

From Left: Austin Gallimore, Menna Elfouly, Liam Perkins, Professor Wilson Chiu

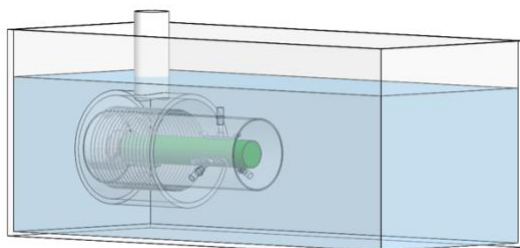
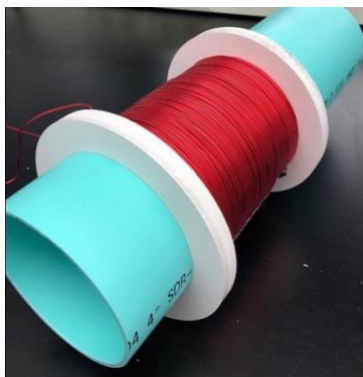
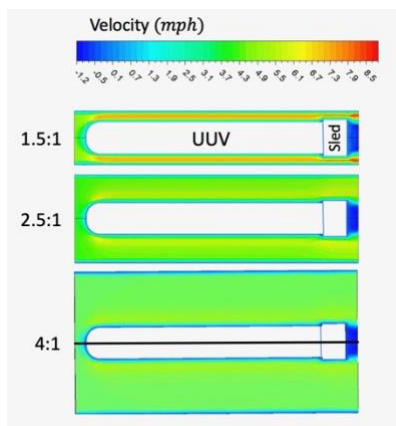
MECHANICAL ENGINEERING

TEAM: ME28

SPONSOR: Naval Undersea Warfare Center

ADVISOR: Professor Wilson Chiu

Electromagnetic Expulsion of Unmanned Underwater Vehicles



The Naval Undersea Warfare Center (NUWC) is the United States Navy's research division. NUWC develops, improves, engineers, and tests technologies to aid the nation's fleet of naval vessels. A current area of research is the launching of unmanned underwater vehicles (UUV's) from surface vessels and submarines. These UUV's are used for reconnaissance missions, surveillance and mine detection, so launching them from submarines is optimal. Our group has been tasked with determining the feasibility of using an electromagnetic scheme to launch UUV's from submarines to replace a current method water slug method.

To test the feasibility, we have designed and built several prototype concepts and analyzed different design iterations' performances. Our design utilizes a fully waterproofed coil with an integrated circuit and control system to generate a magnetic field. This magnetic field propels an sled that is held in the center of the launch tube. The sled in turn expels the UUV.

With this design we can obtain a predictable amount of force without relying upon the magnetic properties of the UUV itself. We have been able to optimize the coil and circuit design, sled design, and UUV restraint system design to ensure smooth and predictable launches. Factors include coil geometry, number of coil turns, and the material/shape of the sled to optimize magnetic field, magnetic permeability, and friction forces. The restraint system of the UUV has also been optimized to securely hold and release the UUV before and during launching. A fluid simulation study, helped us minimize fluid drag to ensure that the most of the generated force was being exerted onto the UUV.

The sled material most ideal for this application is a high carbon steel. It is held in the center of the coil/tube using a pipe crawler type system to allow for axial motion. Once fired the sled moves through the coil, pushing the UUV, and eventually hitting stops to ensure it stays within the tube. This fully expels the UUV after which it can engage independent propulsion systems.