Minimum Pressure Envelope Cavitation Analysis Using Two-Dimensional Panel Method

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An analysis tool for calculating minimum pressure envelopes was developed using XFOIL. This thesis presents MATLAB® executables that interface with a modified version of XFOIL for determining the minimum pressure of a foil operating in an inviscid fluid. The code creates minimum pressure envelopes, similar to those published by Brockett (1965). XFOIL, developed by Mark Drela in 1986, is a design system for Low Reynolds Number Airfoils that combines the speed and accuracy of high-order panel methods with fully-coupled viscous/inviscid interaction. XFOIL was altered such that it reads in command line arguments that provide operating instructions, rather than from the operator via menu options. In addition, all screen output and plotting functions were removed. These modifications removed XFOIL's user interface, and created a "black box" version of XFOIL that would perform the desired calculations and write the output to a file. These modifications allow rapid execution and interface by an external program, such as MATLAB®. In addition, XFOIL's algorithms provide a significant improvement in the accuracy of minimum pressure prediction over the method published by Brockett.

Development of the modified XFOIL and MATLAB® interface contained in this thesis is intended for future interface with *Open-source Propeller Design and Analysis Program* (OpenProp). OpenProp is an open source MATLAB®-based suite of propeller design tools. Currently, OpenProp performs parametric analysis and single propeller design, but does not perform cavitation analysis. Minimum pressure envelopes provide the propeller designer information about operating conditions encountered by propellers. The code developed in this thesis allows the designer to rapidly assess cavitation conditions while in the design phase, and make modifications to propeller blade design in order to optimize cavitation performance.