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Assessment of Nighttime Airborne Visual ASW Capability

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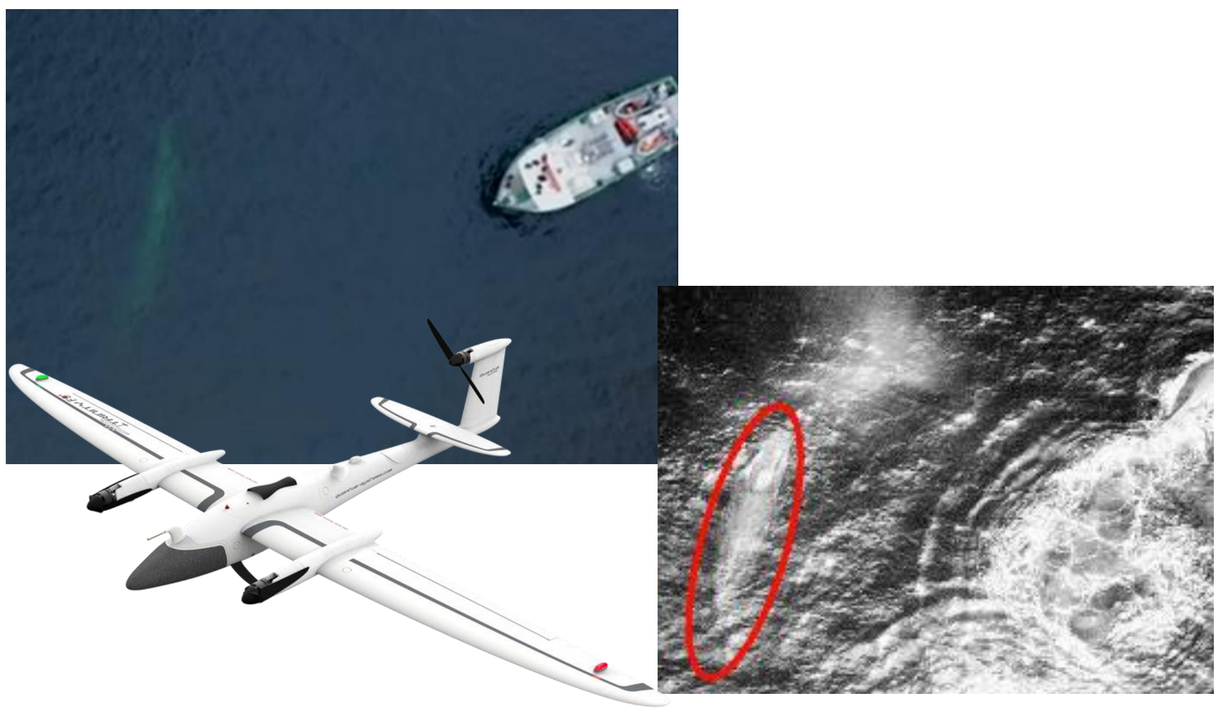
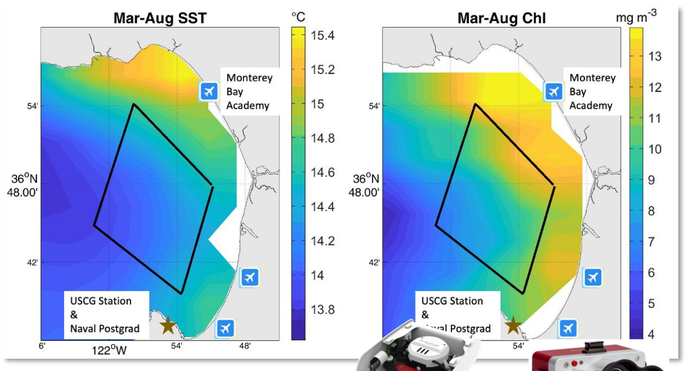
Background and Motivation

- Combine low-light sensors, advance signal processing, and small unmanned aerial system (sUAS) technologies to provide an innovative relatively inexpensive, nighttime antisubmarine warfare (ASW) capability.
- Leverage marine bioluminescence to enhance nighttime imagery of subsurface objects.
- Utilize Monterey Bay's diverse marine mammal habitat to experimentally determine the efficacy of the proposed technology for marine mammal detection.



