

Preliminary Design and Prototyping Results of an Encapsulated Underwater Launch System for Micro Unmanned Aerial Vehicles (UAVs)



James Buescher
Chris Mailey
Ryan Stenson
Daniel Sura

Ocean Systems Division
SPAWAR Systems Center San Diego, California



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AGENDA



Introduction to SPAWAR Systems Center

Introduction to WaterWorks

System Properties

Field Test Results

Problem Solving & Optimization

Future Work

Conclusions

POINT LOMA PENINSULA HOME OF SPAWAR SYSTEMS CENTER (SSC) SAN DIEGO



***4000
Employees***

***Leader in
C4ISR***



***\$1.7B / yr
business***

***At any time, the Center has
approximately 1500 active programs!***

SSC SAN DIEGO – ISR – OCEAN SYSTEMS DIVISION



- Test & Evaluation
- Fleet Support
- Undersea Vehicles/ Robotics
- Undersea Search & Work Systems
- Radiation Detection
- Undersea Materials
- Fiber Optics
- Undersea Communications
- Electro Optics
- Acoustic Warning Systems
- Targets
- Rapid Prototyping
- Diving



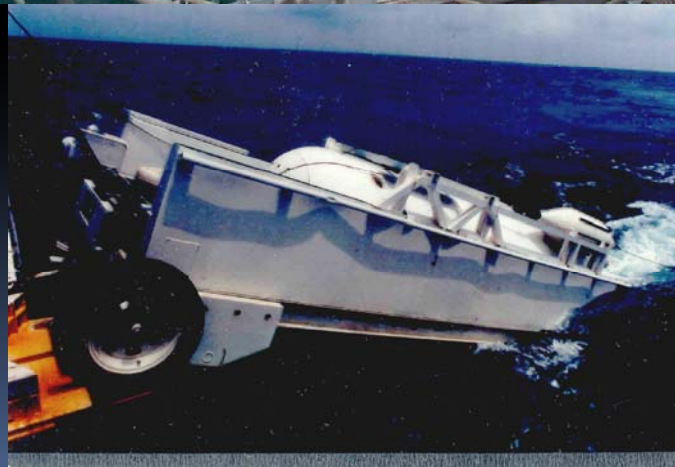
SSC SAN DIEGO – OPEN OCEAN UNDERSEA ROBOTICS



ROVs



AUVs



Launch &
Recovery

UNMANNED SYSTEMS TEST ENVIRONMENT



SPAWAR
Systems Center
San Diego

Proximity to Fleet
and Operational
Commands

Ocean Access

- Shallow
- Very Deep

Paved & Unpaved
Roads

Off Road Terrain

Bunkers & Tunnels

UAV flight ops area



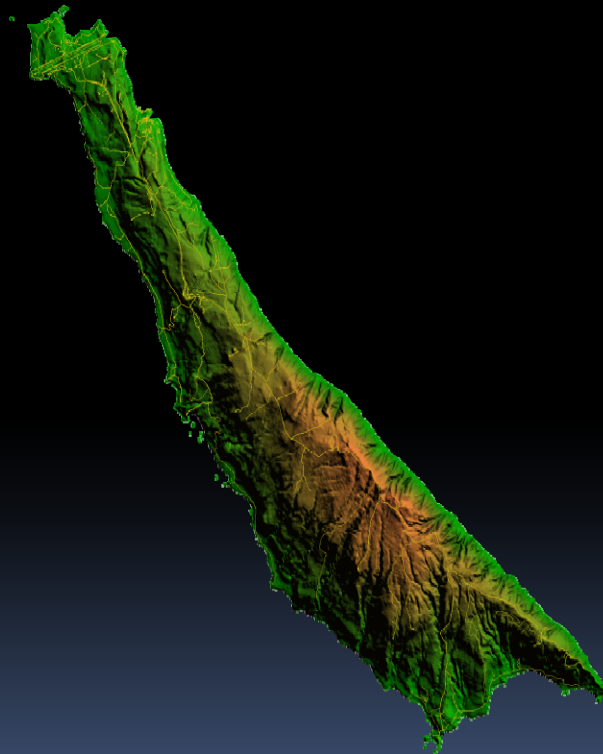
Miles of Coastline for Unmanned Systems RDT&E and experimentation

