Solvability Condition and Its Application to Fast Numerical Solution of Overposed Inverse Problems in Compressible Flows

P. Daripa
Department of Mathematics
Texas A&M University, College Station, TX 77843
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In this paper we derive some results that give the existence of solutions (restricted by a compatibility condition) to overposed inverse design problems in a satisfactory manner. An overposed inverse design problem is concerned with generating a profile which will have a specified speed distribution $q_0^s(s)$ at a given free stream Mach number M_∞^s. This is equivalent to specifying pressure distribution. This problem has been of interest in aeronautical engineering. The overposedness of this problem is due to the specification of M_∞^s. An important issue has been the relation between $q_0^s(s)$ and M_∞^s. We derive this relation. A very useful approximation to this relation is established through numerical experiments which is exact for all practical purposes. We show the importance of this result in solving the overposed problem in an efficient manner.

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