A Demonstration of Autonomous Survey with a Shallow water Multibeam and Near Real-Time Processing

Reducing Risk and Expanding the Operational Window
Advantages of Autonomous Operation

- **Safety**
  - No surveyors in the field
  - Reduced vessel count
- **Cost**
  - Lower fuel cost
  - Lower victualling cost
  - Lower personnel cost
- **Efficiency**
  - Fewer surveyors per sonar
Liquid Robotics Wave Glider® SV3
Wave Glider® SV3
*World’s first wave and solar propelled ocean robot*

- No fuel, no manpower, no emissions
- Long duration missions – 1yr.+ at sea
- Onboard computational power for in-situ processing
- Real time communications
- Intelligent Autonomy
Wave Glider SV3 Core Components

**Wave and Solar energy harvesting system**
Solar power for computing, communications & sensor payloads

- **Wave Powered Sub**
  Wing system converts wave energy into forward thrust

- **Hydrodynamic Float**
  Modular design for maximum payload & solar collection capacity

- **High speed Umbilical**
  High power connection between the Float and Sub

- **Adaptable Modular Power system (AMPS)**
  Advanced power system with large rechargeable battery capacity

- **Solar Powered Auxiliary Thruster**
  For thrust and burst speed thru doldrums and high currents

- **Computational Power**
  On-board processing power and cloud computing environment
How It Works

A rising wave lifts the float, pulling the sub up. The wings are pushed down, moving the sub up and forward.

The float moves off the wave, the sub drops. The wings are pushed up, moving the sub down and forward.

5 U.S. and 14 foreign patents issued. 10 U.S. Provisional applications, 33 foreign applications.
Precision Navigation
Ease of Launch & Recovery
The Wave Glider in Action
Wave Glider SV3
Hydrographic Development
MB1 Integrated System

- Sonar Control and Acquisition
- Navigation & Hdg
- Interface Box
- Sonar, SV, & HPR Data Packets
- Motion
  - Sonar Head
  - SV Probe

Data flow:
- ALL Data Packets
- Serial data
- Network data
CARIS Workflow

- Create Vessel File
  - Enter lever arm measurements
  - Supply device model for MB1
  - Build model for Total Propagated Uncertainty
- Create Project
- Raw data conversion
- Apply correctors
  - Load Tide
- Georeference data – Merge Process
- Optionally compute Total Propagated Uncertainty
- Create BASE Surface using CUBE algorithm
- Export to raster format, GeoTiff
CARIS HIPS & SIPS Automated Processing

**Acquisition**

- **Monitor**
  - Look for TDY files

- **TDY**

**CARIS Batch Engine:**
- Convert / Read TDY
- Apply Tide
- Compute TPU
- Create BASE Surface / Grid (CUBE)
- Export to GeoTiff

**On-board (miniaturized) i7 Quad Core machine running Windows 7**

**View product: GeoTiff**
Demonstration Survey

- Survey Operation on the west side of Hawaii
- Survey Monitored in St Maarten, Caribbean at the MACHC IHO meeting
- Uplink/downlink by cell phone
- Control for
  - Vehicle
  - Sonar
  - Caris processing
Products and Visualization

Vessel Track
Products and Visualization
BASE Surface and GeoTiff Export
Further Processing

- Sound Velocity Correction
- Load observed Tides
Further Processing

- Swath and/or TPU filters
- Area-based editing
Final BASE Surface
- All post processing corrections applied
- Ping edited
Final Products
Conclusions

- Autonomous Hydrographic Survey has been Demonstrated.
- The hydrographic survey can be adequately operated from shore.
- Survey control and oversight is similar to survey launch operations.
- Capacity can be quickly and economically scaled.
- Manpower, operational cost, and risk are significantly reduced.
Back up slides
How It Works