

Development of an Adaptable Monitoring Package for Marine Renewable Energy

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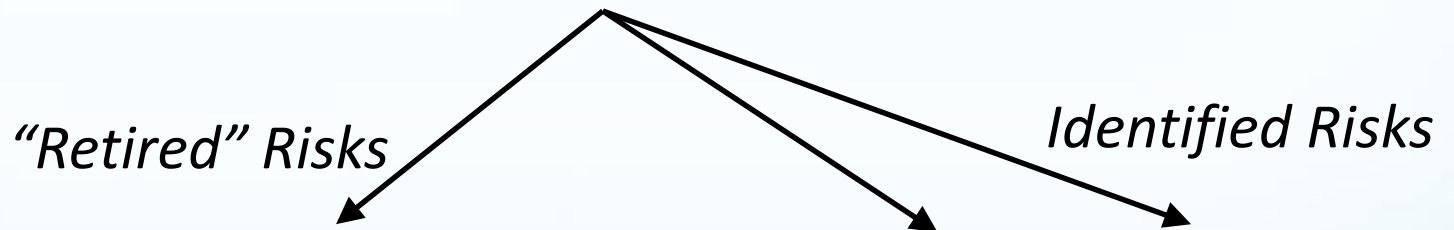
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Environmental Risk Uncertainty



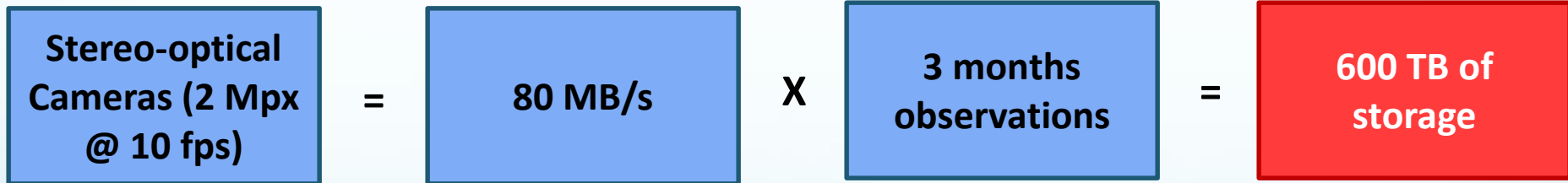
Strategic Research Investment



Residual Uncertainty

Reducing Risk Uncertainty

- Severe outcomes are likely to rarely occur
- Observing interactions may require spatially *comprehensive* and temporally *continuous* monitoring
- Strategy likely to generate “data mortgages”



Example: Continuous stereo-optical monitoring for a single camera pair. Comprehensive monitoring would require multiple pairs.

