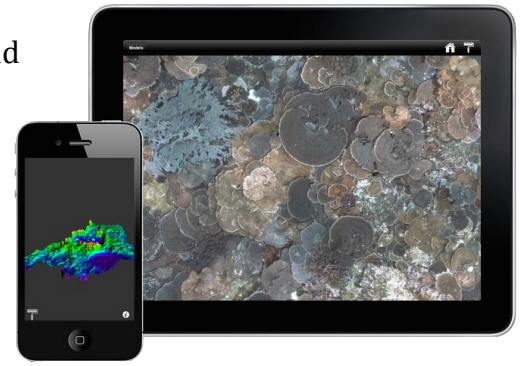
Summary of Some Computer Science Technologies Relevant to Geoscientists
Katie Skinner & Matthew Johnson-Roberson http://droplab.engin.umich.edu

Optical Autonomous Underwater Vehicles and SLAM

Underwater vehicles, capable of high precision navigation and equipped with downward-looking stereo cameras, can recover bathymetry at fine resolutions over relatively large, contiguous extents of seafloor. Measures derived from these surveys make it possible to obtain dense coverage over larger spatial extents more rapidly than with human divers. Given that the surveys and calculations can be performed without humans, a potential source of measurement bias is eliminated. Furthermore, the submersibles and the navigation systems proposed in this grant would provide the ability for easy repeat transects, making it possible to revisit an area of interest for monitoring purposes.

A great deal of work has been done in the domain of 3D mapping for underwater vehicles and this work has established the practicality of performing georeferenced mapping, using SLAM (Simultaneous Localization and Mapping), followed by post-processed 3D reconstruction. An example of the state-of-the-art in offline models generated with AUV data appears at right.



3D image data classification

The recent success of convolutional neural networks (CNNs) in tasks such as image recognition, object detection and semantic scene recognition has spurred a renewed interest in multi-layer hierarchal feature learning in the computer vision community. One of the most exciting aspects of research in this direction is that network architectures such as CNNs alleviate the need for domain specific feature engineering. Such methods, which learn feature representations directly from the data, are thus desirable because they can be applied to a multitude of input modalities, and are not limited to 2D RGB data.

Long-term persistent autonomy with hybrid AUV gliders and chemical sensing

AUV gliders have begun to blur AUV class distinctions by combining active thrust and buoyancy. Hybrid glider with an embedded decision architecture that assimilates data to generate and continuously update an environmental model of the study site could allow for long term site monitoring. An AUV glider can operate as a reconnaissance platform in coastal zones to autonomously identify benthic areas for follow up investigation with a higher resolution sensor. Combing this with in-situ mass spectrometry can quantitatively identify a wide range of dissolved chemicals at trace concentrations in the subsurface environment. This technology can be used to track and follow plumes of chemicals, environmental phenomenon, and disasters like oil spills.