Future towed arrays – Operational drivers and technology solutions

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- **Drivers**
- **Trade Offs**
- **Solutions**
- **New Technologies**

Towed Array Drivers - Evolving threat

https://commons.wikimedia.org/wiki/File:Sub_Noise_Comparison_ENG.svg

Towed Array Drivers – Maritime Autonomous Systems (MAS)

- Autonomous Underwater Vehicles
  - Propulsion
  - Energy and Power
  - Depth
  - Integration
  - Autonomy
    - FAR & Communications

Towed Array Drivers – Maritime Autonomous Systems (MAS)

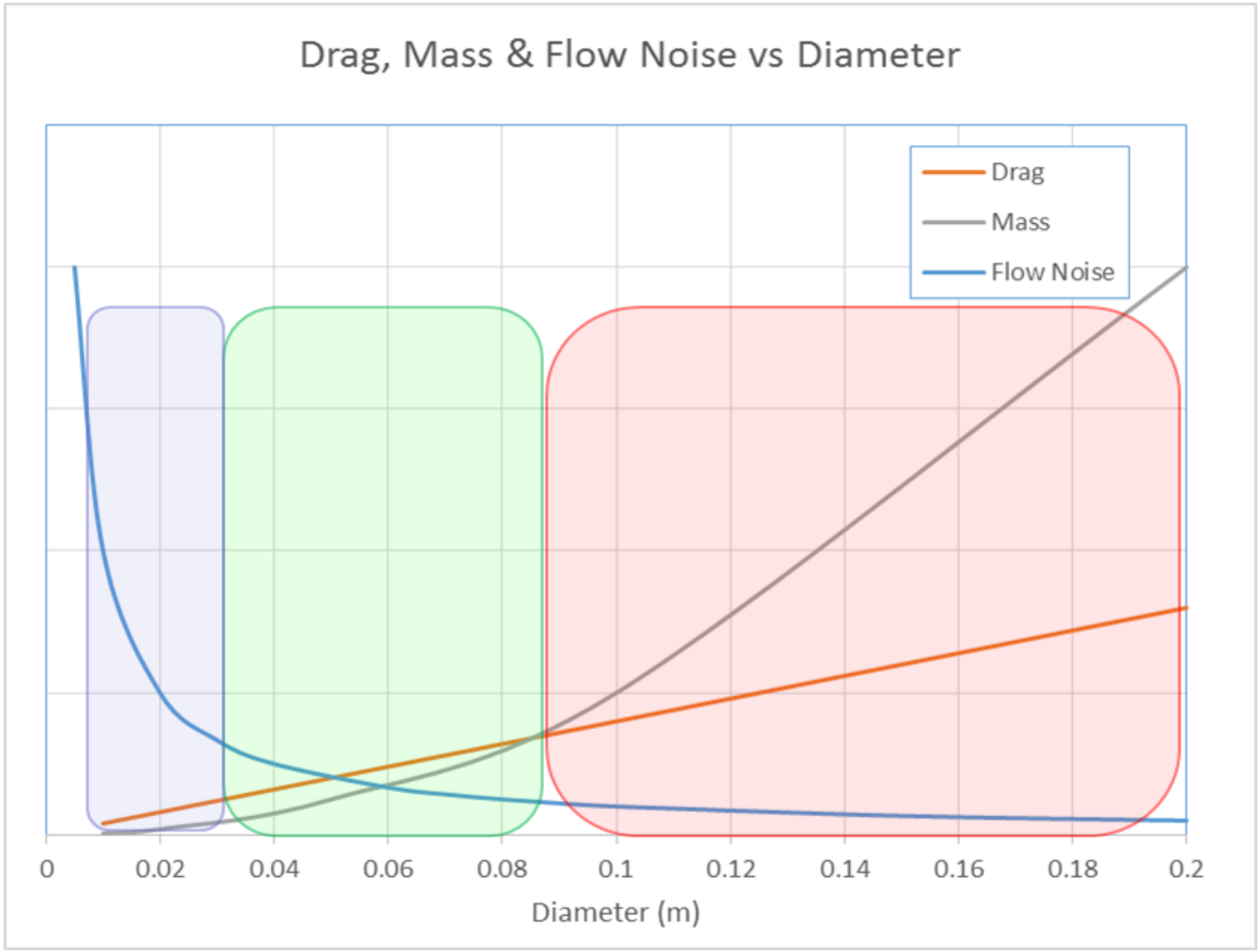
- Autonomous Surface Vehicles
  - High Speed
  - Energy and Power
  - Active Sonar Operation