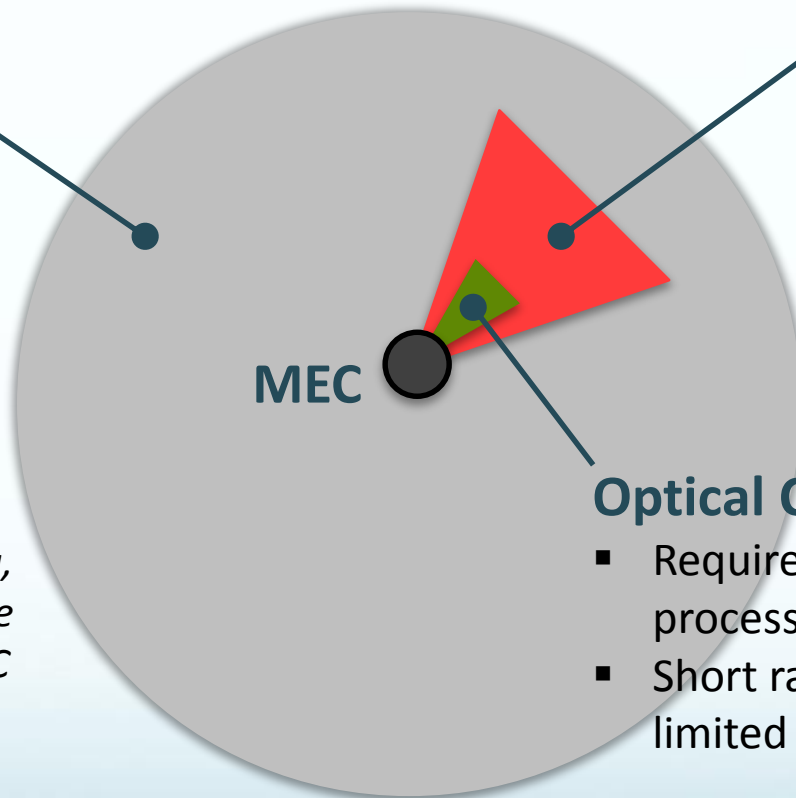
Integrated Instrumentation Packages

- Need low-cost and near-term approaches to improve ratio of information gained to data archived

Passive Acoustic Detection

- Processing in near real-time
- Omni-directional coverage at ranges on the order of 1 km

Example: Detection, tracking, and identification of a marine mammal approaching a MEC