sUAS Whale Detection Concept



Bioluminescence in Monterey Bay Measured by MBARI AUV

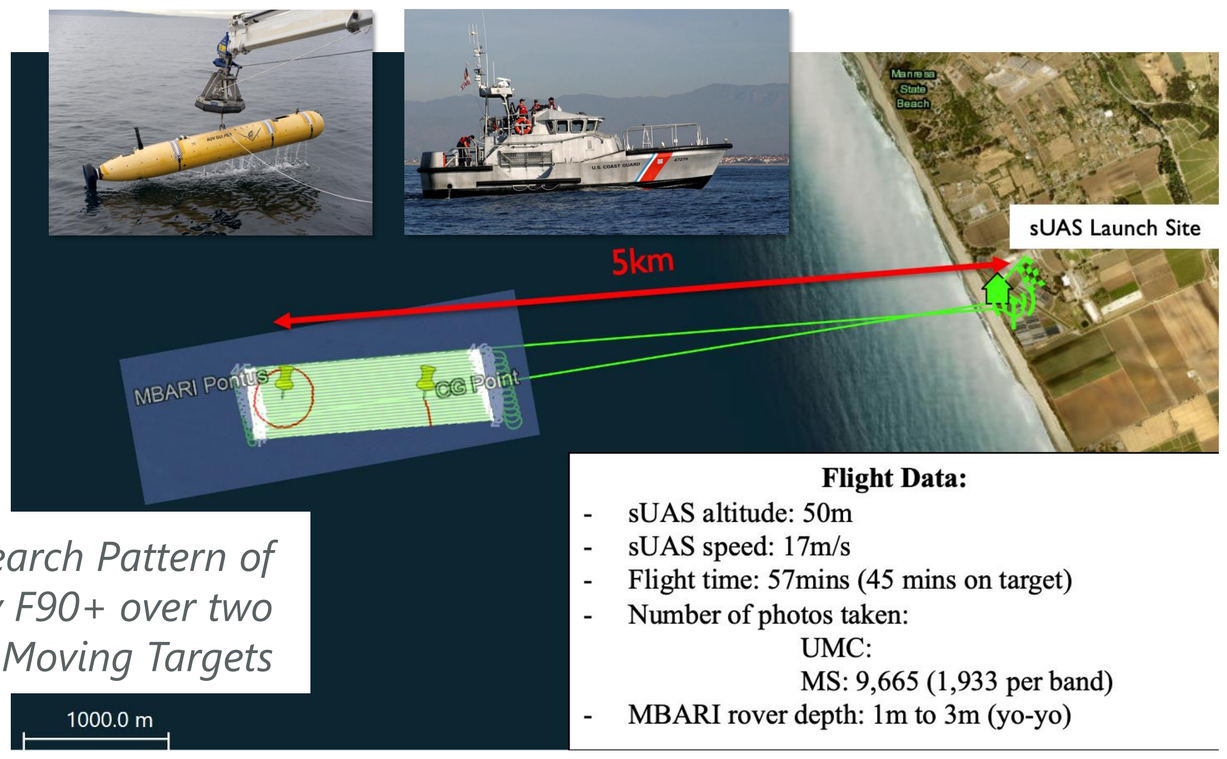
	MicaSense RedEdge-MX	MicaSense RedEdge-P	Sony UMC-R10C	Sony RX1R II	SBIG STC-428-based sensor
Spectral Bands	blue, green, red, red edge, near-IR	blue, green, red, red edge, near-IR, panchromatic	RGB	RGB	grayscale
Dimensions, pix	1,280×960	1,456×1,088	5,456×3,632	7,952×5,304	3,208×2,200
Total Number of Pixels	1,228,800 (per band)	1,584,128 (per band)	19,816,192	42,177,408	7,057,600
Field of View, °	47.1 × 36.2	49.6 × 38.3		54.3 × 37.8	
Ground Sample Distance (GSD) @ 100 m AGL, cm/pix	6.7 (per band)	6.4 (per band)	2.66	1.29	
Dimensions / CMOS Sensor Size, mm	4.8 × 3.6	4.8 × 3.6	23.2 × 15.4	35.9 × 24.0	14.4 × 9.9
Output bit depth, bits	8	12	16	16	8
Lens	f = 5.5 mm	f = 5.5 mm	f=16 mm, F2.8	f=35 mm, F2.0	
Capture Rate / Trigger Interval, s	1 (1.4)	1 (1.4)	1.1 (1.6)	1.4	0.9
Exposure, s	0.00066 … 0.245				0.001 … 3,600
Dimensions / CMOS Sensor Size, mm	4.8 × 3.6	4.8 × 3.6	23.2 × 15.4	35.9 × 24.0	14.4 × 9.9
Dimensions, cm	9.4 × 6.3 × 4.6	8.7 × 6.8 × 6.3			
Weight, g	380	315	429	694	2,100

