Geometric Modeling and Numerical Simulation of Airfoil Shapes Using Integrated MATLAB® and COMSOL Multiphysics

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Abstract

This paper proposes a framework for an efficient integration between geometric modeling program and analysis tool for an automated aerodynamic design optimization mission. This well-organized integrated system (Figure 1) will then applied to the turbomachinery blading process where CAD/CAM systems should be integrated specifically for the industrial applications. This demand can be addressed by using both in-house codes and commercial software which have the good ability of live-link and efficient integration. In this study, the mathematical modeling of a turbomachinery airfoil shape using NURBS curve within MATLAB® and two-dimensional numerical simulation of the flow around the airfoil using COMSOL Multiphysics 4.2 is carried out as the case study. To establish this integrating process in analyzing software, use of LiveLink(TM) for MATLAB(R) which is an important option of COMSOL Multiphysics is considered. The results (Figure 2, Figure 3 and Figure 4) demonstrate the high ability of COMSOL to be a really helpful analysis tool in an automated design optimization loop, including geometric models, fluid/structural analysis results, field experimental data and an optimization program.

Figures used in the abstract

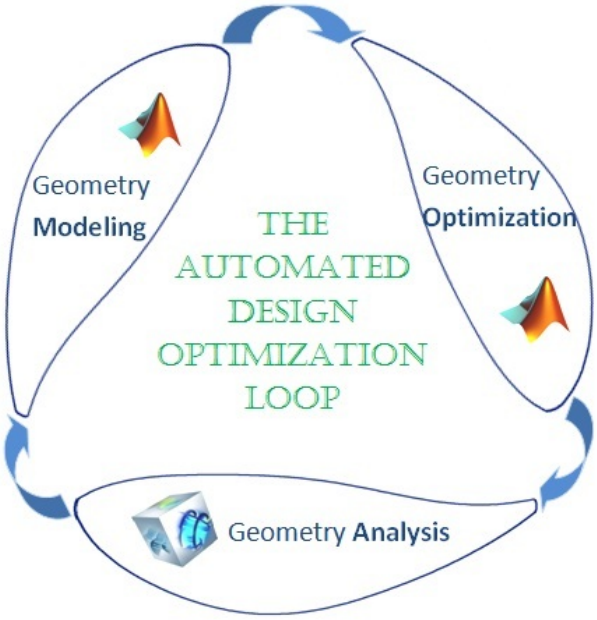

Figure 1: The proposed integrated system.

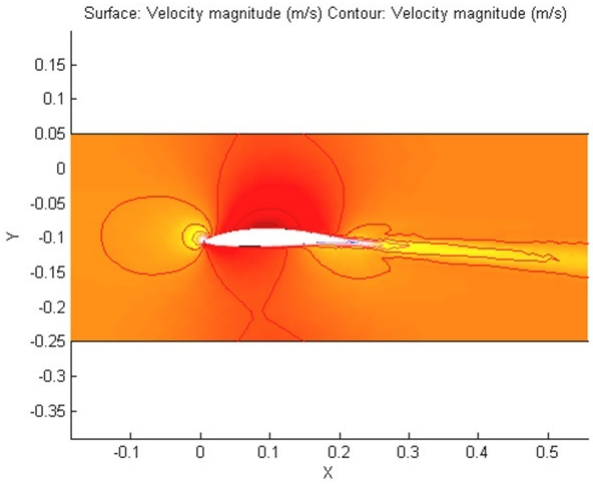

Figure 2: The surface velocity magnitude (m/s).

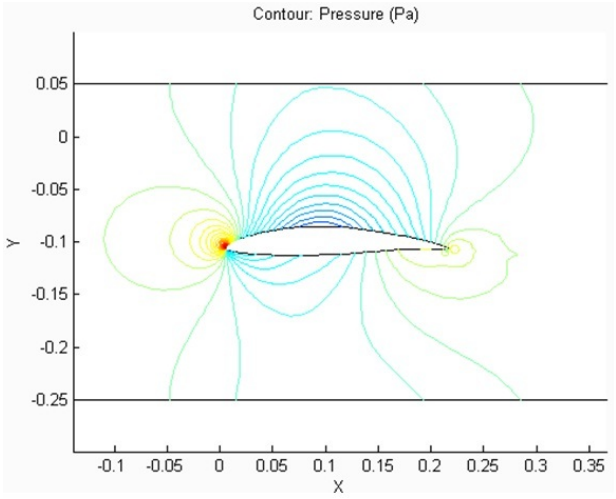

Figure 3: The contour of the airfoil pressure distribution (Pa).

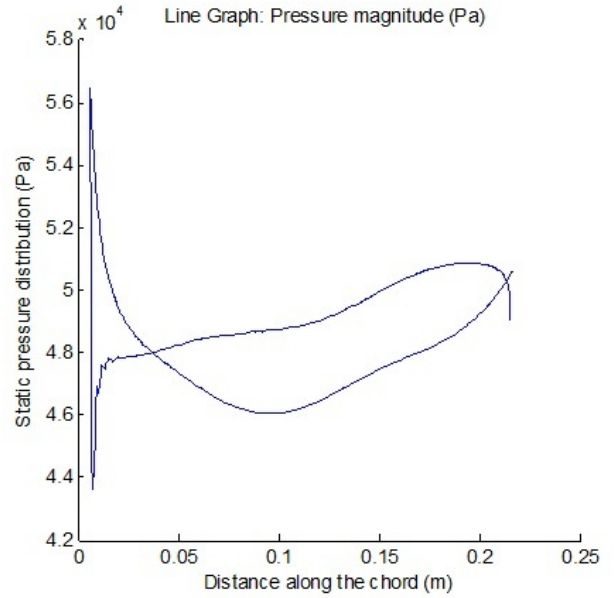

Figure 4: The static pressure along the chord.