

# Nina Mahmoudian

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## Persistent Operation of Mobile Robots

In Nonlinear and Autonomous Systems Lab, we are developing theoretical, computational, and experimental tools for long-term operation of network of autonomous vehicles in complex environments. The application is for a air, ground, and sea robots.





## Challenge

- Collective power management for long-term multi-robot operation.
- Effectively respond to energy needs in the presence of dynamic conditions and environmental uncertainty.

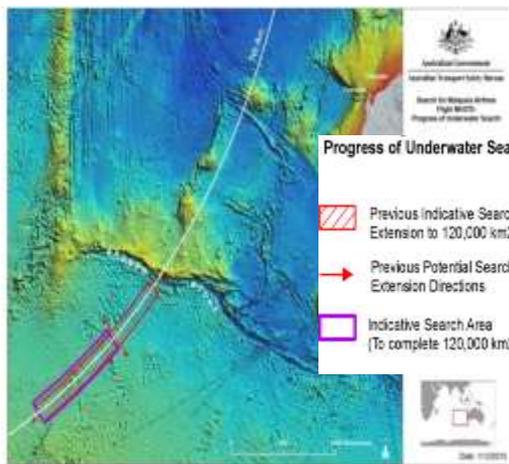


# Solution

The key is lowering deployment and operating costs, while also increasing efficiency, endurance and persistence.

Our approach includes:

- task and energy routing scheduling,
- efficient path planning and coordination,
- low-infrastructure platforms.



COST OF THE SEARCH		
HMS SUCCESS 14 days at sea <b>USD 7.15 MIL</b>	US PLANES & SHIPS as of Wednesday <b>USD 3.34 MIL</b>	VIETNAMESE search in South China Sea <b>USD 8.07 MIL</b>
HMAS TOWOOMBA 7 days at sea <b>USD 2.51 MIL</b>	US BLACK BOX LOCATOR /UNDERWATER DRONE <b>USD 3.62 MIL</b>	PAYOUT TO FAMILIES <b>USD 1.16 MIL</b>

US = United States of America Source: The Sydney Morning Herald

### Robot sub to search seabed for MH370

An unmanned submarine is expected to be deployed in the coming days to search for wreckage on the sea floor, after acoustic signals consistent with an aircraft black box narrowed down the likely search area

**BLUEFIN-21** Length: 4.93m Weight: 750kg Speed: 4.5 knots Autonomy: 25 hours

Sonar buoys dropped in 600 square km area to help triangulate source of signals detected by Australian navy ship since April 5

Zeewijk Ridge, Zenith Plateau, Underwater search area, Cuvier Plateau, Perth Basin, INDIAN OCEAN, RAAF Learmonth, AUSTRALIA

Bluefin-21 can search 100km per day

Bluefin-21: Side-scanning sonar and multi-beam echo sounder can examine underwater objects in minute detail

