ле отбора скорости плотностного течения. Исследованы автомодельные решения и найдена их связь с асимптотическим поведением нестационарных численных решений. Проведено сравнение с экспериментальными данными в задаче об эволюции термика над склоном [Rastello, Hopfinger, 2004].

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Multi-dimensional shear shallow water flows and compressible turbulence

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The multi-dimensional equations of shear shallow water flows represent a $2D$ hyperbolic non-conservative system of equations which is reminiscent of generic Reynolds averaged equations for barotropic turbulent fluids. The model has three families of characteristics corresponding to the propagation of surface waves, shear waves and average flow.

I present a new splitting technique to define the weak solutions to this non-conservative system of equations. The full system is split into several subsystems for which the notion of the weak solution is almost classical. Each split subsystem contains only one family of waves (either surface or shear waves) and contact characteristics. The accuracy of such an approach is tested on the exact $2D$ solutions describing the flow where the velocity is linear with respect to the space variables (generalisation of L. I. Sedov's and L. V. Ovsyannikov's solutions to the Euler equations of compressible fluids), and on the solutions describing $1D$ roll waves. The capacity of the model to describe multi-D experimentally observed phenomena was shown : 'fingering' of plane one-dimensional wave fronts, and the formation of singularities in radially convergent flows.

I will also discuss the perspectives of such a 'splitting approach' for the description of $3D$ compressible turbulent flows.

This is joint work with K. Ivanova and N. Favrie.

Литература

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Challenges in modeling supersonic reacting flows and scramjet combustion simulation

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The scramjet (supersonic combustion ramjet) engine is conceptually a ramjet in which the compressed air flow from the inlet is kept supersonic throughout the whole flowpath. These engines are designed for air-breathing propulsion of vehicles at high Mach number values (above 5 or 6) where practical ramjet engines feature lower performance, especially in term of specific impulse. The corresponding conditions concern several fields of application including civil transport, space launchers or missiles. In comparison with experimental investigations, which remain very challenging to conduct in such flow conditions, computational fluid dynamics (CFD) offers an attractive alternative and nonetheless complementary tool for the study of such high-speed turbulent reactive flows.

The challenges to model high speed combustion in the frame of RANS (the Reynolds-averaged Navier–Stokes equations) and LES (Large Eddy Simulation) approaches are summarized. The state of the art of CFD capabilities for predicting supersonic combustion is presented. The models available to account for turbulence-chemistry interactions (TCI) are critically described (flamelet model (FM), linear eddy mixing model (LEM), eddy dissipation concept (EDC), partially stirred reactor (PaSR) and extended (transported) PaSR models, probability density function (PDF) approach (transported and assumed PDF)). The review shows that the description of combustion in high-speed turbulent flows where turbulent mixing, compressibility effects and chemical kinetics processes are competing still remains a challenging issue for numerical simulations. The review