga/2WTEN13/reader.html?refUrl=https%253A%252F%252Fexpress.yudu.com%252Fitem%252Fdetails%252F3930739%252F2WTEN13**)
- SmartBay Newsletter Issue 14 (**http://www.smartbay.ie/News/tabid/96/FID/0/NewsID/162/Default.aspx**)

5. Technical and Scientific preliminary Outcomes

Syrinx is a prototype 5-beam ADCP derived from Sonarydyne's Syrinx Doppler Velocity Log (DVL). The objective of the deployment was to evaluate the instrument capabilities for current and wave measurement, specifically:

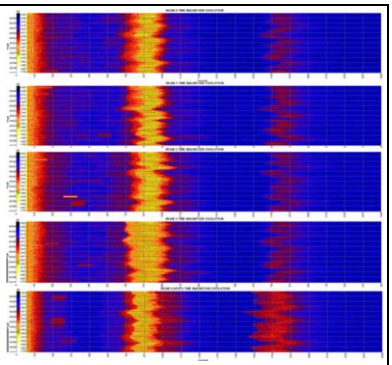
- Measurement of 5 x beam surface and volume raw backscatter
- Per-beam Measurement and tracking of surface wave raw backscatter
- Per-beam measurement of subsurface backscatter
- Time synchronised non-acoustic sensors
- Pressure sensor
- MEM's tilt & heading
- Temperature (defective during this deployment)
- GPS/other

The key attributes of the instrument are:

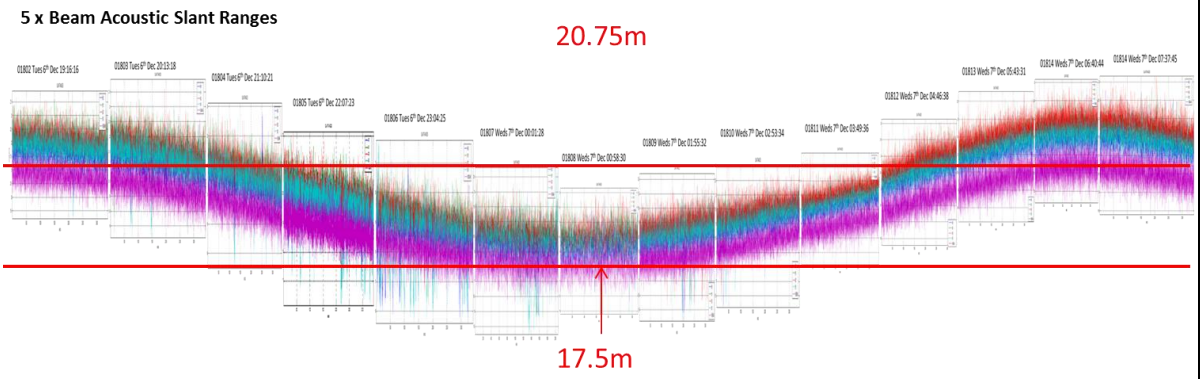
- Linear processing chain
- Configurable Temporal and Spatial resolutions
- Temporal Sampling up to 20Hz
- Spatial sampling configurable from 10s cm to 100s cm
- Oversampling velocity noise reduction
- Independent surface range tracking on vertical and Janus tilted (5 x wave elevation & slope observation)
- High resolution subsurface Doppler calculation (5 x beam)

Implicit in the trial was both real time and off-line data analysis: the former comprised use of a real time-Ethernet interface to a laptop hosting GUI and processing algorithms & data storage; while the latter included replay and re-processing of stored raw acoustic/non-acoustic data through the GUI.

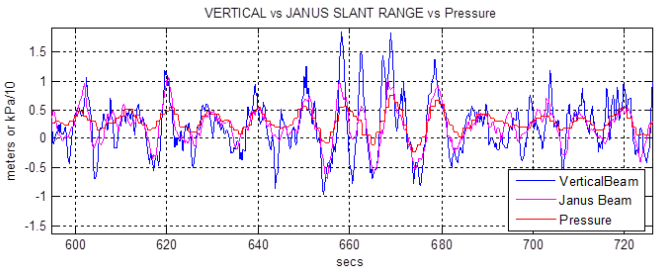
Within the trials period, the sensor real time displays were continuously evaluated. These are too numerous and complex to illustrate here, but included time series of a range of parameters such as raw acoustic data, ping return spectrum, beam slant range, surface elevation, non-acoustics (pressure and roll/pitch), backscatter, real-time ADCP processing and averaged subsurface layer magnitude and direction. The graphic to the right shows raw backscatter from the five beams, clearly showing the surface return as well as fish in the water column.



A typical example of the data collected (see below) shows passage of a weather system between 6th - 7th December 2017, and comprises 14 x 1hr data sets, which were recorded at 4Hz and covered a full tidal cycle (19:16pm – 07:40am.) The plot shows summarised surface tracking data from vertical (purple) and Janus (20°) tilted (red/cyan/green/blue) beams. The tidal range was ~3m and wave height ~+/-1.5m. The graphic shows surface tracking range data provided by both vertical and tilted beams, with outliers being more prevalent during low water and more evident on one beam. It is suspected that this is related to a wind direction change.



Taking a subset of this (1804), detailed comparison with the pressure sensor shows highest noise on the vertical beam, which is possibly attributable to signal saturation of acoustic return, while the titled Janus beams, which are averaged and resolved to vertical shows the highest coherence with the pressure sensor. Note though that the pressure data is biased low at peak wave height due to spatial LPF action.



The examples above give some insight into the results from this deployment, but are only a fraction of an extremely large and valuable data set. Consequently, analysis is continuing and it will be some time before final conclusions are drawn. Sonardyne are continuing to deploy the ADCP with a number of specific end-users in order to carry out further evaluation before making the instrument commercially available.

SUBMITTED, 24 AUGUST 2018