Литература

1. 2017 S. Gavrilyuk, K. Ivanova, N. Favrie, Multi-dimensional shear shallow water flows : problems and solutions (submitted).

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 provides also short description and references to experimental databases that can be used for the validation, improvements and development of phenomenological TCI models for RANS, subgrid scale models for LES, and reduced-kinetics models.

The author was financially supported by ONERA and by the Grant of the Ministry of Education and Science of the Russian Federation (Contract No. 14.G39.31.0001 of 13.02.2017).

Бигармоническая проблема теории упругости. Точные решения

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В виде рядов по собственным функциям Фадля–Папковича (однородным решениям) строятся точные решения краевых задач теории упругости и теории изгиба тонких прямоугольных пластин. Функции Фадля–Папковича точно удовлетворяют нулевым граничным условиям на двух противоположных сторонах прямоугольника. Удовлетворяя граничным условиям на его торцах, приходим к проблеме разложения заданных здесь граничных функций в ряды по системам функций Фадля–Папковича (бигармоническая проблема).

Функции Фадля–Папковича комплекснозначны и не образуют базиса на отрезке – торцах прямоугольника. Поэтому найти неизвестные коэффициенты разложений по ним, основываясь на классических представлениях теории базиса функций, невозможно. Их нужно рассматривать как пример представляющих систем экспонент с комплексными показателями (А.Ф. Леонтьев, Ю.Ф. Коробейник) и с вырожденной в отрезок областью аналитичности. Основываясь на преобразовании Бореля в классе квазицелых функций экспоненциального типа, к функциям