3D Chirp

True 3D Decimetre-Resolution Subbottom Profiling

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- Jointly developed by the University of Southampton and Kongsberg GeoAcoustics, the 3D Chirp subbottom profiler is designed to record the reflected seismic wavefield in true 3D at decimetre-resolution.
- The 60-hydrophone groups are distributed in a 25.0 x 25.0 cm spaced grid around a central source array of 4 Chirp transducers, permitting a theoretical mid-point bin size of 12.5 cm with regular sampling both along- and across-track as well as full azimuthal coverage.
- Custom source waveform specifically developed to provide > 3 octave (1.5 – 13.0 kHz) bandwidth signal with proven vertical resolution < 10 cm and penetration of > 30 m in fine-grained silts/clays, 5 – 10 m in coarse-to-medium sands, and 5 – 10 m in mudstone/siltstone/limestone sequences.
- Bespoke processing software/workflows developed at Southampton permit:
  - Near real-time NMO/Stacked and NMO/Semblance volume generation;
  - Natively anti-alias filtered 3D pre-stack Kirchhoff time migration;
  - Stochastic impedance inversion and intrinsic Q_p determination.
- Writes standard-compliant IEEE SEG-Y files for processing using off-the-shelf software.
- Data sets have been acquired for both academic and commercial purposes from a broad range of different environments, including:
  - Pre- and post-installation offshore infrastructure site surveys;
  - Inshore and near-shore geohazard imaging and characterisation;
  - UXO and archaeological target imaging;
  - Reservoir analogue characterization.

Specification	System Dimensions:	3 x 2 m
	Source Array:	4 Chirp transducers arranged in a Maltese Cross
	Source Waveform:	1.5 – 13.0 kHz broadband Chirp sweep Up to 8 Hz shot-rate.
	Receiver Array:	60 hydrophones groups at 25 cm spacing (inline and crossline)
	Typical Resolution:	Vertical: < 10 cm Horizontal: 37.5 cm
Navigation	Normal Accuracy:	1-2 cm horizontal and vertical
	Absolution Position:	RTK-GPS with post-processed base station surveying
	Relative Source and Receiver positions:	Dual-antenna RTK-GPS heading combined with motion reference unit (MRU) attitude measurements
Typical Operation	Water Depths:	< 5 m to at least 80 m (maximum to date)
	Survey Speed:	3 – 5 knots
	Survey Areas:	Several 100s m^2 to c. 150,000 m^2
	Processing Workflow:	Real-time data QC Near real-time NMO-stacked volumes Pre-stack Kirchhoff time migration imaging

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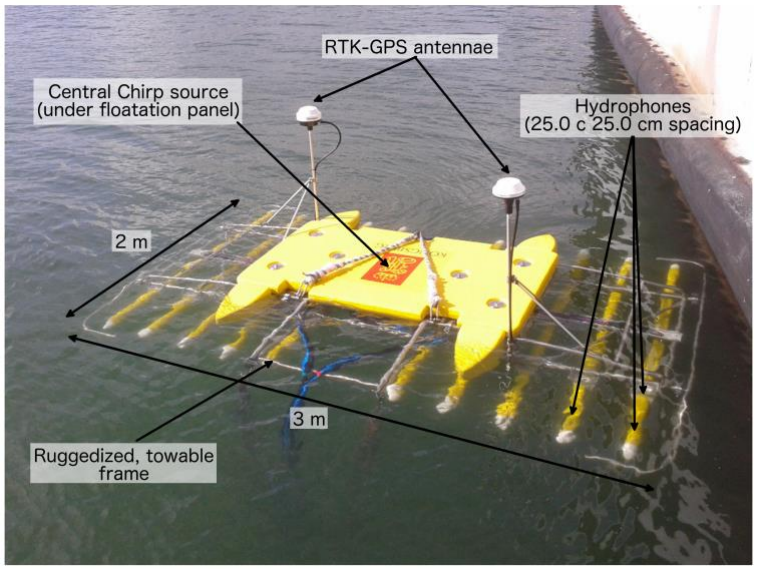

Figure 1: *Annotated photo of 3D Chirp towed array. System is surface towed either alongside or a short distance behind a vessel of opportunity.*