Lines of Effort

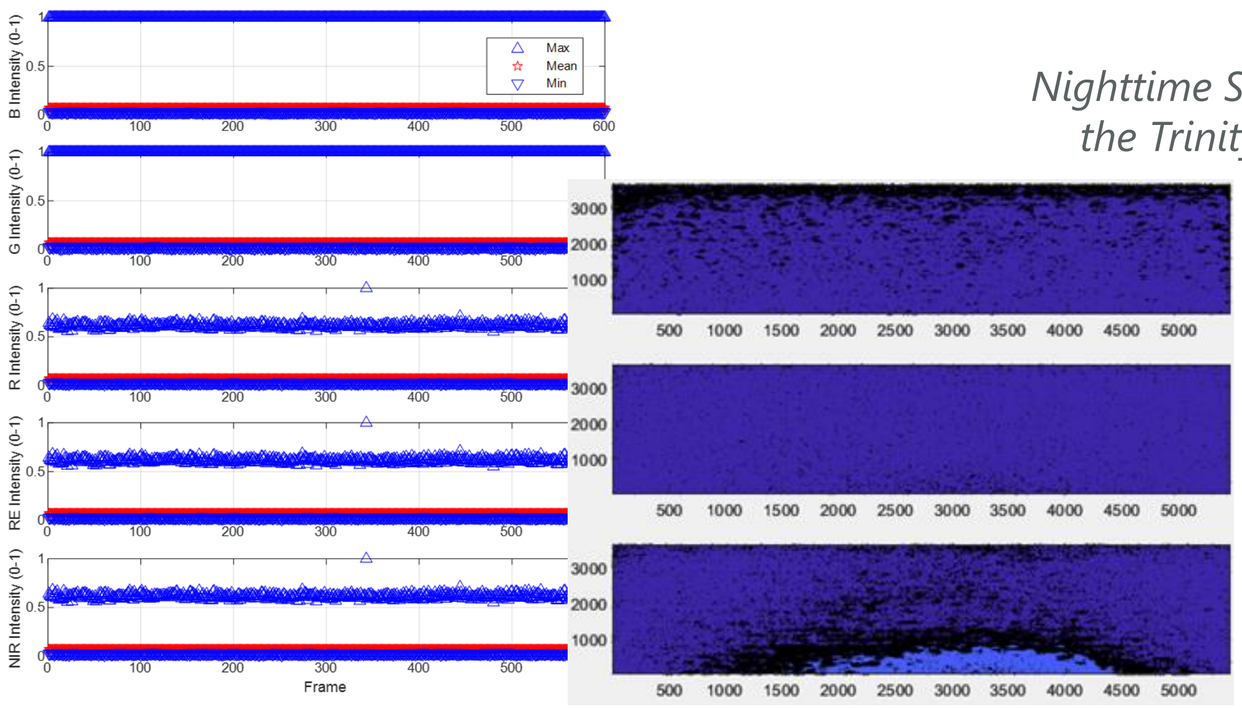
- Building a partnership with USCG, MBARI, NOAA, several commercial organizations to explore feasibility of using bioluminescence to detect moving subsurface objects at night.
- Integration of an array of sensors with a COTS electric vertical take-off and landing (eVTOL) long-endurances UAS and getting clearances for night over-the-water operations.
- Analysis of bioluminescence in Monterey Bay at different depths throughout a year.
- Development of algorithms to analyze nighttime multispectral imagery.

To-Date Accomplishments and Future Research

- Conducted lab testing of different COTS and inhouse-built sensors to identify best performing settings for nighttime bioluminescence experiments.
- Coordinated a large scale nighttime offshore experiment in conjunction with MBARI, USCG, and NOAA.



Nighttime Search Pattern of the Trinity F90+ over two Moving Targets



Searching for Imagery Anomalies

Further Testing and Data Analysis

- Conduct more realistic lab tests varying sensors parameters.
- Execute another nighttime sUAS flying campaign involving heterogeneous moving targets.
- Execute nighttime flight operations from a boat.

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Topic Sponsor: N8 - Integration of Capabilities & Resources

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