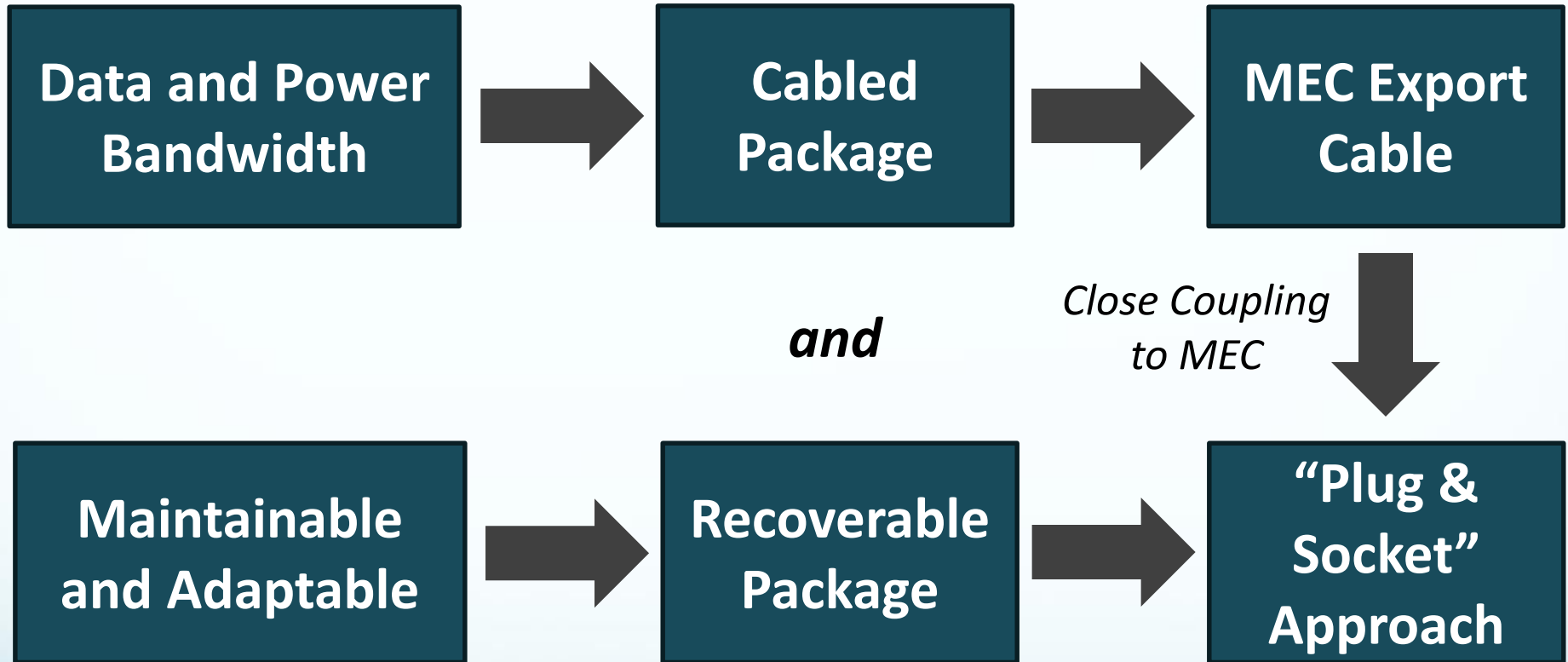
Multi-beam Sonar

- Processing in near real-time
- Tracking capability at ranges out to 100 m

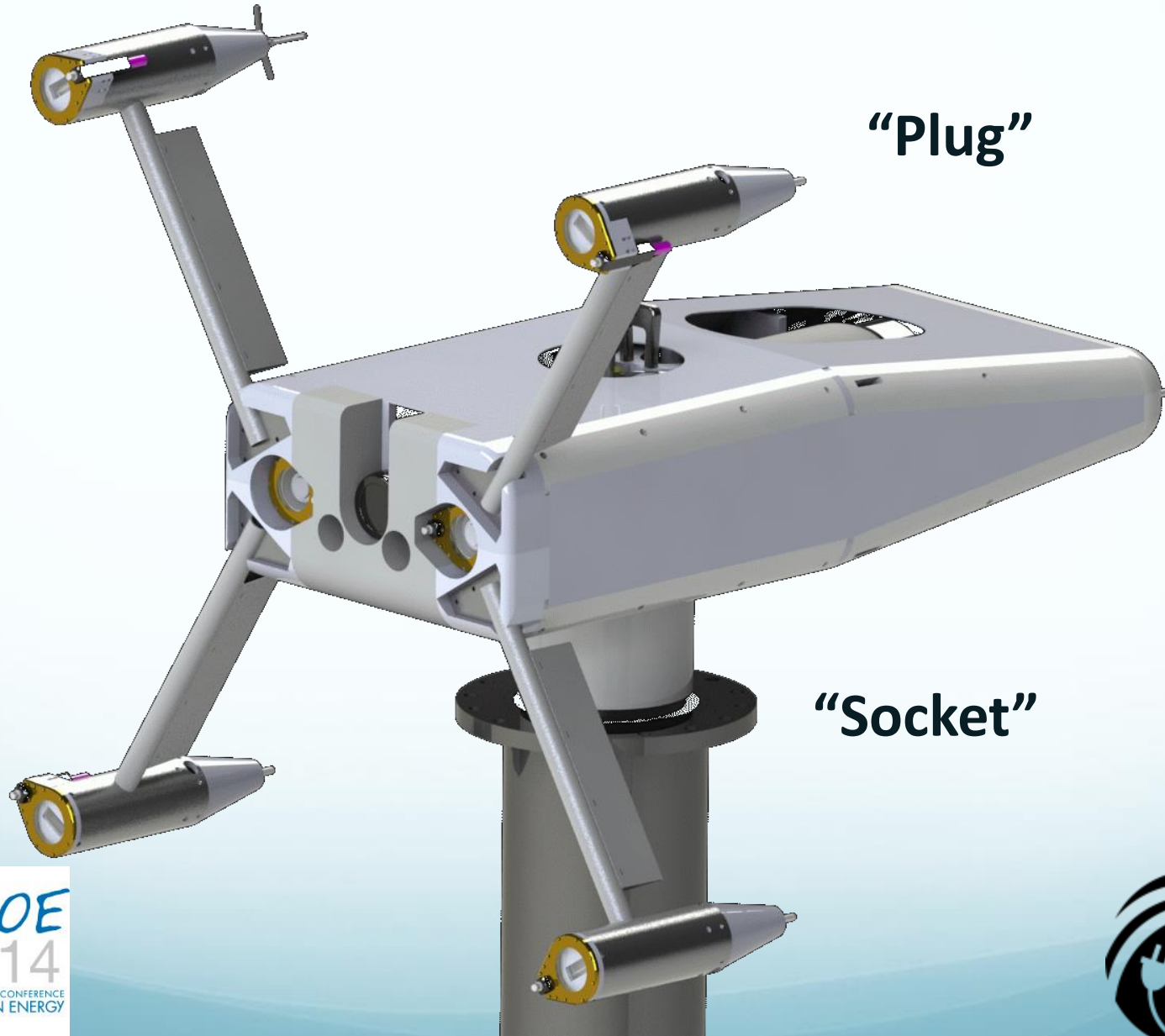
Optical Camera

