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A Presentation for the NRC-IOT Workshop on Underwater Vehicle Technology

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High Resolution Seabed Sub-Bottom Imager for an AUV

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NRC-IOT
Workshop on Underwater Vehicle Technology

Presentation Outline

I. MUN *AUV Explorer*

II. PanGeo Subsea Sub-Bottom Imager

III. Design Conditions

IV. Design Concept

V. Slow Speed Analysis

VI. Future Work

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MUN *AUV Explorer*

- A flier type AUV built by International Submarine Engineering Ltd. in Port Coquitlam, British Columbia.
- The vehicle was tested in 2009 for Arctic conditions as part of Canadian economic zone claims under UNCLOS.
- Principle Characteristics
  - Length – 4.5 meters
  - Hull Diameter – 0.69 meters
  - Rated Depth – 3000 meters
  - Speed – 0.5 to 2.5 m/s

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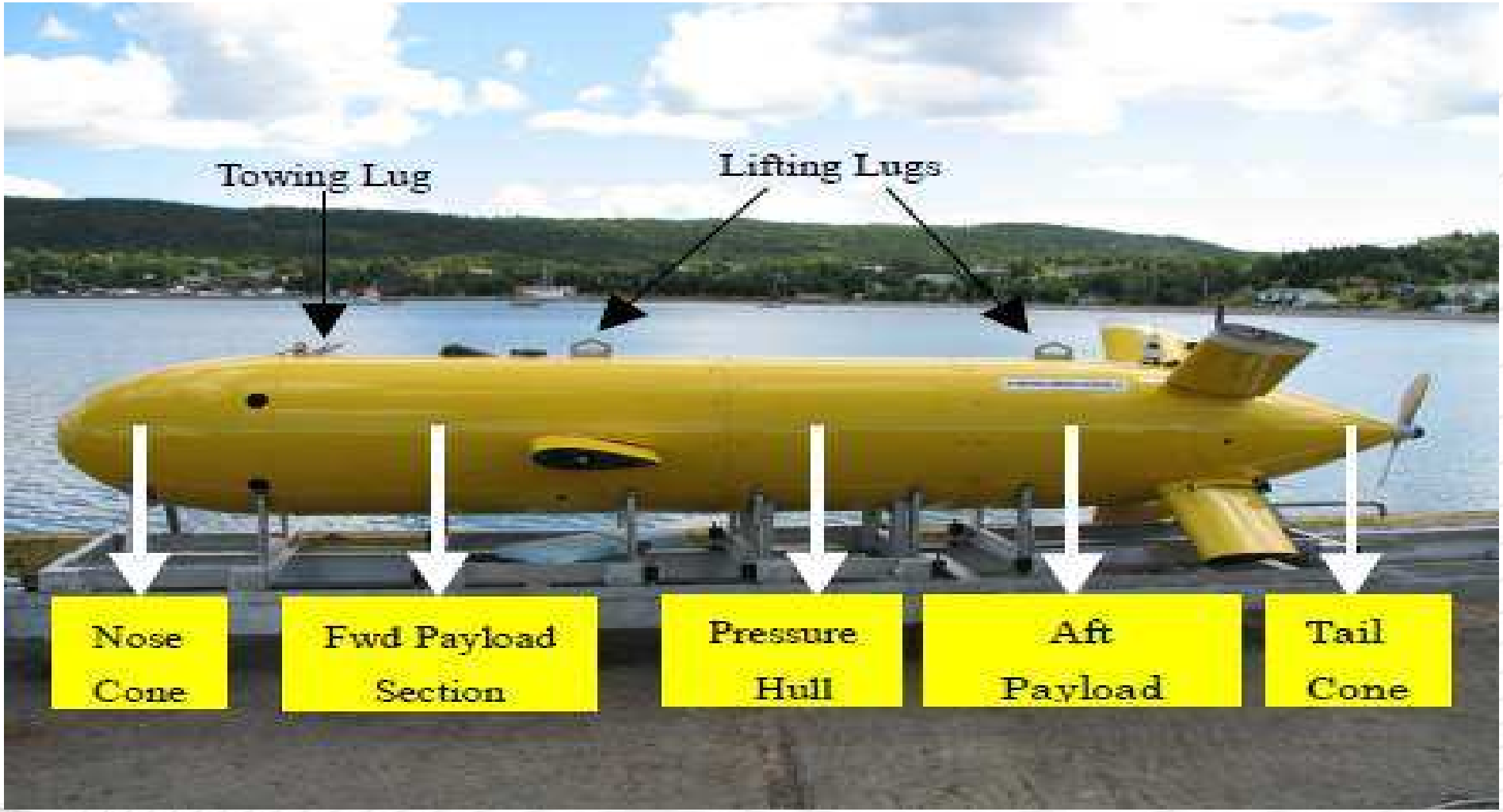
MUN *AUV Explorer*