OTHER SUPPORTING FACILITIES

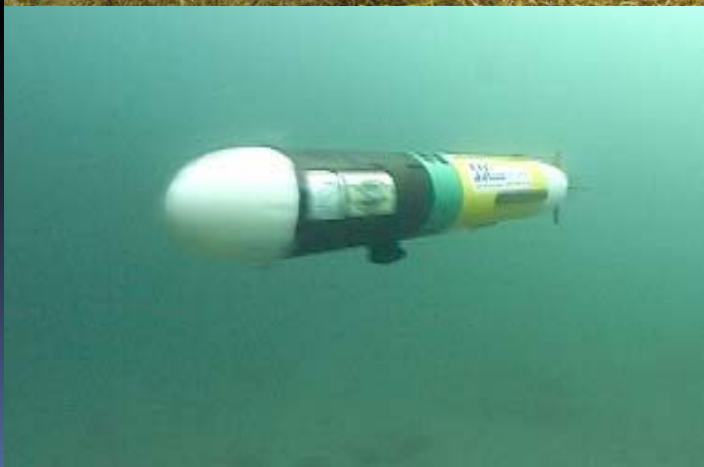


San Clemente Island

TRANSDEC



ALL AREAS OF THE BATTLESPACE



WATERWORKS



A new innovations cell at SPAWAR Systems Center San Diego designed to react rapidly to warfighter needs

Vision:

Systematically innovate and transition prototypes to rapidly create solutions that solve latent unmet warfighter needs.

The Waterworks team demonstrated its capabilities by designing, fabricating, testing, and improving an underwater launch system for an unmanned aerial vehicle.