Towed Array Drivers – Cost Effectiveness

- Affordability is and will always be important.
  - Unit Price Cost
  - Through Life Costs
- Manned Platforms
  - Will continue to demand the best capability
  - Seek capability cost savings through reliability & availability improvements and reduced impact on platform and combat system
- Autonomous
  - Diverse range of platforms
  - Cost performance balance will be platform and mission dependent

Design Trade-Offs

- Towed array design is a trade-off
- Competing factors
- Outcome will be different driven by its intended use
- Important factors to determine the basic architecture of array
  - Drag
  - Mass
  - Flow noise



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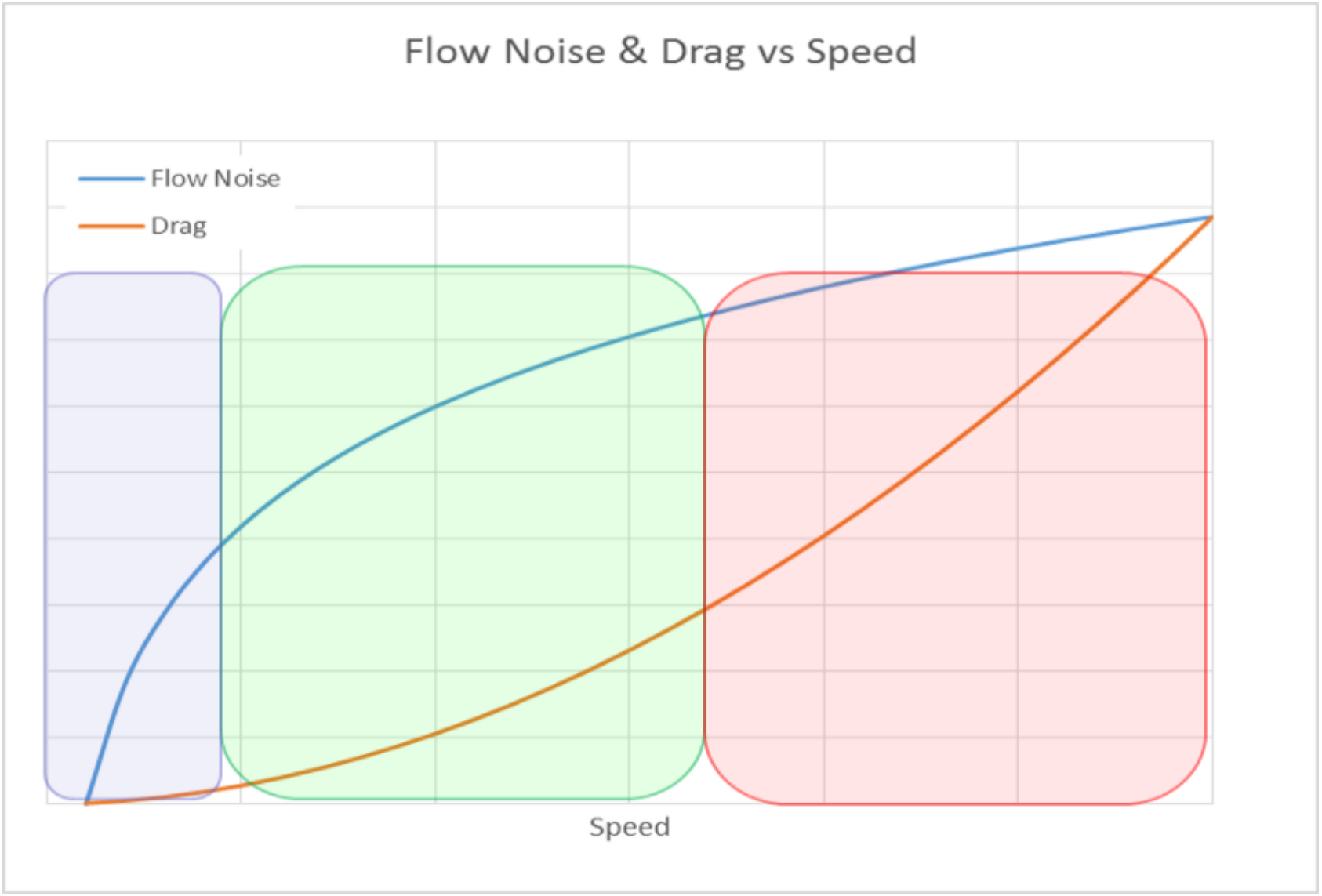