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Sub-Bottom Imager™ (SBI)

- Originally designed for skid mounting on an ROV.
- Essential AUV components weigh approximately 200 kg.
- The folding hydrophone array can scan an area 5 m wide and to a depth of 5 m into the seabed.

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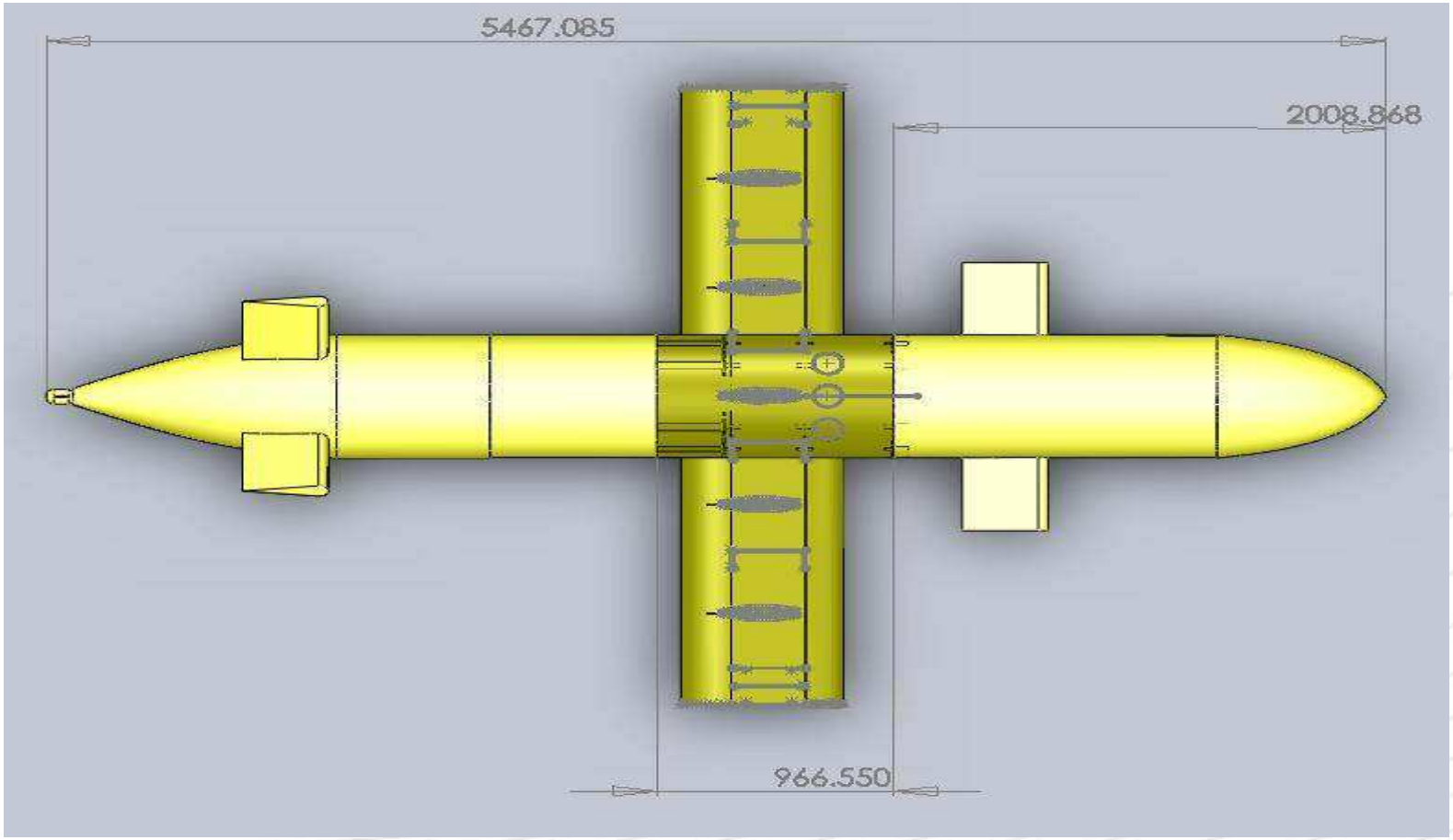
Design Conditions