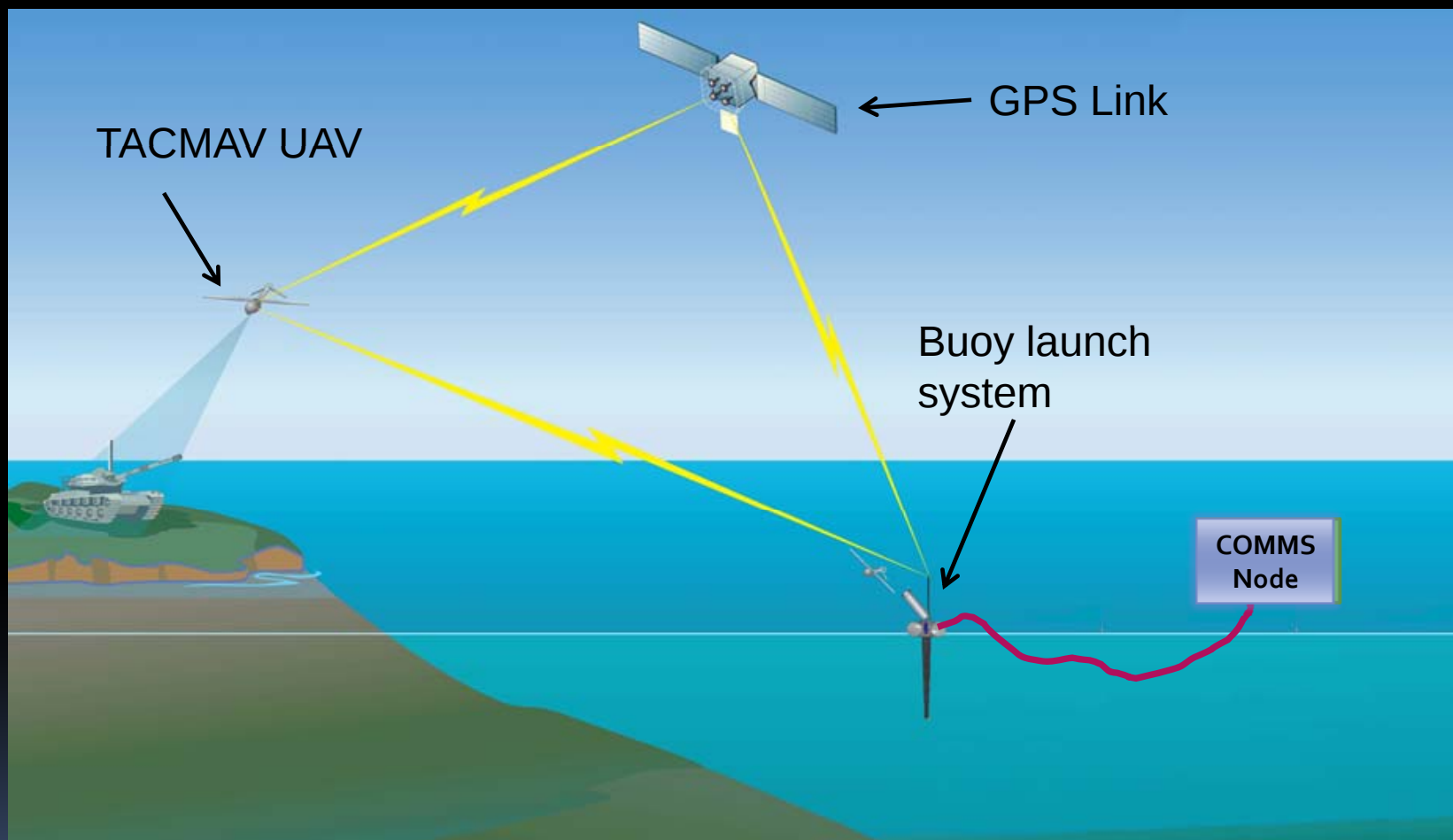


WATERWORKS GOALS



- Develop *game-changing* solutions for warfighters
- Systematic innovation through methodology, culture, and infrastructure
- Create pockets of Innovation that can be replicated across the center
- Create and strengthen ties among warfare centers, industry and international partners

