High-resolution optical and acoustic 3D seafloor reconstructions from robot and diver-based surveys

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Robust simultaneous localization and mapping (SLAM) techniques have become standard techniques for navigation of robotic platforms over the last decade. SLAM allows autonomous robots to use environmental information to improve their navigation and map estimates. A key aspect of SLAM is that it maintains a representation of the uncertainty of the map and vehicle trajectory. This enables a principled (and automatic) approach to enforcing consistency in maps when revisiting an area (such as when 'closing a loop' or when using overlapping tracklines). In essence, SLAM allows multiple views of the same feature to be mapped to the same location, reducing map errors such as drift and repeated structures. In the context of underwater surveys, SLAM enables properly instrumented robots to collect data and generate geo-referenced, self-consistent maps. In practice, these algorithms fuse multiple sources of navigation data such as surface GPS, acoustic positioning, Doppler velocity log (DVL), inertial measurement units (IMU) and depth, with environmental observations from cameras and sonar.

This paper presents a brief overview of the capabilities that the marine robotics group at the Australian Centre for Field Robotics (ACFR) has developed in terms of improved high resolution optical and acoustic mapping, automated interpretation and visualization. We then show how some of these technologies have been applied to SCUBA-based surveys that result in high-resolution, geo-referenced 3D mosaics without requiring robotic platforms.

We present results from the autonomous underwater vehicle (AUV) Sirius and a diver-held stereo camera rig. Both natural and man-made structures are reconstructed, with techniques that enable large-scale composite views that preserve 3D structure. Preliminary results for monitoring applications are also presented, discussing the ability to revisit an area and detect changes in time.

The range of capabilities developed at the ACFR can potentially assist underwater archaeology in a broad range of applications including the automatic generation of 3D reconstructions of large underwater sites, effective visualization and interaction of archaeologists and general public with these reconstructions, and potentially automated monitoring for degradation or disturbance of archaeological sites.

Tracing the ancient tectonic processes by coarse-grained, mass-flow deposits: the Western Carpathian Mesozoic – Palaeogene case history

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Tectonically generated mass-flow deposits, such as terrigenous tectonosedimentary breccias and flysch-related conglomerates, form stratiform bodies of coarse-grained, poorly sorted resediments inserted within more fine-grained, usually deep-marine clastic and/or pelagic sediments. They were emplaced by some gravity-driven mechanism and include various block-in-matrix type sediments named as olistostromes, pebbly mudstones, scarp breccias, wildflysch, etc. The mass-flow deposits may occur in a range of environments and