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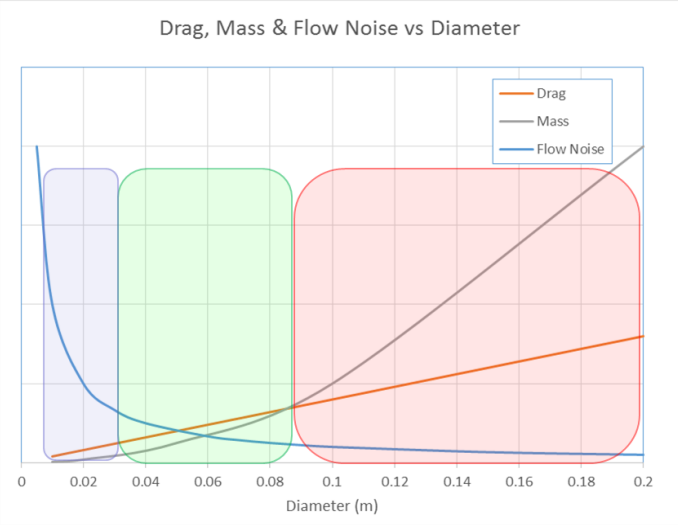
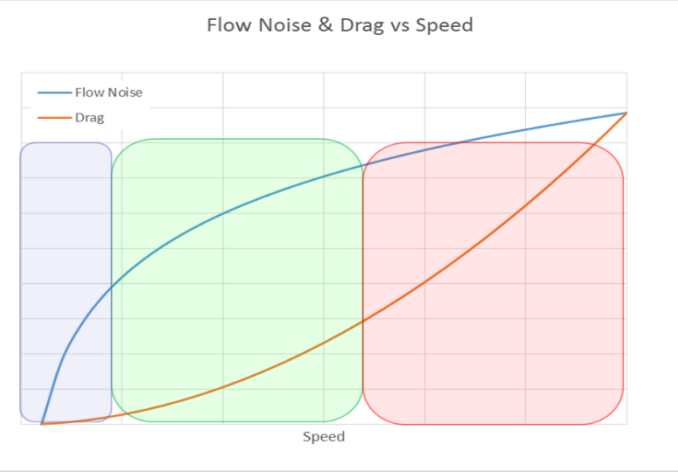
Solutions - Submarine

- AEUK Thin Line Array
- Advanced sensing capability
- Configured to fit with a compact space making ideal for use for submarines with towed array handling systems
- Delivers advantages of more conventional and larger systems
- Designed around performance and reliability principles
- An effective and available towed array