- Requires archival processing
- Short range and limited field of view

Constraints for Integrated Instrumentation

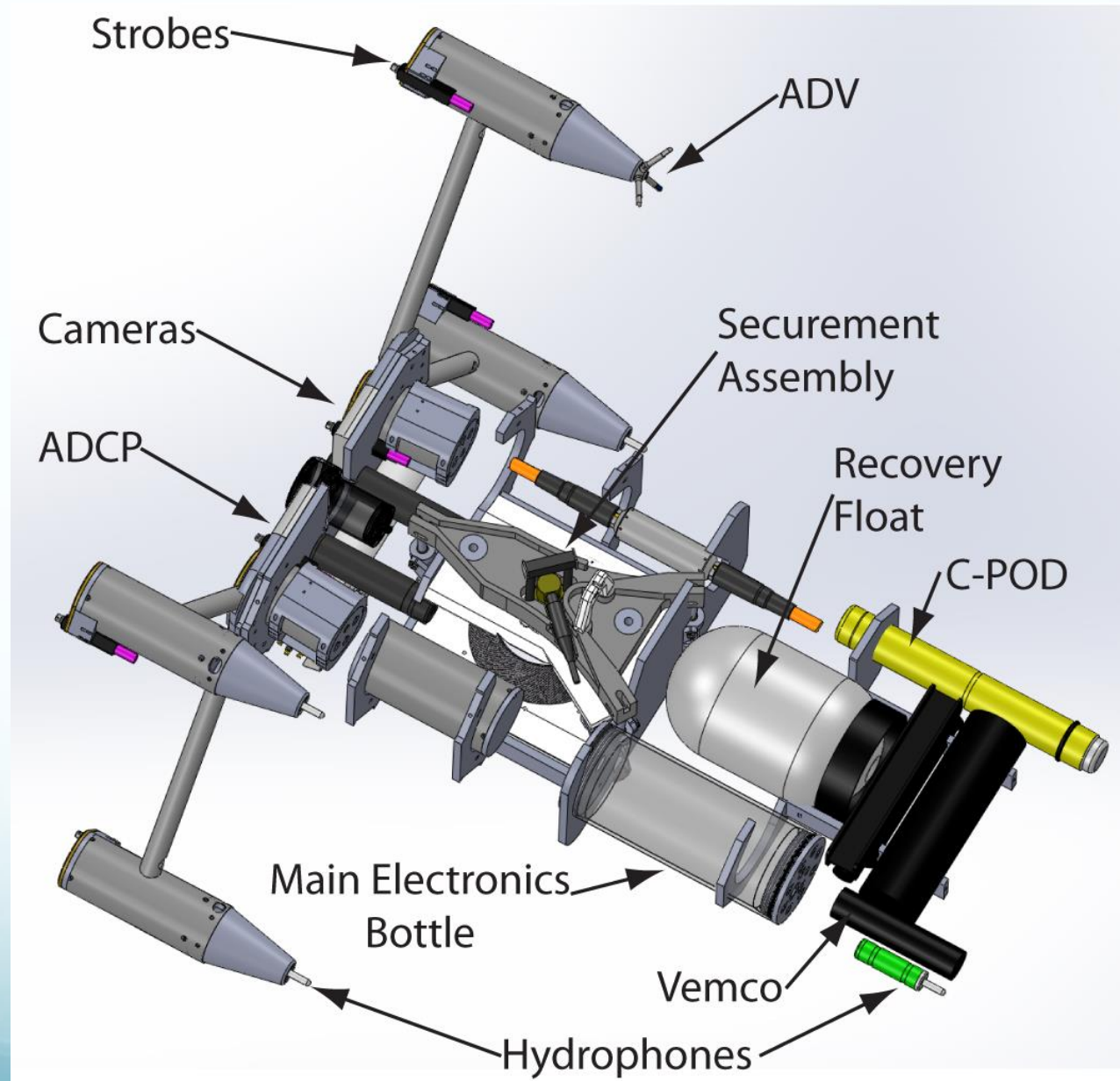


Adaptable Monitoring Package (AMP)

