

# Makai's SASS System for Horizontal Tow Cable Control

Topic N171-055

SYSCOM: NAVSEA

Speaker: Hermann Kugeler

# About Makai Ocean Engineering

- Professional Ocean Engineering Service Provider Since 1973
  - Known worldwide for subsea cable software and hardware development
  - World leader in other areas including marine pipeline design, Ocean Thermal Energy Conversion (OTEC) & Seawater Air Conditioning (SWAC)
- Significant Technical History
  - Involved in multiple subsea cable and towed array Small Business Innovation Research (SBIR) projects related to this topic
  - Holds several patents for Department of Defense (DoD) funded tech.
- Key Resources
  - 37 employees including 29 with advanced degrees
  - Makai Research Pier in Waimanalo, HI
    - Access to shallow and deep waters within the pre-permitted Makai
  - Ocean Energy Research Center (OERC) in Kona, HI
    - Novel advanced manufacturing and test facilities for ultra-compact heat exchangers
  - Office and Workshop facilities in Ventura, CA
    - Supports Oceans Multiple Award Contract (OMAC-3) work for Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC)
- Commercialization/ Transition Success
  - 2016 Tibbetts award winner for successful execution and transition of SBIR projects
  - SBA-designated Commercialization Achievement Index of 100 out of 100
  - Makai submarine cable products used by multiple Government customers

# The Navy Challenge

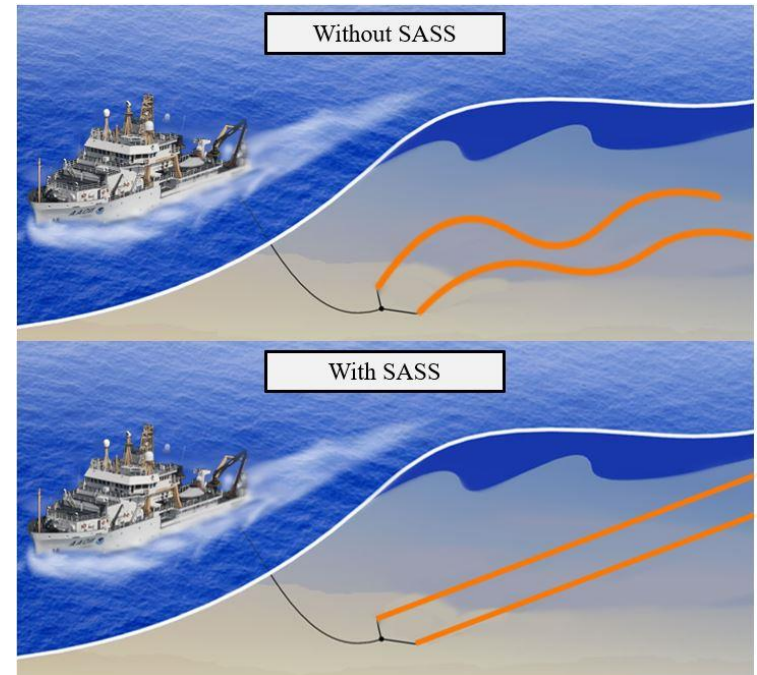
- Requirement
  - Navy needs a way to straighten the horizontal tow cables during operations
  - Drooping tow cables subject to damage from dragging on seafloor
- Expected transition target
  - Vessels that use horizontal tow cables
- Expectations
  - Maintain tow cable linearity within +/- 2 feet
  - Protect itself from bottom damage
  - Passive or autonomous controls
  - Cannot induce acoustic noise
  - Cannot increase vulnerability to entanglement

# Operational Need & Improvement

- Problem:
  - Tow cables dragging on seafloor can cause \$8M in damage/ incident
- Need:
  - Ability to maintain tow cable straightness during operations
  - Reduce tow cable droop at low speeds
- Improvement:
  - Passively controls tow cable straightness during operations
  - Maintains tow cable depth at aft end during all operational speeds
- Platforms with this need:
  - Vessels that use horizontal tow cables

# The Solution

- Makai's SASS System
  - Consistent, constant control of drag and lift to aft end of tow cable
  - Completely passive system
    - No external power or communications
    - Robust and reliable
  - Compensates for any roll and pitch
  - Does not impact tow cable function
  - Do-no harm failure modes
- Specs achieved
  - Corrects straightness to within two foot displacement anywhere on the cable throughout operational speeds
  - Increases range of operational speeds
  - Maintains tow cable depth



# Current Status

- Maturity Schedule to Technology Readiness Level (TRL) 7

Milestone	CY20	CY21	CY22
Pier-Side Testing of Full-Scale SASS Prototype	★ TRL 4		
At-Sea Testing on Full Length Ropes Instead of Tow Cables	★ TRL 5		
At-Sea Testing on Representative Tow Cables		★ TRL 6	
SASS Prototype Demonstrated in Operational Environment			★ TRL 7

- Currently at TRL 5 with plans to reach TRL 7 at the end of 2022
- Currently in the SBIR Phase II Option I period

# Key Features / Advantages / Benefits

	With SASS	Without SASS
<b>Straightness</b>	Maintains straightness within 2 feet	Free to move with little constraint
<b>Droop</b>	Limits tow cable droop, and possibility of damaging the cable on the seafloor	Able to droop at low speeds, causing costly tow cable damage and decommission time
<b>Control</b>	Completely passive control system. No external power or comms.	No control
<b>Roll &amp; Pitch</b>	Passive ailerons limit roll & pitch	No control over roll & pitch

- Passive control provides:
  - Improved tow cable straightness
  - Increased range of operational speeds

# Transition to Fleet

- What's needed to transition beyond Ph II?
  - Additional funding will be required to certify for use on vessels during operations
  - Looking for support in the transition onto an operational vessel
- Transition advocate
  - Looking for primary transition advocate for legacy ships
  - Looking for transition advocates for secondary applications
    - Incorporation into future tow cable designs



# Transition/Partnership Pitch

- Business Model
  - Need input from Program Offices to transition onto legacy tow cable systems
  - Interested in working with Program Office and partnering with Primes for future vessel applications that use horizontal tow cables
  - Additional funding is needed to transition to other applications
- Other Transition Paths
  - Commercial markets including oil and gas.

# Reach Out to Discuss Your Needs!

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# Reference Sheet

## Reference Sheet for Makai Ocean Engineering, Inc. Topic Number N171-055

Slide Number	Slide Title	Content Citation	Graphic Citation	Notes	Checked by BC
1	Makai's SASS System for Horizontal Tow Cable Control	N/A			
2	About Makai Ocean Engineering	Makai Business Development			
3	The Navy Challenge	Solicitation			
4	Operational Need & Improvement	Solicitation			
5	The Solution	Makai Derived R&D	<a href="https://oceanexplorer.noaa.gov/technology/vessels/pisces/pisces.html">https://oceanexplorer.noaa.gov/technology/vessels/pisces/pisces.html</a> And Copyright 2020 Makai Ocean Engineering		
6	Current Status	Makai Derived R&D			
7	Key Features / Advantages / Benefits	Makai Derived R&D / Solicitation			
8	Transition to Fleet	Makai Business Development			
9	Transition/Partnership Pitch	Makai Business Development			
10	Reach Out to Discuss Your Needs!	Makai Business Development			