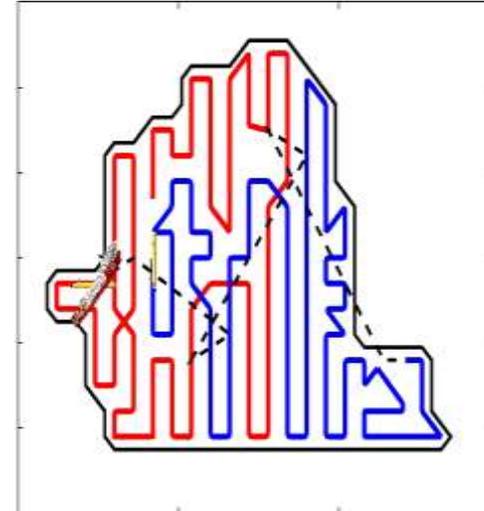
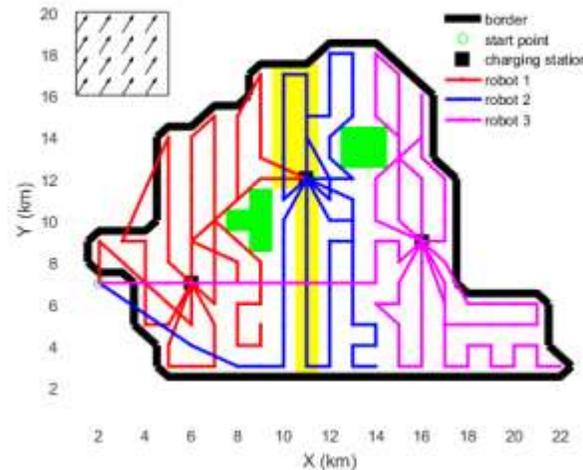
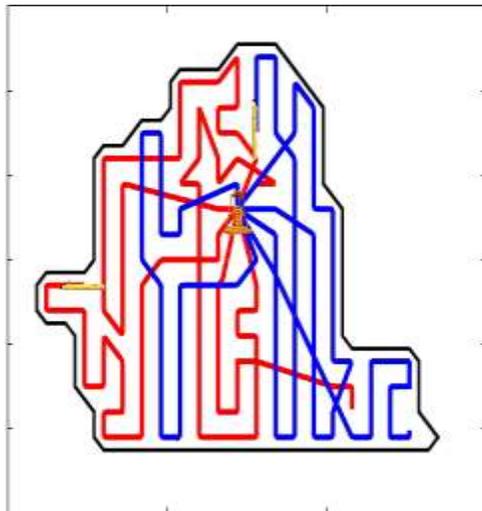
Sources: U.S. Navy, Bluefin Robotics, Australian Maritime Safety Authority © GRAPHIC NEWS

## Task and Energy Routing Scheduling

Mission planning architecture for persistent operation to

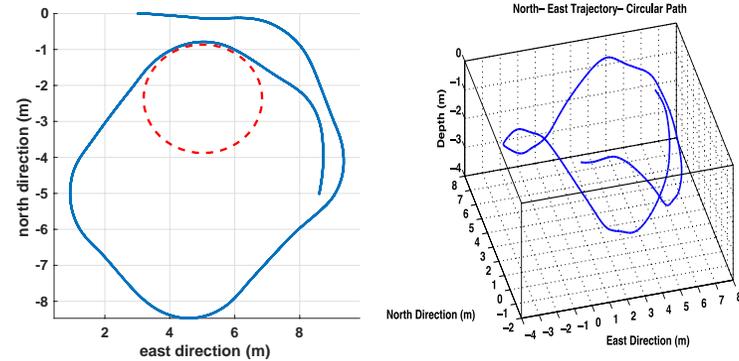
- place and uses static charging stations
- Or
- find the rendezvous positions of mobile chargers

With primary objective: minimize the energy spent



## Low-Infrastructure Platforms

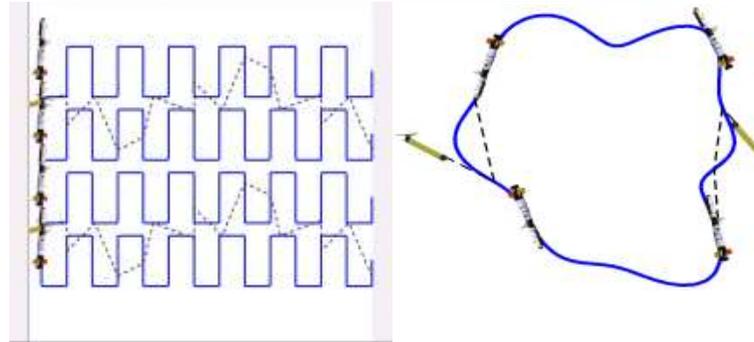
- Reducing the cost of deployable AUUVs while increasing maneuverability and capability of operation



### ROUGHIE: Research Oriented Underwater Glider for Hands-on Investigative Engineering



- Developing experimental test-bed including a mobile charger capable of autonomous docking and wireless energy transfer for marine settings.



## NAS Lab Team

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