LiDAR

Principle: Airborne LiDAR (Light Detection and Ranging) is an optical remote sensing technique that uses a laser pulse, emitted from an aircraft, to measure the terrain elevation derived from the time between emission and reception of reflected pulses. Through laser altimetry, the x-, y- and z-coordinates are registered. The technique has known a very fast development over the last years, including the application in shallow water (so-called Airborne Lidar Bathymetry or ALB). The most recent advancements involve the use of reflectivity information in the ALB data (the amount of energy reflected from the seabed for each individual laser pulse at the wavelength of the laser). This requires integration of the entire return pulse.

Basic features: One of the biggest problems involves the accurate determination of the location of the air/water interface for each laser pulse. To this end ALB systems are commonly equipped with a dual signal measurement unit. The first signal will be reflected by the dry ground and the water surface; the second will penetrate into the water and will reflect on the sea bottom. Due to interference of the two signals in very shallow water automatic detection of the shoreline will be hampered. This can eventually be overcome by additional algorithms or multiple scan campaigns during different tidal situations.

Resolution and horizontal precision: Although the ALB technique generally results in coarser digital surface models with lower accuracies compared to general airborne LiDAR under the same acquisition circumstances, the quality of the ALB data may in some cases be comparable to multibeam data in nearshore areas. Besides, the acquisition time and cost of ALB are often lower in comparison with conventional bathymetric acquisition techniques.

Platforms: Airborne LiDAR surveys involve the use of aircraft.

Advantages:
- Highly efficient and fast method (up to 70 km^2 per hour over large linear areas)
- Relatively high accuracy (optimally 1x1 meter grid)
- Not dependent on the sea state
- Reflectivity gives information on seafloor characteristics (seabed classification)
- Data are acquired on both sides of the land-water interface

Disadvantages:
- Use of aircraft is also weather dependent
- Generally less resolution than multibeam (unless very high resolution survey)
- Only applicable in clear shallow water (maximum water depth few tens of meters)
- Very limited penetration in high turbidity areas (sandy shores)
- Difficult use in extreme shallow water depths < 0.5 m

Literature:

Gary C. Guenther1, A. Grant Cunningham2, Paul E. LaRocque2, and David J. Reid2. 2000. Meeting the accuracy challenge in Airborne Lidar Bathymetry. Proceedings of EARSeL-SIG-Workshop LIDAR, Dresden/FRG, 27 pp.

Pe'eri, S., Morgan, L.V., Philpot, W.D. and Armstrong, A.A. 2011. Land-Water Interface Resolved from Airborne LIDAR Bathymetry (ALB) Waveforms. Journal of Coastal Research, 62, 75-85.

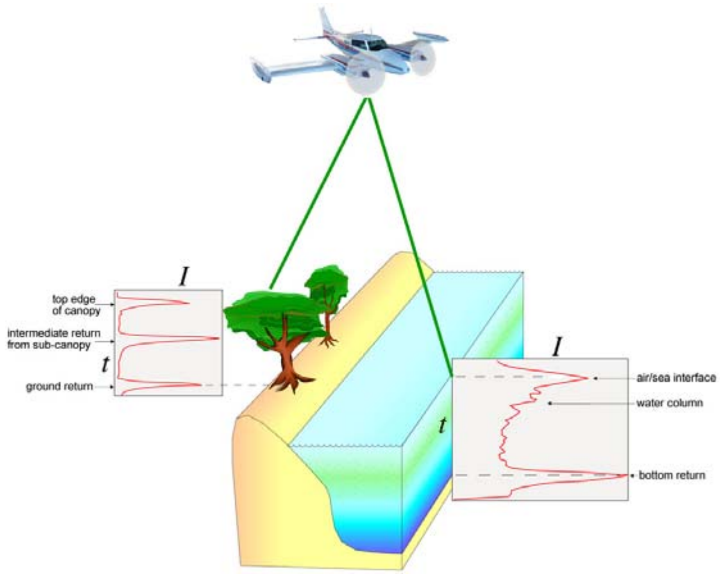

Fig.1 Schematic showing the principles of airborne LiDAR (© USGS)