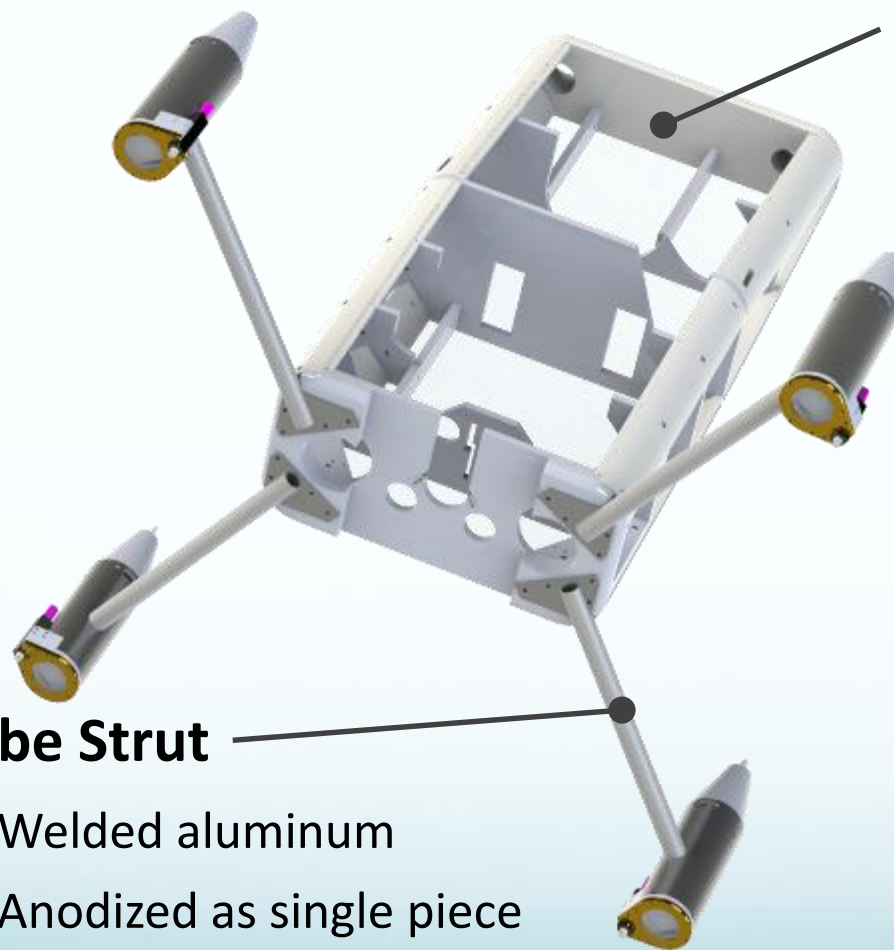


AMP Infrastructure and Instrumentation

- Power and data infrastructure
- Securement and recovery system
- Instruments



Package Mechanical Design



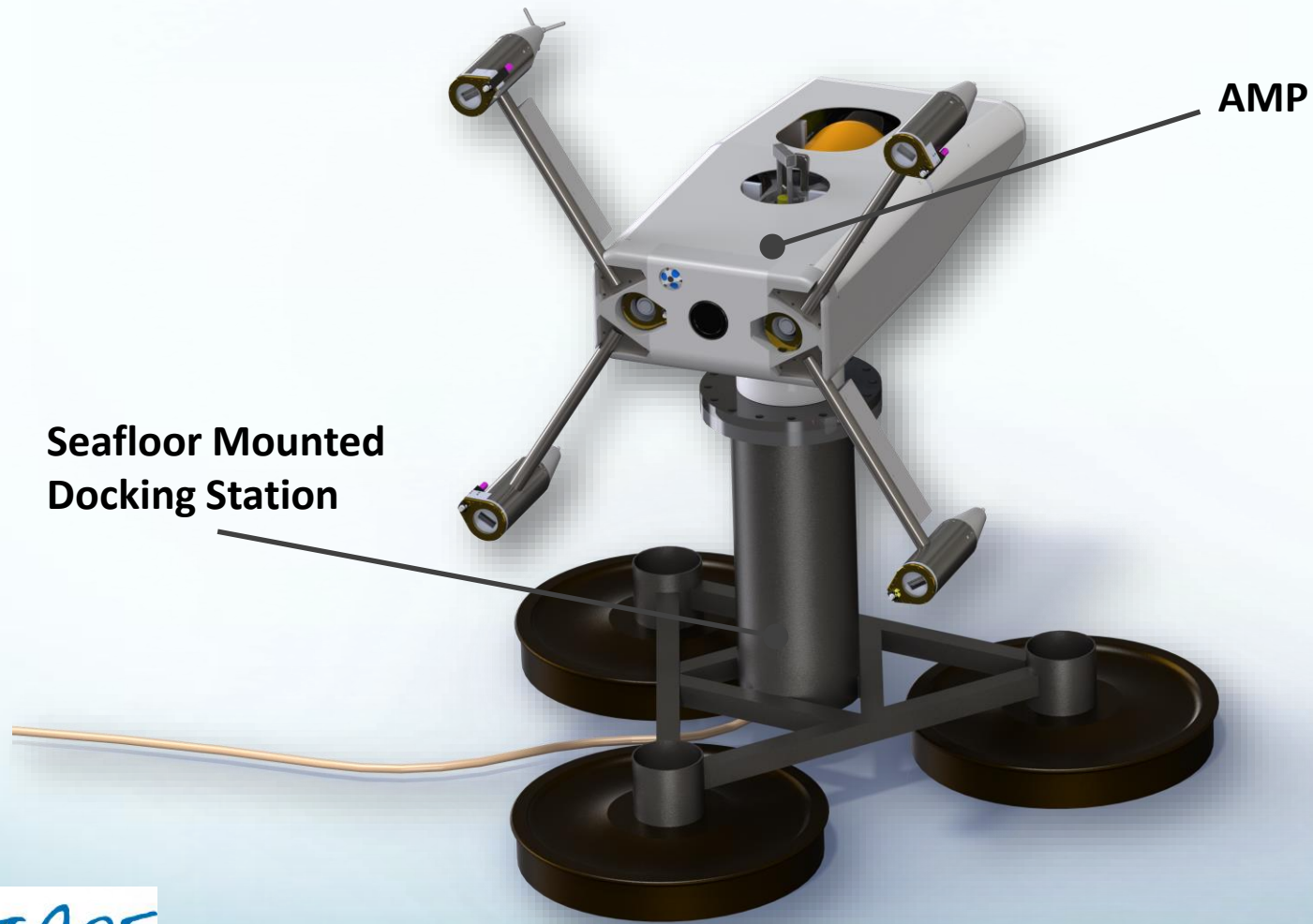
Hull and Frame

- Engineered plastics (no corrosion risk and near-neutrally buoyant)
- Longitudinal stiffening
- Modular, swappable bulkheads

Strobe Strut

- Welded aluminum
- Anodized as single piece
- Fairing (not shown)

AMP Integration: Cabled Docking Station



Recovery/Deployment Options

Divers

- Short work windows
- Human safety risk

Converter Recovery

- Can be expensive and risky

Subsea Winch

- Moving parts in the ocean
- Winch failure can cause catastrophic system failure