- The objective of this project is to incorporate the SBI technology into the *AUV Explorer*.
- It is desirable for the SBI system to be removable from the AUV when not being utilized.
- The hydrophone array requires an external housing on the underside of the AUV.
- The system manufacturer specifies operating the system at speeds less than 1.0 m/s and an altitude of 3.5 m from the ocean floor.

Initial Design Concept

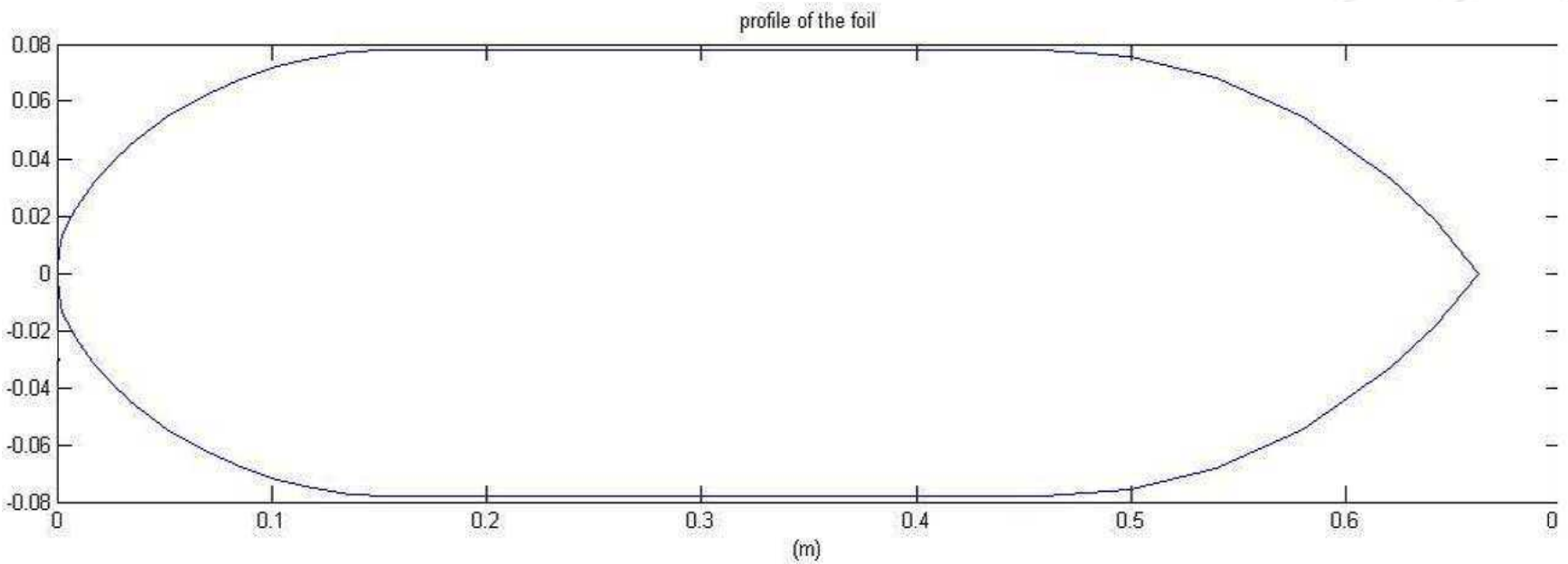


Drawn by: Wilfrid Merlin

Institut des Sciences de l'Ingénieur de Toulon - Var

Wing Profile

- A symmetric profile was chosen to eliminate lift during level flight.
- A modified NACA 664-021 profile is currently being investigated for this use.



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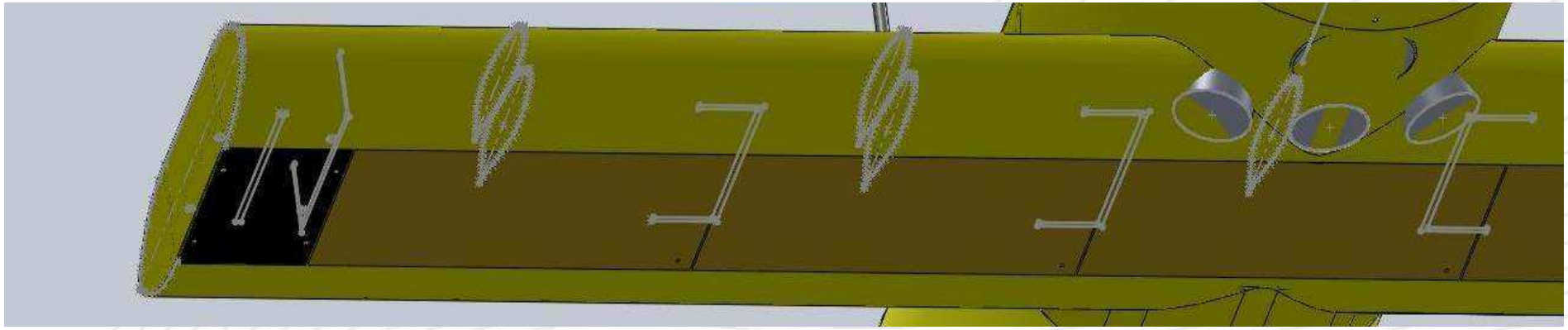
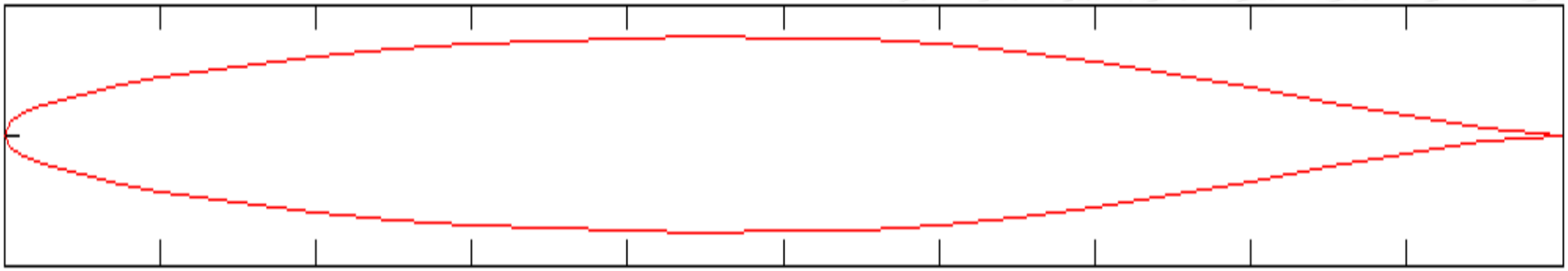
Wing Profile Cont.

