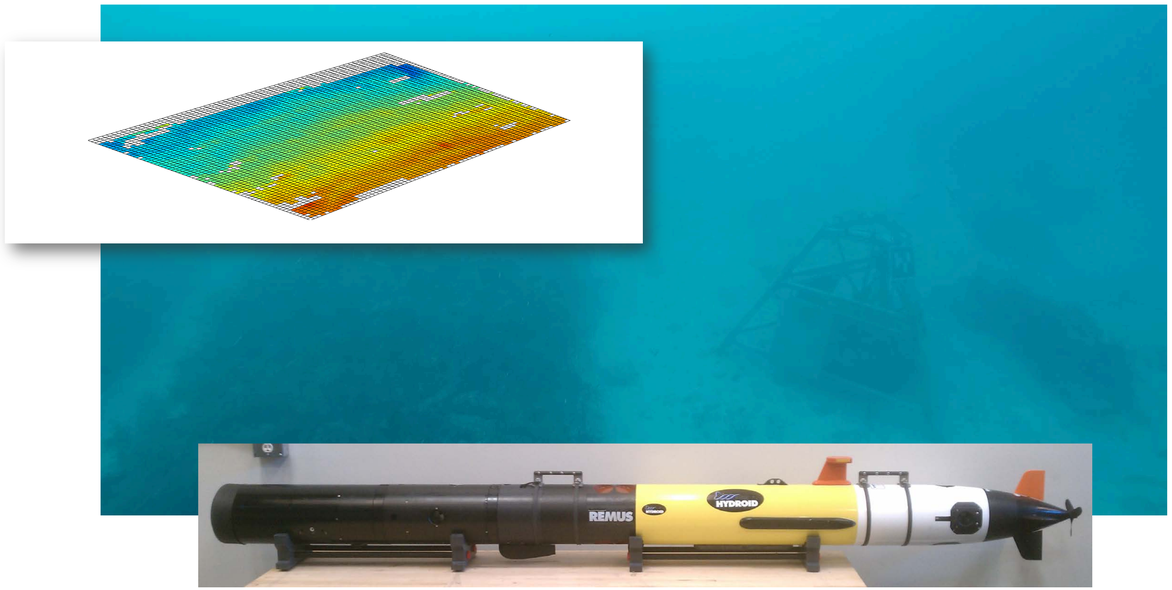
Alternative PNT - Precision Undersea Navigation

Naval Postgraduate School



- Image from REMUS Conducting Mapping Experiments as part of NASA Extreme Environment Mission Objectives (NEEMO 21)

Overview

- Combine together elements of Simultaneous Localization and Mapping (SLAM) with Terrain Aided Navigation (TAN) to create a new capability for accurate undersea navigation
- The proposed technique emphasizes the real-time creation and correction of a high resolution bathymetric map.
- The bathymetric map is created using a combination of forward, downward and side scan sonars with mosiacked video imagery “draped” over the top.
- Experimentation includes NOAA Damage Assessment for Coral Reef rehabilitation and Marine Archeology.

Technical Approach Highlights

- Map building leverages and improves upon Optimal Spatial Estimation:
  - Improve semi-variance functional analysis through the use of Epi-splines to improve curve fitting techniques with “soft-constraints”
  - Generate near real-time bathymetic maps through development of probabilistic techniques for modeling semi-variograms as AUV collects measurements
  - Improve map accuracy through the use of prior low resolution maps to develop specialized data structures for ensuring quasi-stationarity of bounded sub-regions
- SLAM uses point features detected from the forward-looking sonar to update the AUV position and correct prior bathymetric measurements for improved TAN
- Development of multi-layered maps combining sonar with mosciaked imagery for better maps

Experimentation

- Combined experimentation with NOAA Office of National Marine Sanctuaries
- Evaluate use of AUVs for damage assessment of coral reef and marine archeology
- Compare current techniques with accuracy, cost and safety of using AUVs to conduct undersea surveys
- Experimentation tentatively scheduled for Southern Florida
- Experimentation ideal for developing, testing and validating research goals.