Solutions – Small & Slow MAS

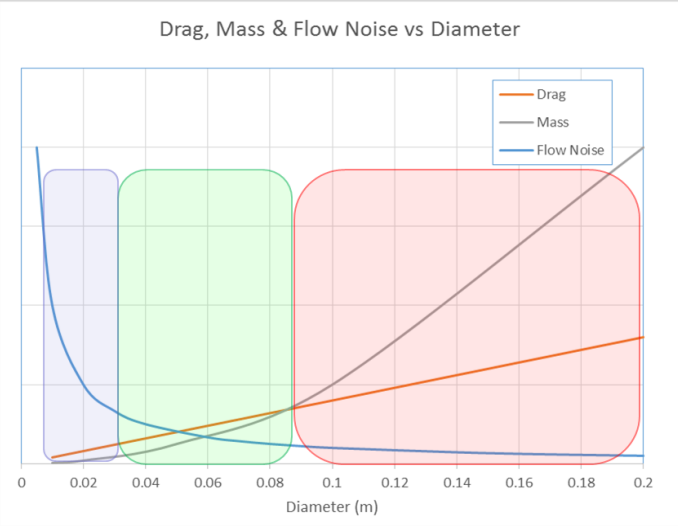
- Small and slow UXV
- Limited in the available thrust for towing
- Array length and / or speed limited due to drag forces
- Mechanical strength of the array is not a key driver
- Low flow noise due to low speed
- Solution for these vessels could be something very simple and cheap. (Blue Zones)
- Not scalable but cost effective sensing system in certain scenarios.

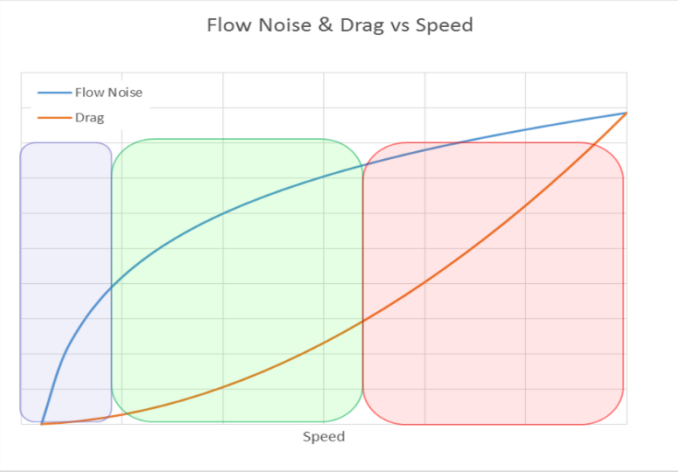




Solutions – Large & Fast MAS

- High capability – Green Zone
  - AEUK Thin Line Array
  - AEUK Triplet Receive Array
    - Active and passive sonar receiver
    - High Gain
    - Bearing ambiguity resolution
- Very thin line array < 30 mm
  - Top end of blue zone
  - Excellent low speed acoustic performance
  - High survival Speeds





Towed array technology for the future

- Connectorless data and power transfer
- Smart Strength Members
- Adaptive Buoyancy control
- Fibre optics for ultra thin sensing
- Advanced Shape Estimation
- Energy Harvesting

Connectorless Towed Arrays

- Underwater connectors
  - Expensive
  - Heavy
  - Failure mode
- Removal of intermodule data / electrical connection for a simple and robust system
- Near Field Communications
  - Bandwidth
- Wireless power transfer
  - Power
  - Heat management

Smart strength member materials

- Use strength members as power / data transmission path
- Simplify array construction and manufacture
- Reduce wiring
  - Allow mass and diameter reduction
- Technology developments
  - Smart textiles and wearable technology
  - Electric fence

Fibre optics for ultra thin sensing

- Fibre optics have not yet delivered the revolution in sonar sensing anticipated in 2000s
- Sensor performance & inboard equipment complexity
- New technology could offer sensor performance from a single optical fibre
- Very thin, cheap sensor for small AUVs

Advanced shape estimation

- Quantum sensing
  - Gyros
  - Accelerometers
  - Timing
- Accurate heading and position
  - Processing out shape
  - Optimise gain
  - Bearing ambiguity resolution

Energy harvesting

- Recover energy from towed array motion
- Deliberately induced drag
- Replace drogue with energy harvesting device
- Long endurance battery powered array
  - No power connection from platform
  - Reliability & improved endurance

Conclusions

- ASW towed array design driven
  - submarine evolution
  - the advent of autonomous systems
  - cost effectiveness.
- Diversity in future towed array platforms will drive diversity in the range of sensor solutions.
  - Balance in cost and capability.
- Technology opportunities will enable a new era of cost effective towed array sensing capability for future manned and unmanned systems

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