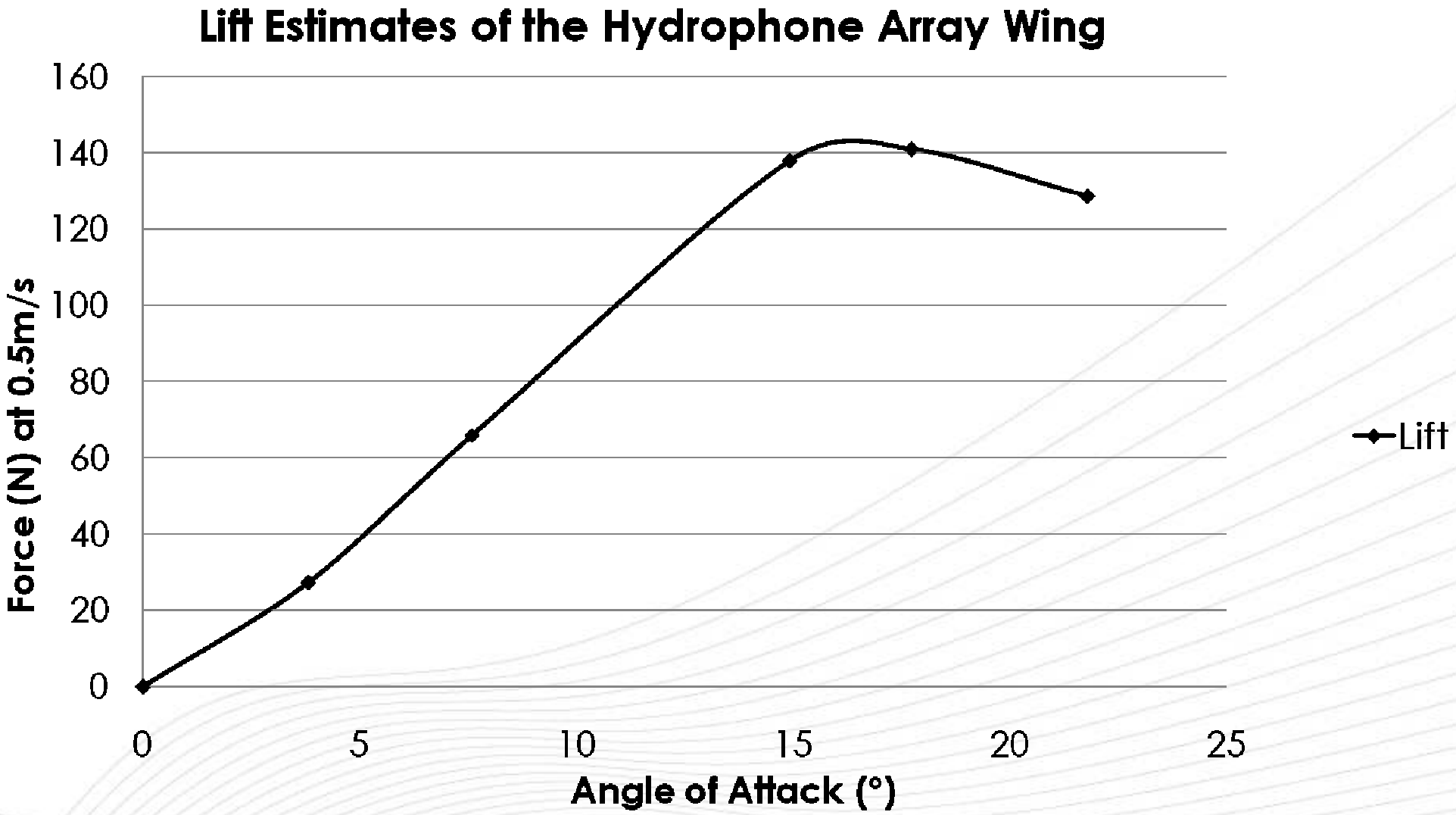


Wing Profile Cont.

