

SOLUTION OF INVERSE PROBLEMS OF GAS DYNAMICS OF FLAT COMPRESSOR CASCADES BASED ON NUMERICAL SIMULATION OF TURBULENT FLOWS

This paper presents a technique for solving inverse problems in gas dynamics of flat compressor cascades, based on a numerical simulation of turbulent flows. This technique is based on the application of quasi-solutions searching method to the solution of inverse problems. In this case the solution of the inverse problem is reduced to solving the problem of finding the global extreme of some target function. A parametric description of the shape of cascade profiles is made using an original method, based on the Bezier curves and the system of Hicks – Henne smooth convex functions. The application of this method makes it possible to vary the geometric parameters of the cascade in wide ranges by means of a relatively small number of variable parameters and the preservation of the physically feasible profile path. The calculation of the target function is performed by simulating the flow from the numerical integration of the averaged Navier–Stokes equations which are closed by means of the Spalart–Allmaras one-parameter turbulence model. A hybrid genetic algorithm is used to find the extreme of the target function. The technique proposed allows the determination of the geometrical parameters of the cascade for a given pressure distribution on the contour of the desired profile as well as from given integral aerodynamic characteristics of the cascade. It can also be used to solve problems of aerodynamic optimization of compressor cascades. In addition, this technique can be easily adapted to the solution of similar problems in the three-dimensional formulation.

Keywords: compressor cascade, inverse problem in gas dynamics, aerodynamic characteristics, geometrical parameters of cascade, pressure distribution, Navier-Stokes equations, genetic algorithm.

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