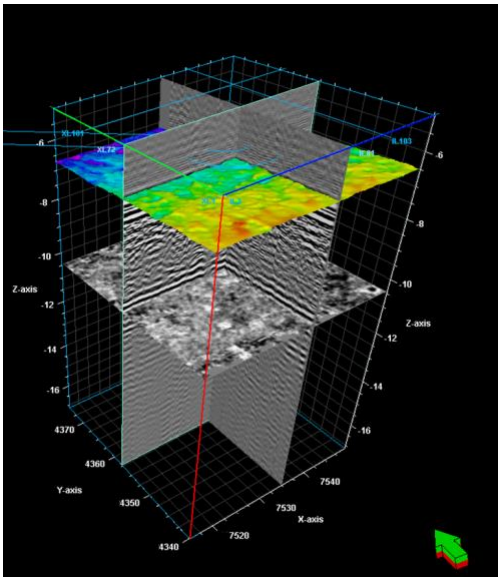

Figure 2: *Example data set from a pre-installation survey over a proposed offshore wind turbine location (Dix et al, 2016).*

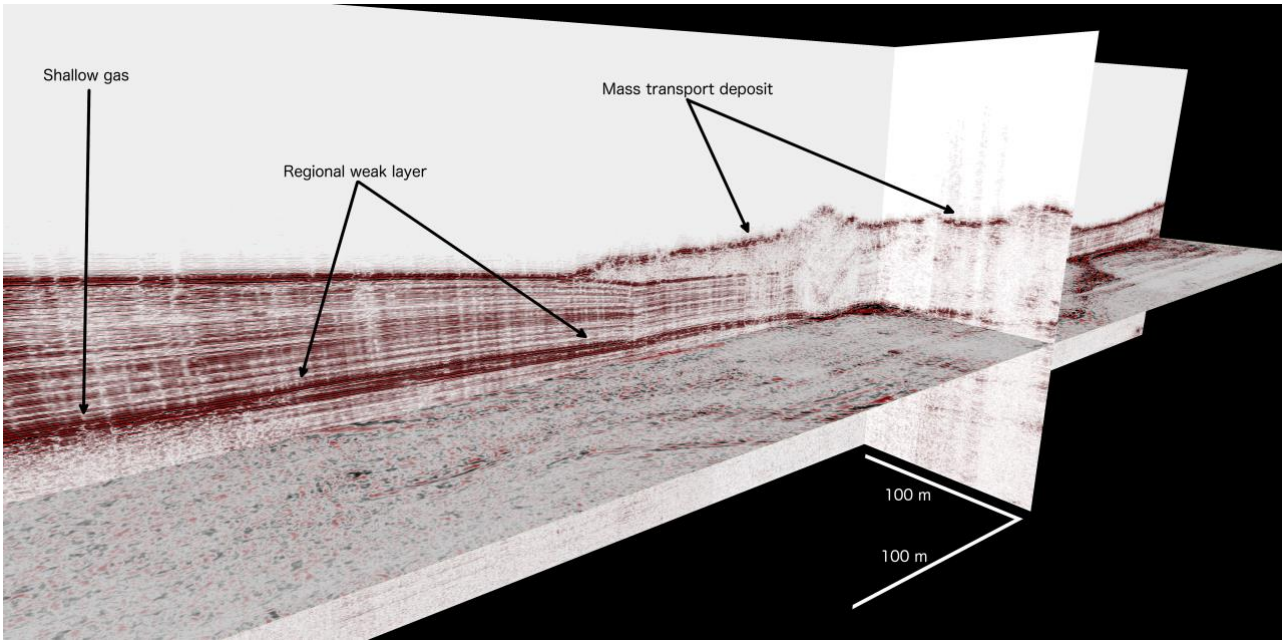

Figure 3: *Annotated example data set from a shallow geohazard case study near Finneidfjord, Norway (Vardy et al, 2012). Imaging target was the interaction between a pre-existing mass transport deposit and a 0.3 – 0.4 m-thick, geologically complex weak layer thought to influence local slope stability. Water depth was 50 – 60 m and area covered 150 x 1100 m. Data are pre-stack Kirchhoff time migrated onto a 12.5 x 12.5 cm mid-point grid using the frequency-approximated algorithm of Vardy and Henstock (2010).*

References

Bull et al (2005), Marine Geophysical Researches 26, p. 157-169; Vardy et al (2008), Geophysics 73(2), p. B33-B40; Plets et al (2009), Journal of Archaeological Science 36, p. 408-418; Vardy and Henstock (2010), Geophysics 75(6), p. S211-S218; Vardy et al (2011), The Leading Edge Feb. 2011, p. 154,159; Vardy et al (2012), Near Surface Geopshyics 10, p. 267-277; Dix et al (2016), Near Surface Geoscience 2016 – The Second Applied Marine Geophysics Conference.

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