

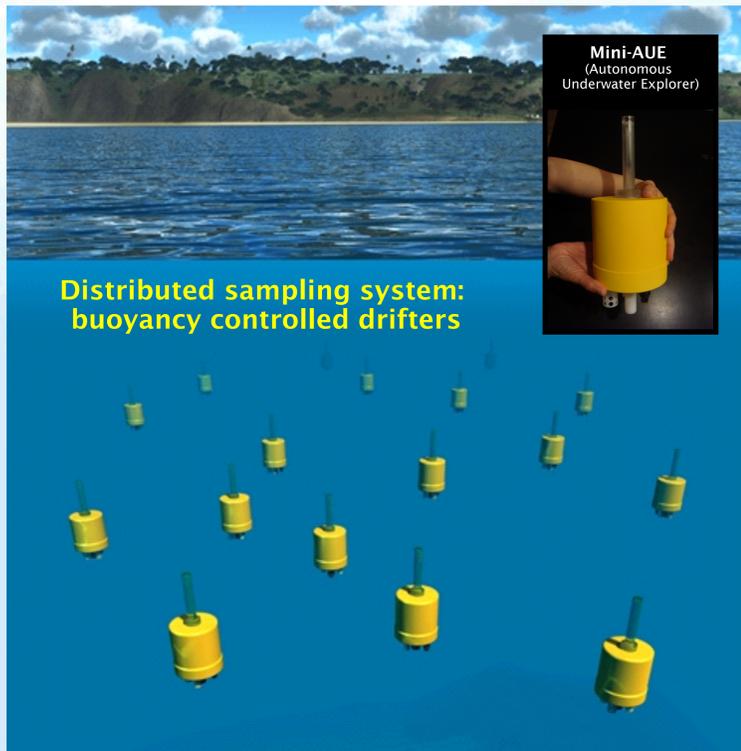


INSPIRE Track 1:

Distributed Sensing Collective to Capture 3D Soundscapes

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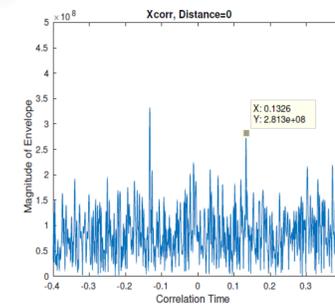
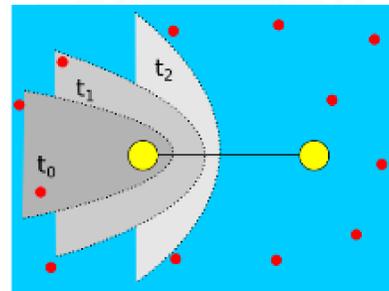
Overview



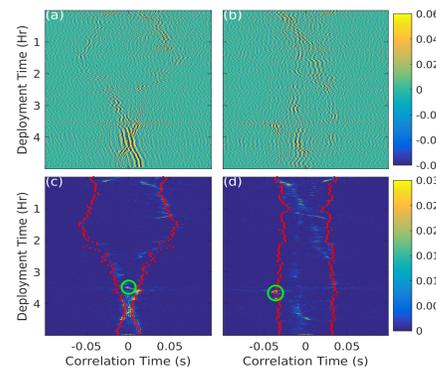
- **Underwater soundscape:** The combination of sounds present in the immersive underwater environment
 - Many marine organisms are highly dependent on sound for navigation, communication, and detection of food and predators
 - Changes in ambient soundscape are an important indicator of the health of an ecosystem
 - Soundscape aids in studying impacts of threats to the ocean ecosystem, such as rising ocean noise levels and anthropogenic noise pollution, global climate change, ocean warming and ocean acidification
- **Project goal:** develop a distributed sampling system to study the underwater soundscape at revolutionary spatial (~100 meters) and temporal (~100 seconds) resolutions within a mobile reference frame
 - Autonomous swarm of buoyancy controlled underwater drifters
 - Tracking based on ambient sound field rather than infrastructure elements
- **Accomplishments**
 - Algorithmic techniques to extract geometric information from the ambient sound field
 - Field testing and sound field data gathering in the Cayman Islands

Experiments

Isotropic Sound Field

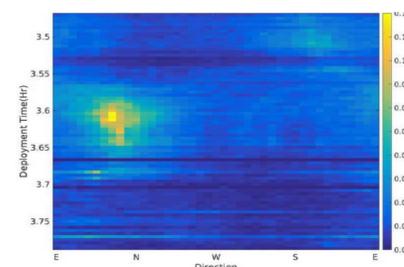
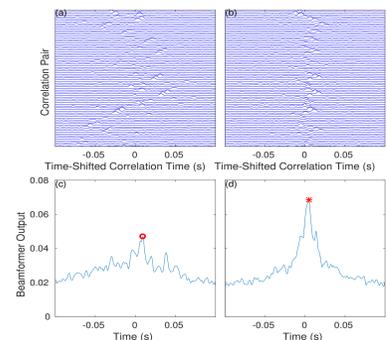
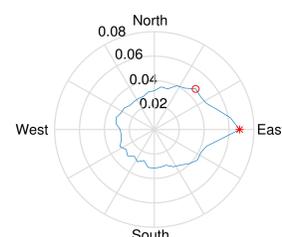


- Correlate sound recordings from two receivers
- Assume sound sources are distributed uniformly around the receivers (i.e., isotropic sound field)
- Each source direction creates a peak in the correlation plot
- Sources near the 'end fire beam' dominate this correlation
- End fire beam peak infers distance between the receivers



Directional Sound Sources

- Incoherent beamformer
 - Consider all receivers
 - Shift correlations to correspond to a sound direction and add contributions
- Can indicate a dominant sound direction



Field Experiments

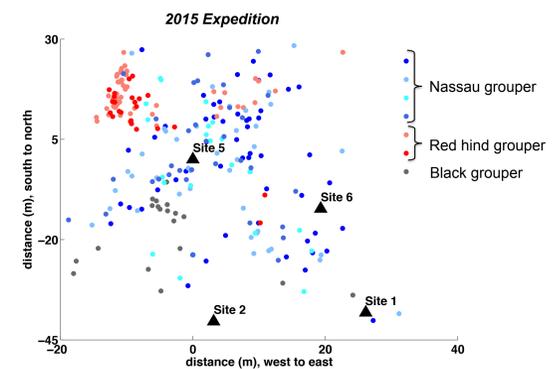
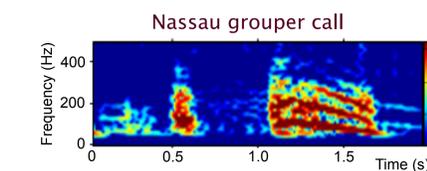
Soundscape recordings

- Grouper Moon project of Reef.org at Little Cayman
- Study spawning aggregations of the endangered Nassau Grouper (*Epinephelus striatus*)
- Field expedition: January 26th to February 29th, 2016

Nassau grouper spawning aggregation



Little Cayman field sites



- Two-channel Wildlife Acoustics SM3M hydrophone recorders; 36 KHz sampling
- Spatio-temporal analysis of calls from 2015

Technology Deployments

- AUE drifter releases: 5 hour deployment over 5 km, tracked through surface drifters acting as buoys
- NetCam tow: towed plankton microscope to measure larval and egg dispersal (4 hours)