ROV Servicing

- Short work windows

AMP Operations Concept: ROV Deployment

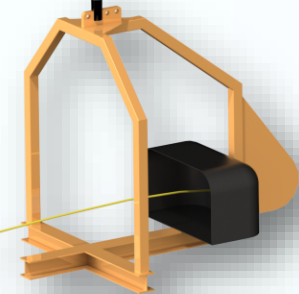


Load Bearing Umbilical

AMP and Deployment ROV



ROV Umbilical



Launch Platform

Cabled Docking Station



Current Direction →

“Millennium” Falcon Deployment System

SAAB Seaeye Falcon

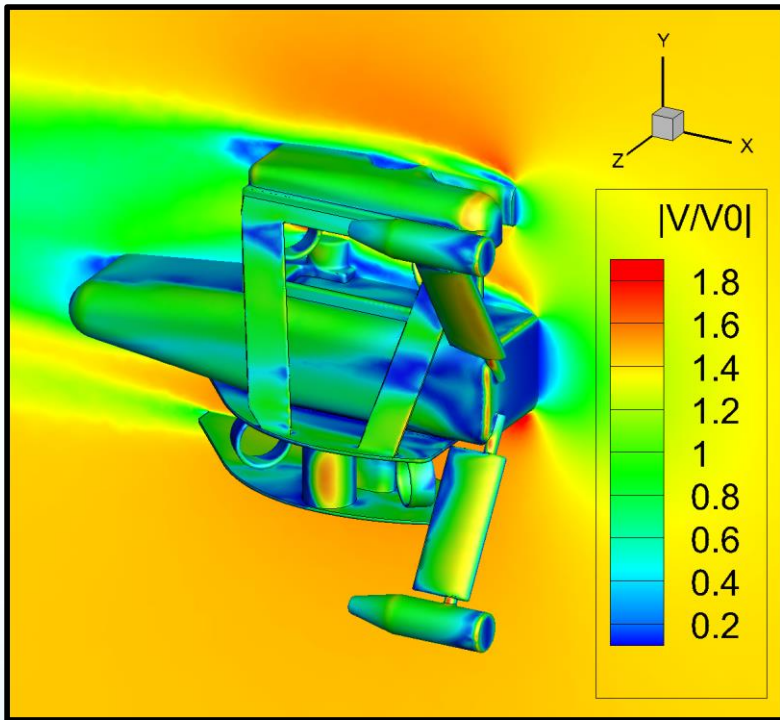
- Inspection-class ROV
- 4 Vectored Thrusters



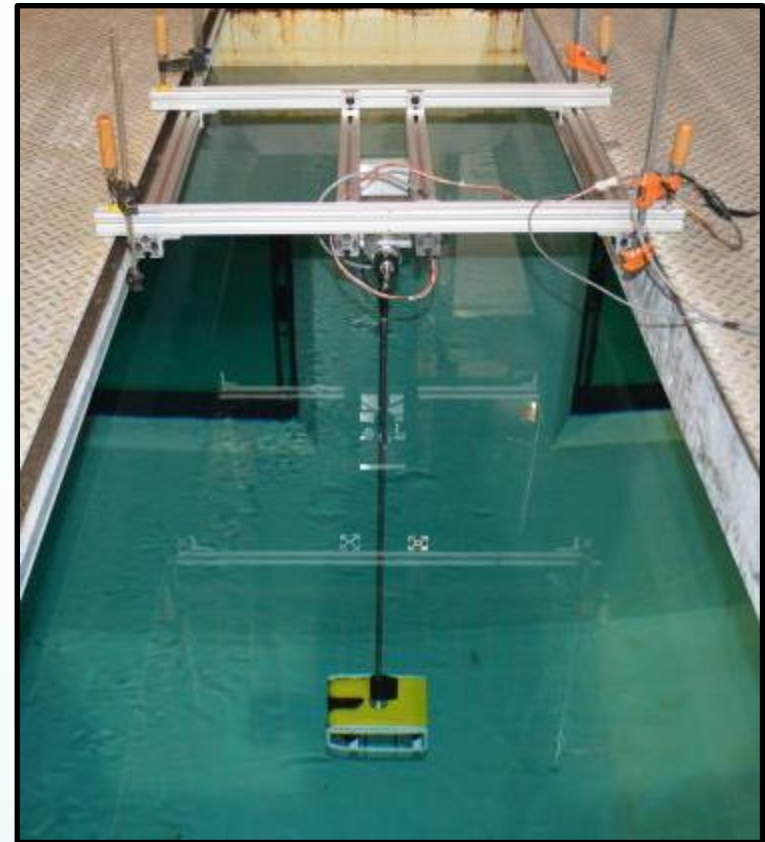
“Millennium” Skid

- 6 Thrusters
 - 4 Vectored
 - 2 Vertical
- Docking alignment
- Securement actuators
- Power and comms (SeaView)

Simulation and Experiments



Normalized velocity around the "Millennium" Falcon and AMP during deployments



Pendulum test setup in the Oceanography test tank

System Stability



Center of Thrust

Center of Pressure

- **Dynamic Analysis during Deployments**
 - Coefficients from simulations and experiments.
 - Centers of pressure, thrust, mass, and buoyancy.
 - Loading from turbulent currents at marine energy sites.
 - Umbilical drag effects.

Summary



Millennium Falcon preliminary tank testing

- **Integrated instrumentation packages will play a critical role in reducing environmental risk without incurring large data mortgages**
- **Package design requires a significant systems engineering effort**

Acknowledgements



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