# Numerically-Based Ducted Propeller Design Using Vortex Lattice Lifting Line Theory

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This thesis used vortex lattice lifting line theory to model an axisymmetrical-ducted propeller with no gap between the duct and the propeller. The theory required to model the duct and its interaction with the propeller were discussed and implemented in *Open-source Propeller Design and Analysis Program* (OpenProp). Two routines for determining the optimum circulation distribution were considered, and a method based on calculus of variations was selected. The results of this model were compared with the MIT Propeller Lifting Line Program (PLL) output for the purpose of validation.

Ducted propellers are prevalent in modern marine propulsion systems, and the application of this technology continues to expand. The theory associated with ducted propellers applies to a wide-range of devices which include azimuth thrusters, pumpjets, and tidal turbines. Regardless of the application, engineers need tools such as OpenProp to design these devices for their expected operating conditions. OpenProp is an open source MATLAB®-based suite of propeller numerical design tools. Previously, the program only designed open propellers. The code developed in this thesis extended OpenProp's capability to be able to design a propeller within an axisymmetrical duct.