- Vertical leeways incorporated on the upper side of the foil allow room for connectors to the hydrophones.
- This design feature reduces the overall thickness of the foil by 4 cm.
- The leeways were designed using a NACA 661-012 profile.

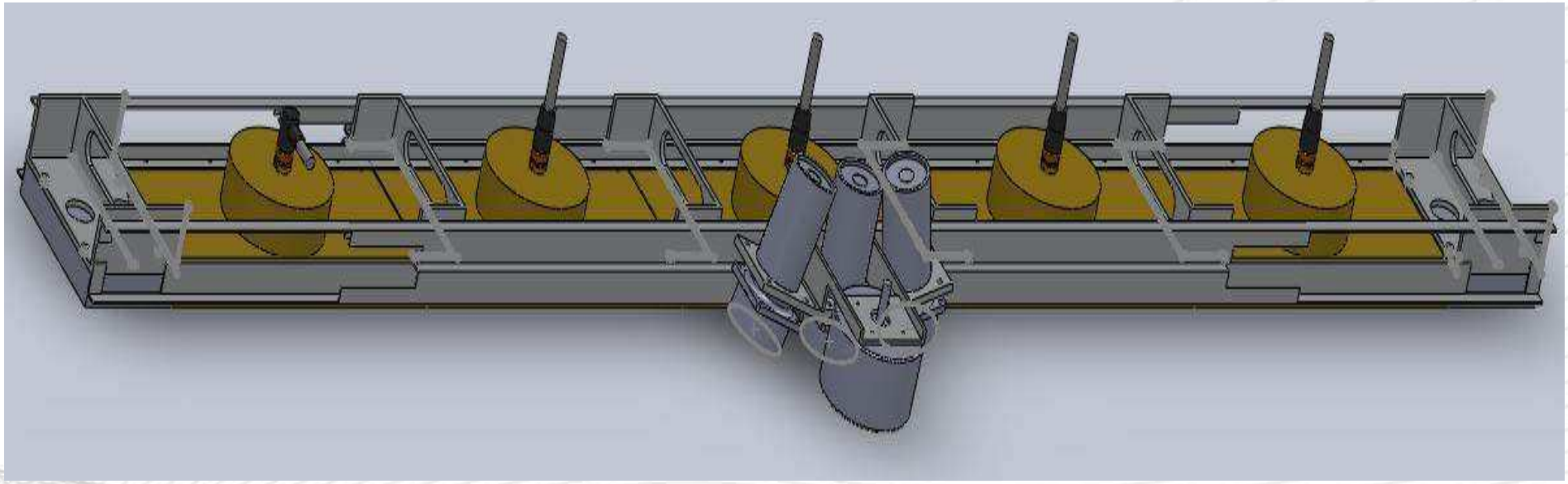


Wing Lift Estimates



Internal Structure

- A lightweight structure is required for the hydrophone array that is rigid enough to resist bending.
- A 6061-T6 aluminium alloy was chosen for its lightweight and cost over other materials.



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Slow Speed Testing

- The biggest challenge with incorporating the SBI system is developing adequate lift from the *AUV Explorer* control planes at slow speeds.
- It is desirable that the buoyant force acting on the vehicle greater than 45 N.
- At the projected operating speed of 0.5 m/s each control surface can only generate 8 N of force at an angle of attack of 18°.