SYSTEM OVERVIEW



SYSTEM PROPERTIES



TACMAV Properties

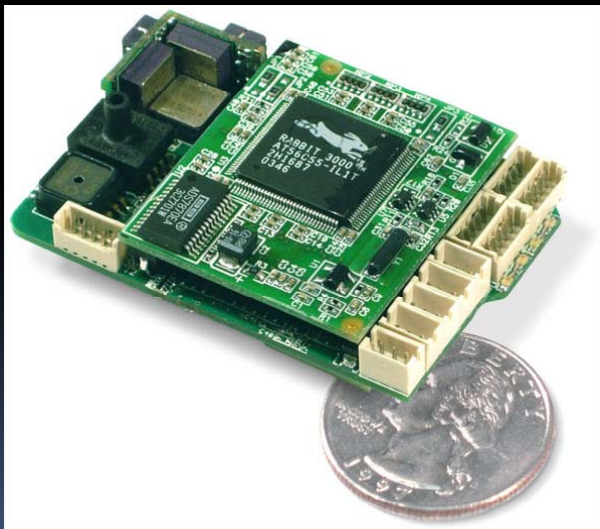
TACMAV Surveillance Video

Buoy Launch Hardware Properties

Communications Setup

Host Platforms

TACMAV PROPERTIES



TACMAV FLIGHT VIDEO

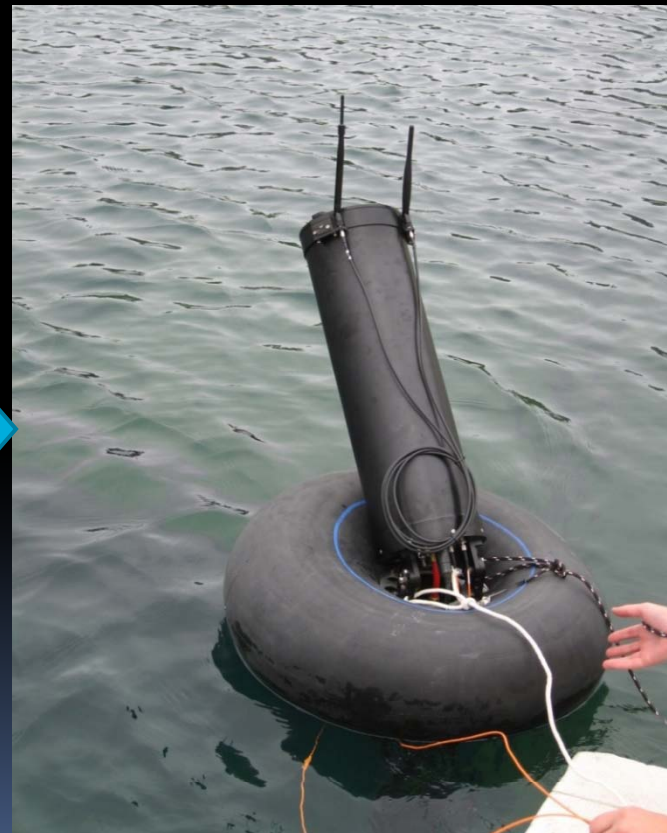


BUOY LAUNCH HARDWARE

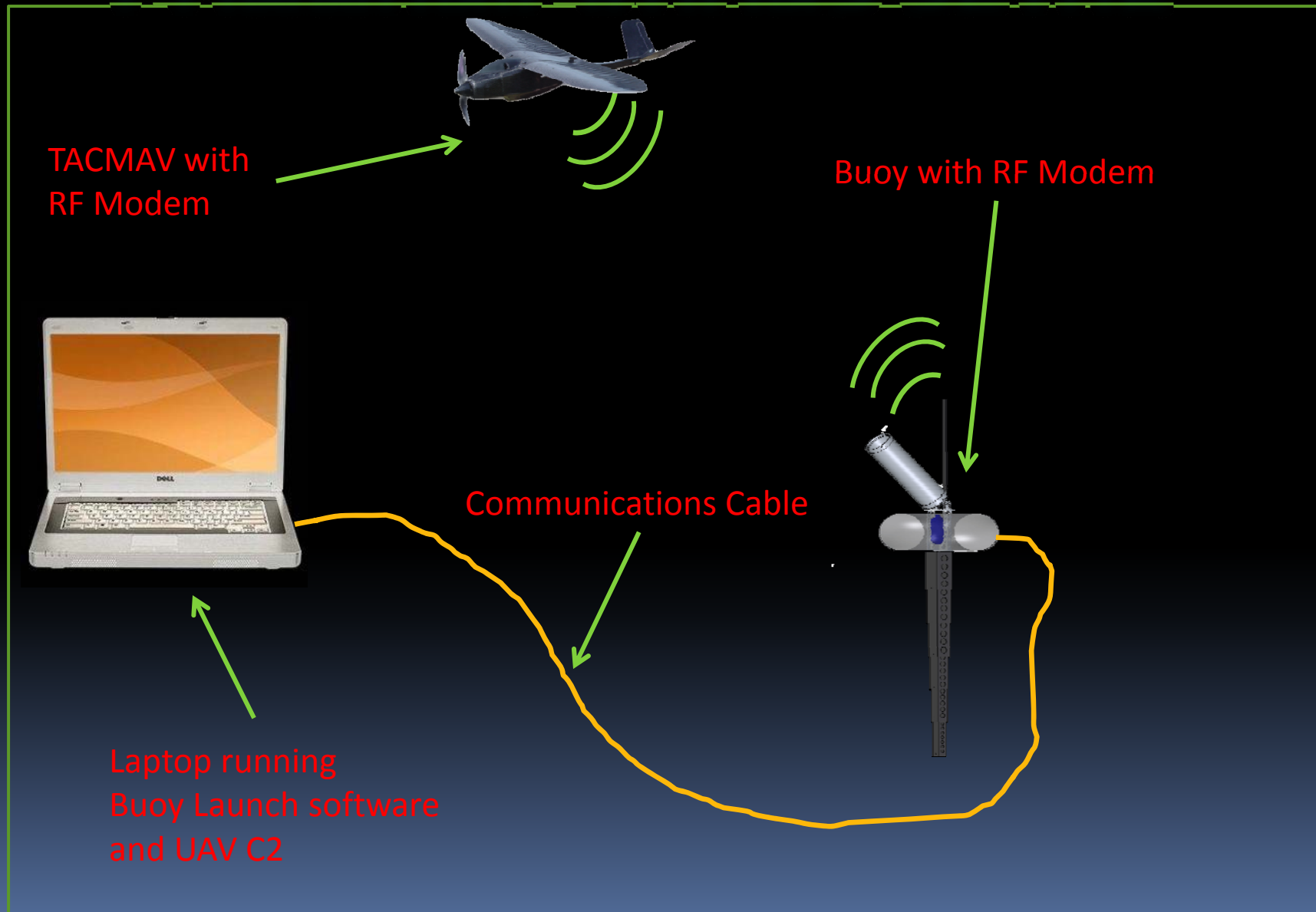
- Compacted



- Deployed



COMMUNICATIONS SETUP



HOST PLATFORMS



UNMANNED UNDERWATER
VEHICLE



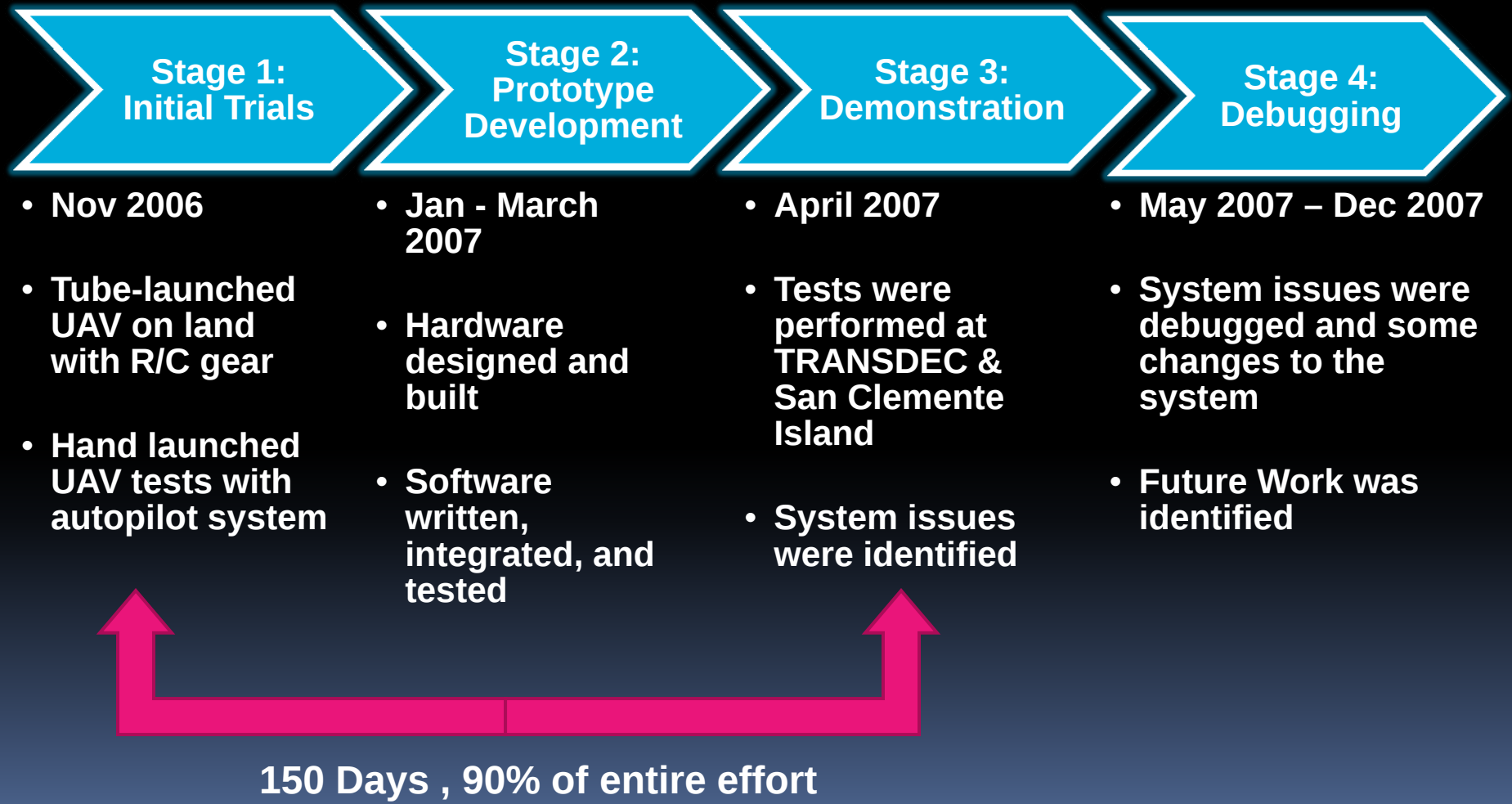
DIVER



HUMVEE

Technology developed can be applied to many platforms

PROTOTYPE & TEST TIMELINE



FIRST UAV FLIGHT



FIRST UAV FLIGHTS WITH KESTREL AUTOPILOT



SPAWAR
Systems Center
San Diego



UAV FLIGHT WITH AUTOPILOT AT TRANSDEC



SAN CLEMENTE ISLAND DEMO

