Numerical Solution of Transonic Flow of Wet Steam by Fractional Step Method.

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Its well known, that most of l;ast stages of steam turbines operates in region of wet steam, i.e. mixture of vapor and condensed droplets. Specific effects of phase transition of wet steam and presence of droplets can decrease efficiency and also lifetime period of turbine stage blading.

Our work deals with numerical solution of one model (Hill's approximation) of wet steam flow. The possibility of creation , growth or evaporation of droplets is considered.

The governing system of equations consist of common conservation laws of fluid mechanics (Euler or Navier-stokes equations) and additional four linear advection - reaction equations with nonlinear source terms. The equation for pressure couples both parts. The material properties of wet steam are described by a set of polynomial functions of temperature (steam tables) instead of some functional dependence (equation of state).

The system of equations is solved by fractional step method. Physical time step necessary for proper description of nucleation and droplets growth is much smaller than common time step given by CFL condition for equations of fluid dynamics and operator splitting yields therefore very effective algorithm of time integration. The one step of explicit scheme consists of one time step of Lax-Wendroff type finite volume scheme for finite volumes of cell vertex type and multiple steps of numerical solution of the system of ODE (source terms) computed with smaller time step locally in each grid node.

Presented numerical results show typical features of solved problem, like condensation shock or oscillatory solution, validation of results with experimental data for simple geometries and applications for realistic technical problems.