An Exact Inverse Method for Subsonic Flows

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A new inverse method for aerodynamic design of airfoils is presented for subcritical flows. The pressure distribution in this method can be prescribed in a natural way, i.e., as a function of arclength of the as yet unknown body. This inverse problem is shown to be mathematically equivalent to solving only one nonlinear boundary value problem subject to known Dirichlet data on the boundary. The solution to this nonlinear problem determines the airfoil, free stream Mach number M_∞ and the upstream flow direction θ_∞. The existence of a solution to a given pressure distribution is discussed. The method is easy to implement and extremely efficient. We present a series of results for which comparisons are made with the known airfoils. This method will be extended to design supercritical airfoils in the future.

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