Formation of Detonation in Confined Moving Regions

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The attempts to actually use detonation in motors and other different energy devices posed a number of problems for the researchers. The most important among them is the task of detonation initiation in the confined space. Results of experimental and theoretical investigations of detonation initiation using rotation or deformation of combustion chambers are not known until now. The one-dimensional problem on detonation initiation by the piston is certainly referred to the issue being considered.

The combustible-mixture flow inside and outside the rotating elliptic cylinder enclosed in the circular cylinder is considered to estimate feasibility of detonation initiation during rotation (Figure 1). Special

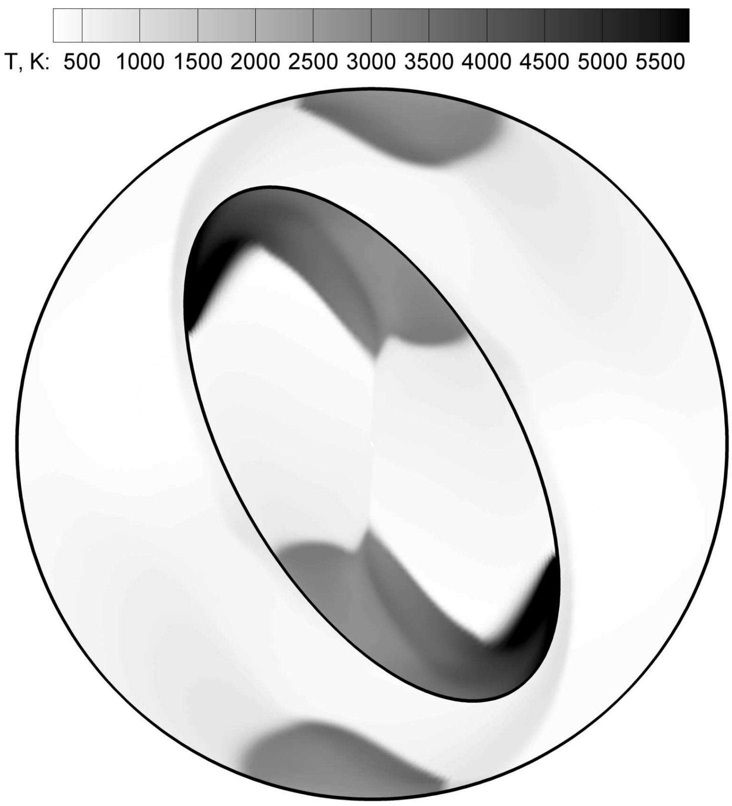

Figure 1: Formation of detonation inside and outside of the rotating elliptic cylinder (temperature field)

rotating cylinders with blades are examined as detonation initiators (Figure 2).

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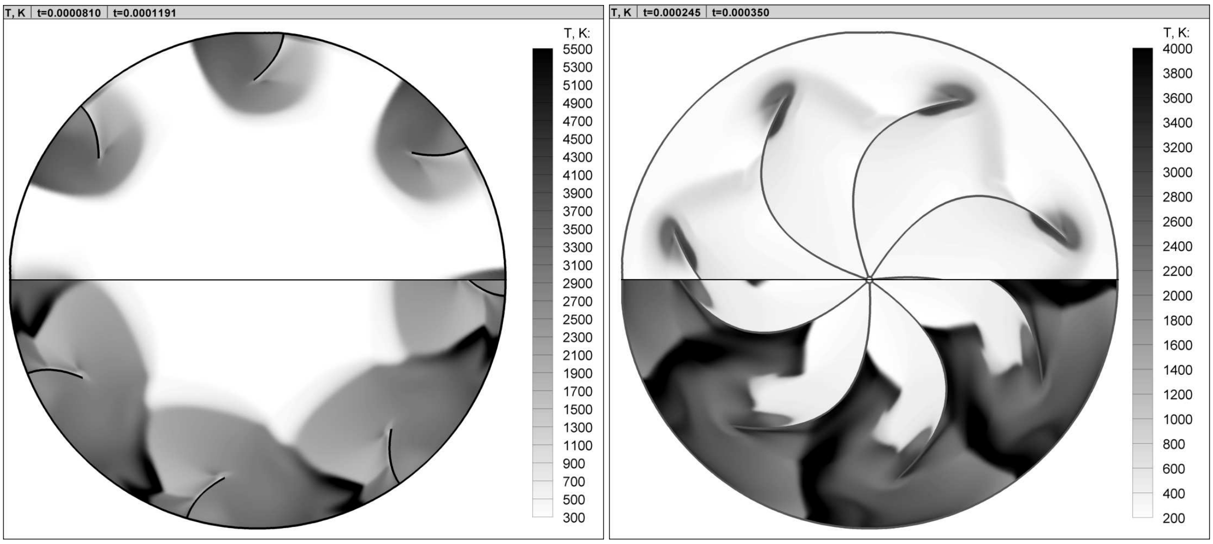

(a) (b)

Figure 2: Formation of detonation inside of the rotating cylinder with parabolic blades (a) and inside of the cylinder with rotating star in the center (b): temperature fields at 2 moments

Critical parameters at which detonation is formed are evaluated. The analogy with detonation initiation in the combustible mixture flow in the channel having the specific spiral form is presented. The numerical method based on the S.K. Godunov scheme with the mobile computation mesh is used to perform this investigation in the framework of one-stage kinetics of stoichiometric air-propane mixture burning. The detailed flow pattern that allows us to identify features of detonation occurrence at movement of the combustible mixture-containing area boundaries was obtained.

Detonation initiation using rotation of the elliptic cylinder enclosed in the circular cylinder, both filled with stoichiometric air-propane mixture, was numerically investigated. The feasibility to form detonation both inside, and outside the elliptic cylinder was stated. Two critical angle velocities of cylinder rotation, which govern the quantitative and qualitative flow pattern, were found. The method to estimate parameters of the three-dimensional spiral channels is proposed based on the plane-sections hypothesis. The comparison with 3D simulation is presented.

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