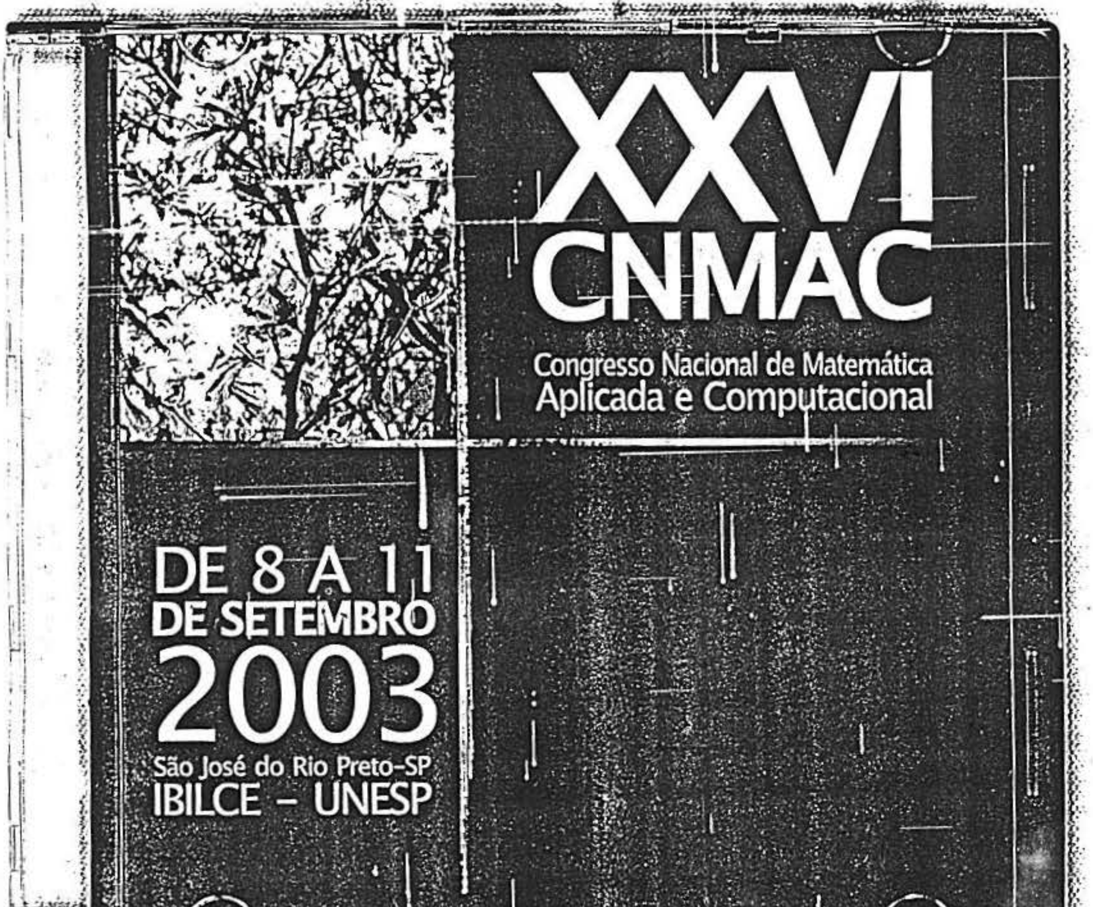
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Design of Airfoils Using Inverse Method

Quadros, R. S., De Bortoli, A. L.
UFRGS - Graduate Program in Applied Mathematics
Bento Gonçalves 9500, 91509-900. Fax:(051)3316-7301
Porto Alegre - RS. Brazil
E-mail: quadros@mat.ufrgs.br, dbortoli@mat.ufrgs.br

Abstract

Contributions to the aerodynamics development have to be involved to achieve an increase in quality, reducing time and computer costs. Therefore, the aim of this work is the attainment of a technique for the optimized modeling of bodies submitted to transonic flows, such as airfoils and wings of aircrafts. We employ Series of Fourier for a set of two linear equations with boundary conditions, based on the Elastic Membrane Technique.

The design of aerodynamic shapes can be classified in two categories: the direct and the inverse. The first intent to find the best global aerodynamic property. Otherwise, the inverse form requires a local special property of the final configuration satisfying the development objectives. Three essential elements characterize the inverse methods: Firstly, a procedure describes and transforms the geometry through the control of the variables; secondly, an implemented model carries through the aerodynamic calculation; thirdly, a method of optimization finds the best global characteristic.

The optimization algorithm modifies the form of an airfoil until finding the form improved for data coefficient. In this work one employs the inverse method based on the pressure distribution to describe a new geometry. Pressure results from the Euler equations solved by finite volumes, based on the Runge-kutta five-stages scheme. These equations are written in generalized coordinates, being all the variables stored in the centers of the control volume. Dissipative terms are introduced to damp the frequencies of high order of error in the solution procedure.

For a given form of a wing based on NACA 0012, whose distribution of pressure for transonic flow is well known, presenting shocks (discontinuities), it is desired to determine a new form, which minimizes the shock effect, providing low losses of energy. The advantage of the finite volumes implementation is that the flux is locally verified in agreement with the idea of the inverse projects for the attainment of the geometric form of a body. Therefore, the objective of the present work is the attainment of one efficient technique for the optimized modeling of bodies submitted to flows of high speed, as airfoils, wings and other aerodynamic geometries, as shown in figure 1.

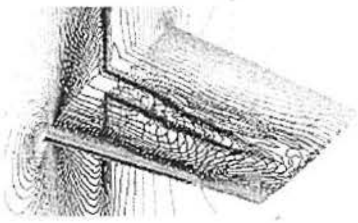

Figure 1: Pressure lines over wing, Mach 0.8 and $\alpha = 0^o$

These calculations are found to compare favorably with experimental and numerical data available in the literature for transonic flows.

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