Underwater Golf: An Evaluation of the Effects of Organized Surface Irregularities on the Hydrodynamic Efficiency of Underwater Projectiles

Toledo, Gustavo (School: Edgewood Junior Senior High School)

Surface irregularities have shown a tendency to reduce aerodynamic drag for projectiles in motion. They do so by reducing the area of low pressure that builds up behind an object when it is in motion by creating spirals of turbulent air to dissipate said area. A textured surface on an underwater projectile, such as a torpedo, could reduce the drag coefficients at both high and low Reynolds numbers, increasing hydrodynamic efficiency. Data gathered points to a definitive conclusion that surface texturing has a positive hydrodynamic effect on the movement of underwater projectiles. Several 1/4.25 scale models of MK-46 torpedoes were 3D-printed, and each was altered to create a differently textured surface (smooth, round dimpled, etc.). Each model was then tested by dropping it into a vertical water tunnel and measuring the time it took to travel between two points. Ten trials with each model were completed, with mean travel times recorded. Data gathered shows a definitive trend towards textured surfaces performing better, with the surfaces ranked in order of increasing efficiency being smooth, circular dimpling, circular protrusions, and elliptical dimpling, respectively. This data supports the postulation that surface texturing should be used to increase the efficiency of underwater projectiles. It is notable, however, that dimples and protrusions faced relatively similar success rates, contrary to the idea that dimpling is more effective in curbing hydrodynamic friction. Increased efficiency in underwater projectiles could lead to more effective ways of surveying oceans, opening the door for new realms of scientific research.