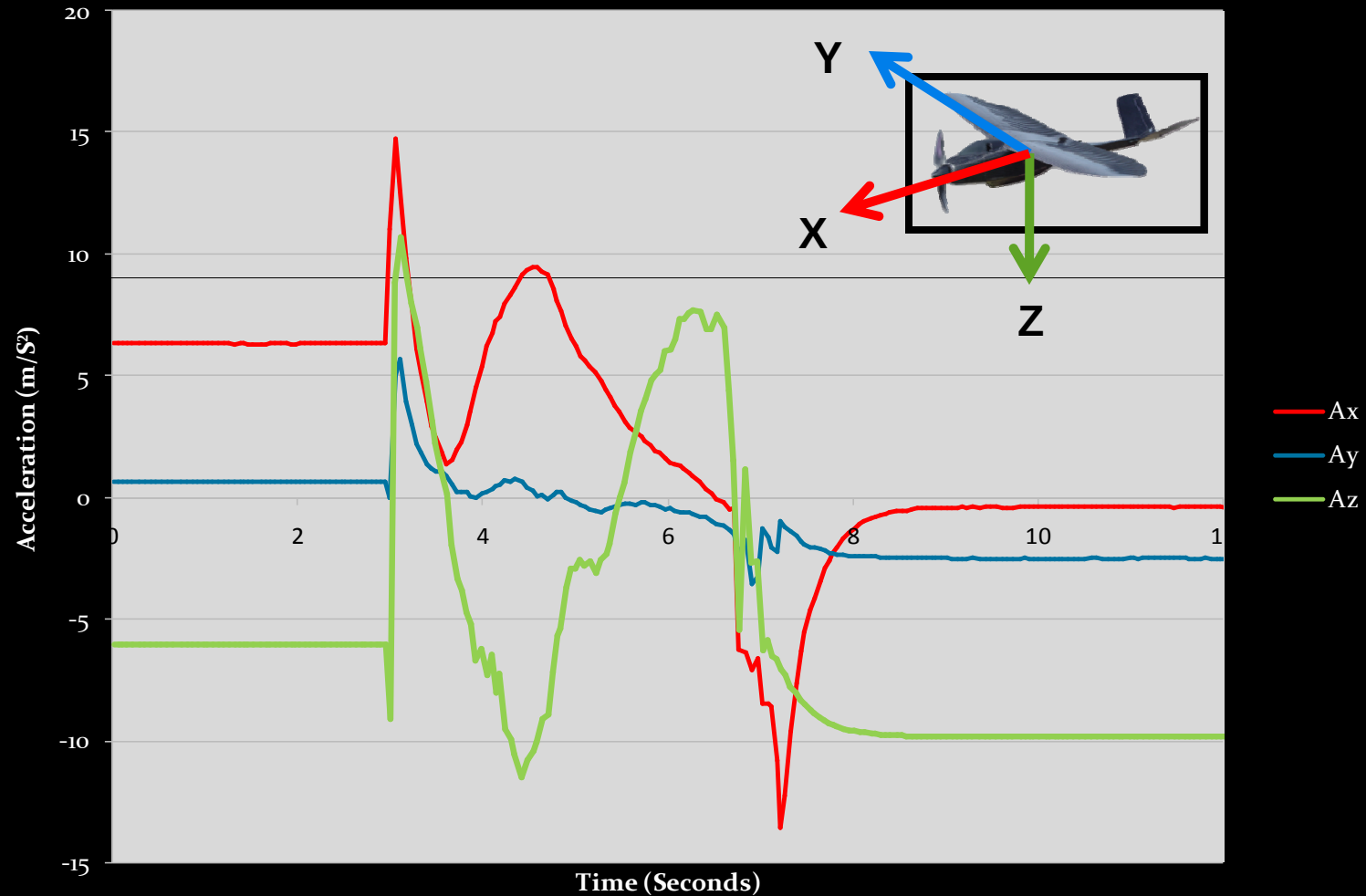


EXAMPLE VIDEO ANALYSIS



EXAMPLE SENSOR DATA

Acceleration A_x , A_y , A_z vs Time



FLIGHTS AFTER MECHANICAL CHANGES



SUCCESSFUL FLIGHT IN AUTONOMOUS MODE



FUTURE WORK



- Demonstration of a reliable system from seafloor deployment of buoy to UAV launching from the surface of the ocean
- Prototype development of a linear track type scheme to launch the UAV with a vertical buoy configuration
- Optimization of the autopilot software code for a better fit to our platform configuration
- More fully autonomous flights to gauge the reliability of TTF with the current system configuration
- Investigations on tactical advantages of ARA's new Nighthawk UAV or other manufacturer's UAV systems

CONCLUSIONS



- The Waterworks team successfully demonstrated unmanned systems innovation by designing, developing, testing, and improving an underwater launch platform for a UAV. This was accomplished in a short time frame.
- Waterworks is committed to improving the UAV launch system configuration features for a more robust warfighter solution that can be tailored to specific uses
- The Waterworks process has been used by various projects at the center
- This innovation effort has been a great opportunity to collaborate with many expert scientists, engineers, and personnel across the SSC Divisions, warfare centers, and industry. We are very interested in teaming with coalition partners as we continue our unmanned systems work.