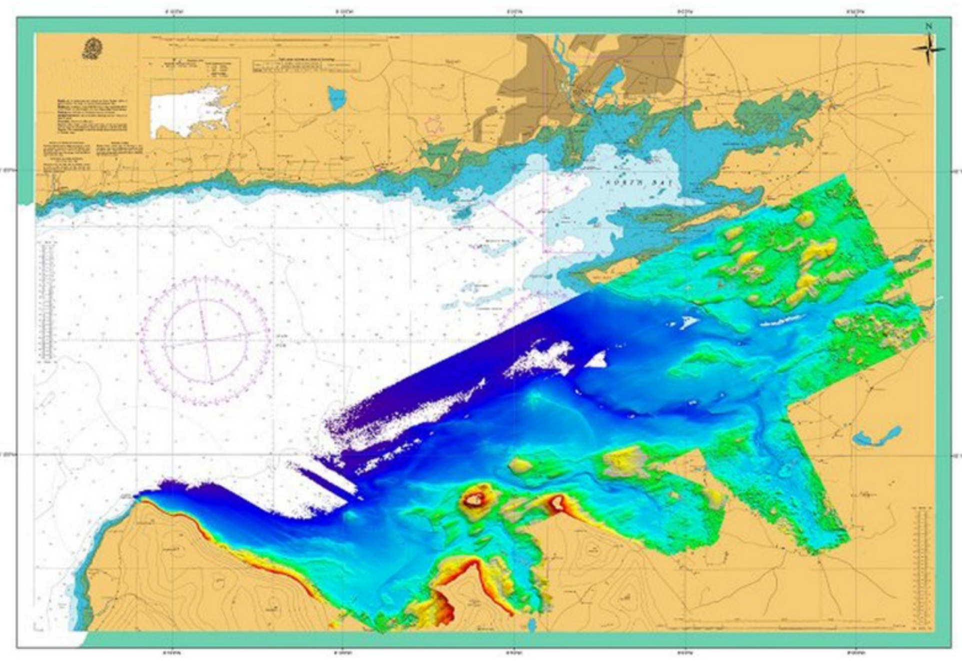

Fig. 2 Airborne LiDAR Bathymetry of Galway Bay, Wales, UK (© INFOMAR)

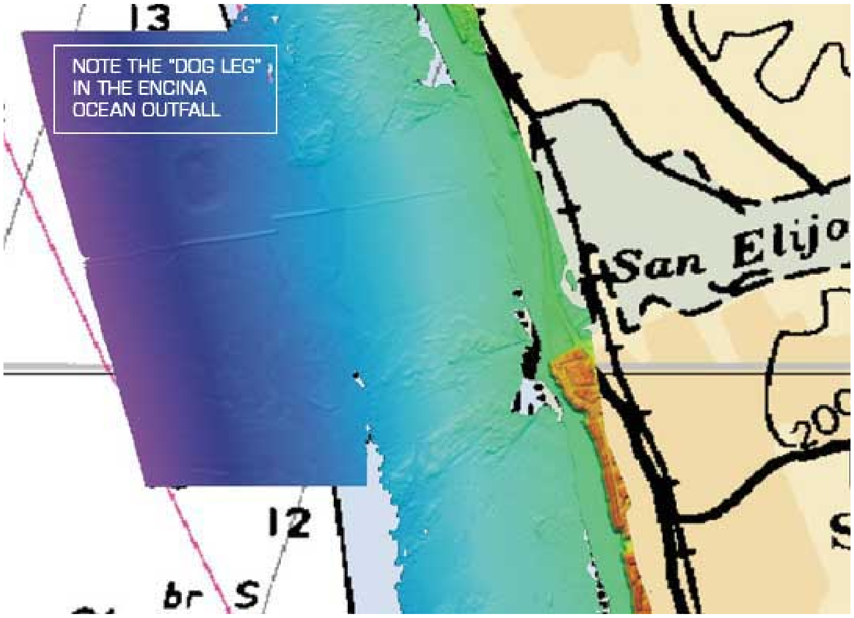

Fig. 3 Integrated bathymetry from airborne LiDAR and multibeam sonar (© Fugro)

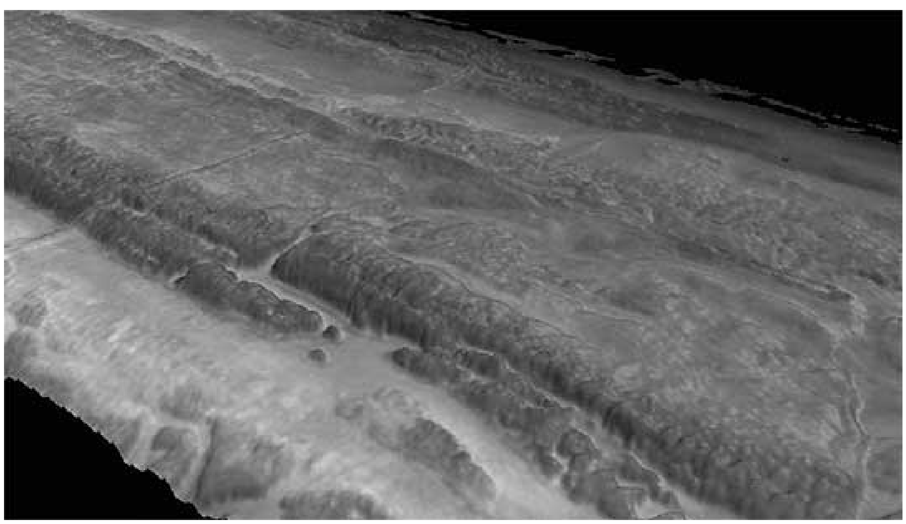

Fig. 4 Seafloor reflectivity map obtained with airborne LiDAR (© Fugro)