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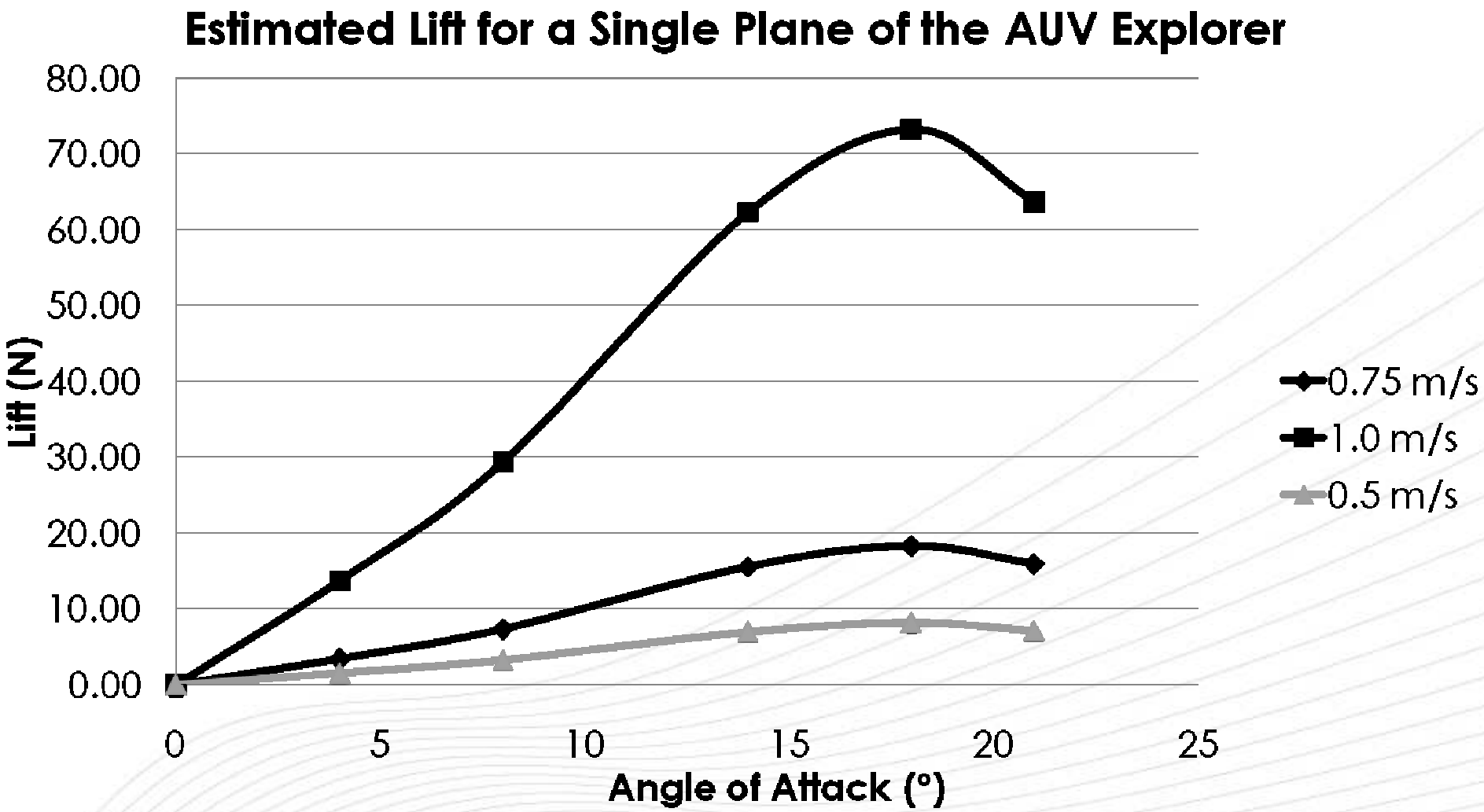
Control Plane Lift Estimates



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Open Water Testing

- Testing of the current AUV configuration took place during early October in Holyrood.
- These tests investigated the flight characteristics of the vehicle at speeds less than 1.0 m/s to confirm lift calculations along with developing proper weight and trim techniques.
- A bladder concept is being discussed to allow more freedom in vehicle ballasting while still maintaining a safety measure for vehicle recovery.

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Future Work

- Fall 2010
  - Development of a Flow-3D concept model
  - Adjustment of new wing profile from CFD estimates
- Winter/Spring 2011
  - Construction of vehicle section with new wing
  - Initial tank tests to confirm CFD estimates
- Summer 2011
  - Full scale trials in Holyrood of new system

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Questions?