NUMERICAL SIMULATION OF THE FLUID FLOW PAST A TORUS WITH ROTATING BOUNDARY

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Pairin Suwannasri: Numerical Simulation of the Fluid Flow Past a Torus with a Rotating Boundary.

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Rotating Torus/ Self-Propelled Body/ Toroidal Coordinates.

In the present thesis, the hydrodynamics of a torus rotating about its centerline is investigated numerically. This problem is important for two reasons: firstly, swimming of micro-organisms can be modeled as a self-locomotion of a doughnut-shaped swimmer powered by surface rotation and secondly, it (the torus) has the simplest geometry which can describe self-propelled organism (particles). Rotation of the torus surface can be considered as a propulsion device for controlling the variation in the drag coefficient for flow past rings orientated normal to the direction of flow.

A numerical model based on the projection method has been developed for the incompressible Navier-Stokes equations in the toroidal coordinate system. The numerical algorithm has been validated by comparing our numerical results with available data from laboratory physical modeling and other numerical results. The drag coefficients and flow patterns for the axisymmetric flow past a torus rotating about its centerline were computed and are analyzed for moderate Reynolds number, various rotational speed and different aspect ratios (the ratio of the ring diameter to the cross-section diameter).

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