

## Mechanical fish learning swimming techniques from a squid

Today, the performance of the vehicles which provide under water travel has been limited by their size and engines which power the propeller they have. When we look at under the water, sea creature like a squid can speed up to 40 – 50 km/h in a short duration of time. Although squid's length can vary from 1 cm to 10 m and weight can change from 0.1 kg to 500 kg, a squid can exhibit incredible swimming performance (i.e., high maneuver and acceleration skills). This swimming performance gives squid a priceless opportunity to escape from her enemies and catch her food.

Squids in nature generate pulsed jet to be able to move by expelling high pressure water through their funnel in a short period of time. In this study, unsteady jet flow of squids has been investigated during its fast swimming phase. Numerical model has been generated from a real squid's computer tomography images. 2D axisymmetric jet flow has been simulated by using dynamic mesh to mimic the motion of squid's mantle cavity wall. Specifically, diameter of the squid's mantle cavity decreases from 13 cm to 4 cm and a periodic sine velocity profile has been defined for movement of squid's mantle cavity wall. Physical behaviors of jet flow has been investigated to be able to calculate change of ejected fluid's momentum and flow energy in this study. Hydrodynamic drag on an adult squid was also performed during its fast swimming phase. It has been documented that squids can typically swim at velocities from 3.21 m/s to 9.23 m/s under the water. It is realized that streamlined shape of the squid affects drag force associated with total wetted surface area and flow separation; more specifically, streamlined shape of the squid helps to have delayed flow separation and in return the squid experiences lower drag coefficient. This work has been supported by TUBITAK (The Scientific and Technological Research Council of Turkey) under 3501 Program, Project #: 111M598.

### Short Bio:

#### Education

B.S. in Mechanical Engineering, 1999, Middle East Technical University, Ankara, Turkey.

M.S. in Mechanical Engineering, 2001, Southern Illinois University, Illinois, United States.

Ph.D in Mechanical Engineering, 2007, Southern Methodist University, Dallas, Texas, United States.

#### Work Experience

As a mechanical engineer, 2001 – 2002, Wallace Manufacturing, Rayleign, Illinois, United States.

As a graduate assistant, 2002 – 2007, Southern Methodist University, Dallas, Texas, United States.

As an assistant professor, 2007 – 2009, University of Wisconsin, Platteville, United States.

As a consultant, 2008 – 2009, The Shaw Group, Houston, Texas, United States.

As R&D research engineer, 2010, Turkiye Technology Center (GE & TEI), Gebze, Turkey.

As an assistant professor, 2010 – 2013, Dogus University, Istanbul, Turkey.

As an assistant professor, 2013 – Present, Yeditepe University, Istanbul, Turkey.