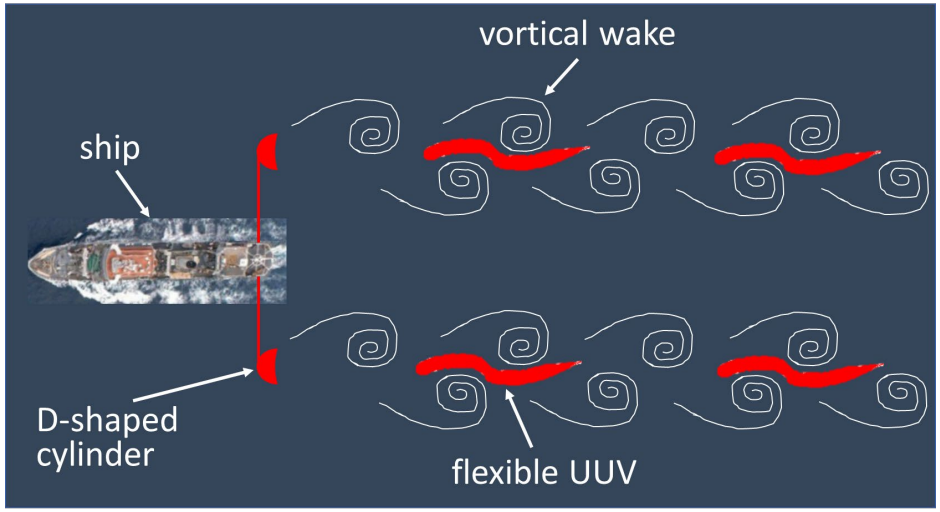
Proof-of-concept: Achieving Free Propulsion for Flexible UUVs Using Vortical Wakes

CRUSER
Consortium for Robotics and Unmanned Systems Education and Research



Schematic showing the free propulsion concept for a group of UUVs trailing behind a ship generating two vortical wakes.

Problem Statement

- Objective: Demonstrate feasibility of free propulsion for *positioning* UUVs around the globe without having them:
  - use any of their own stored energy for long transits;
  - occupy cargo space on ships to transport them.
- Approach: Utilize wake synchronization on flexible underwater bodies to achieve constant speed free propulsion in a vortical wake created by a cylinder.
  - Fabricate synthetic flexible bodies with square cross-sections using rapid prototyping available at NPS.
  - Experimentally test the synthetic flexible bodies in the water tunnel at NPS to demonstrate that they generate enough thrust to overcome drag.

Impact

- Scientific Contribution: Establish an initial understanding of flexible body wake synchronization which has not been explored previously.
- Warfighter Impact: Deployed flexible UUVs will be able to allocate more energy to their hardware providing:
  - better battlefield situation awareness using the larger amounts of data collected from more sensors;
  - ability to perform on-vehicle data processing to support autonomy and intelligent system behavior such as adaption.
- Metric of Success: Experimental demonstration that free propulsion is possible using a synthetic fabricated body.

Transition

- Stakeholders: Combatant commanders (COCOMs) such as USPACOM are responsible for vast areas of the ocean. They demand extensive sensor coverage and reducing UUV energy demands during long distance transits increases mission capabilities.
- Support and Collaboration:
  - UUVs span several operational domains; requirements would be coordinated through OPNAV N95, N96, N97.
  - Platform engineering support and integration would be coordinated through PEO-USC and specifically within PMS-406.
  - Scientific interest from ONR and NSF in understand wake synchronization and underlying physics.

NPS
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