Simulation of Combustion of Supersonic Hydrogen Jets
in a Supersonic Air Flow

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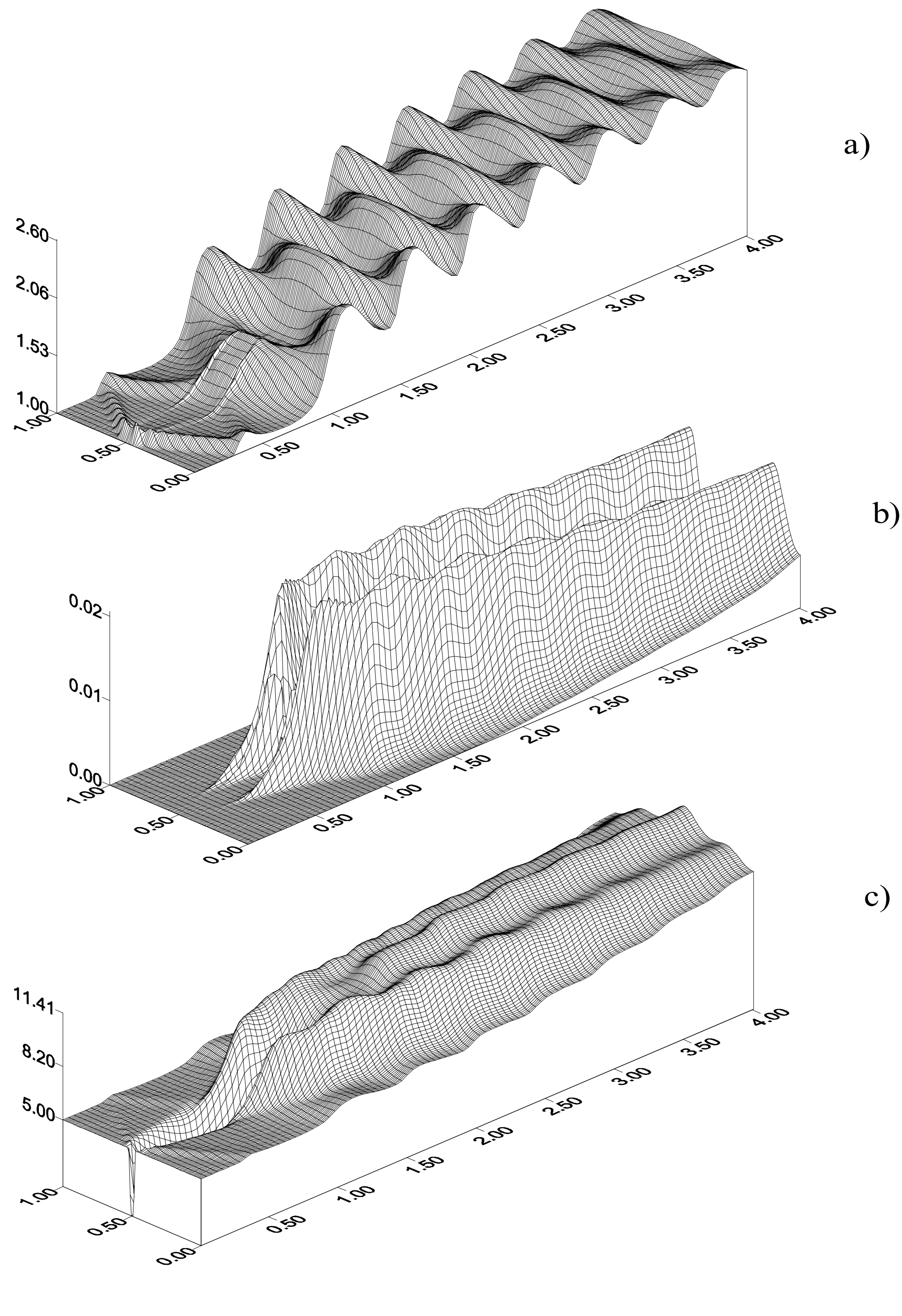
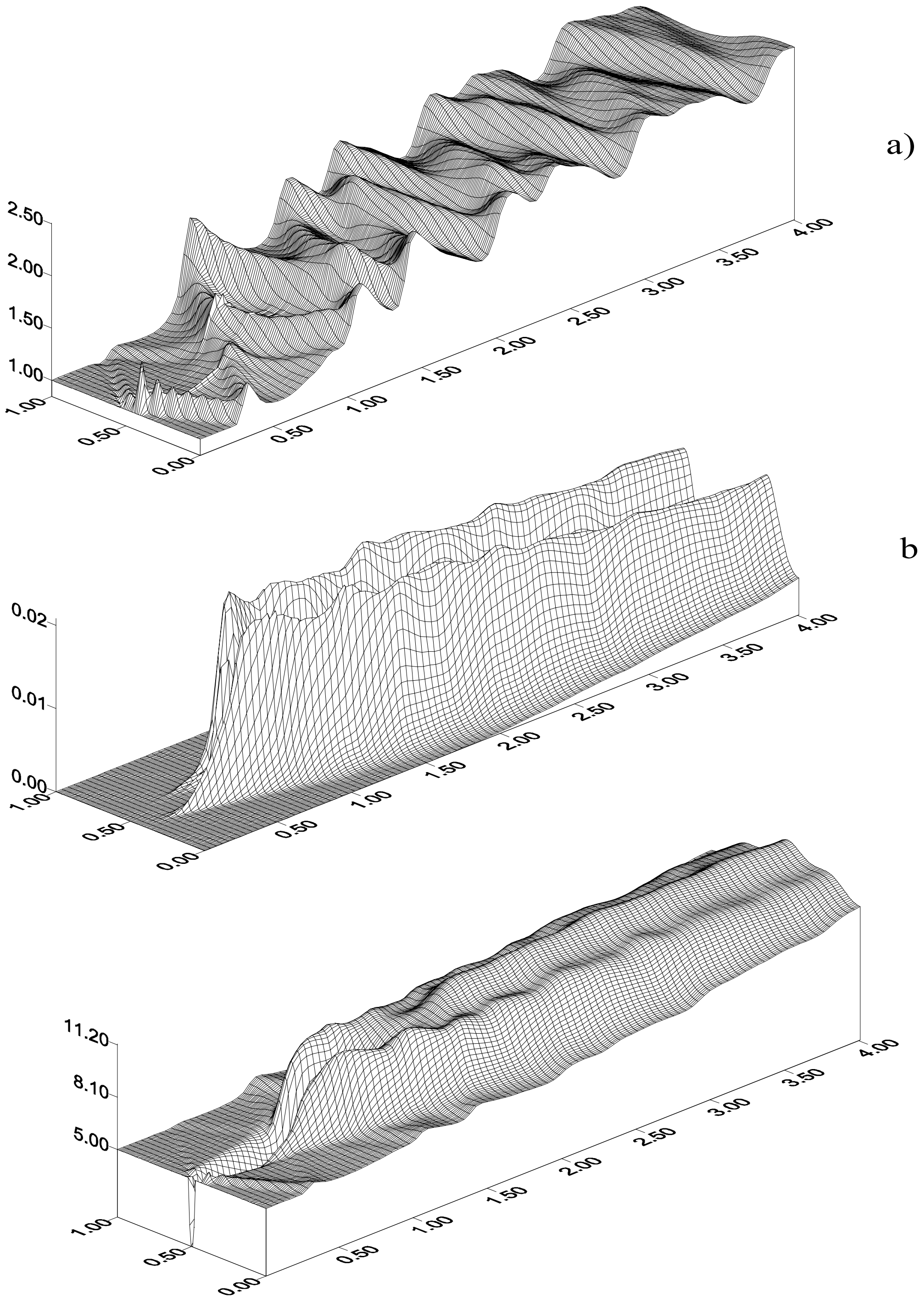
The research of gas-dynamic, acoustic, thermal and constructive conditions allowing to intensify a mixing of fuel jets with air-flow, plays the important role at creation of supersonic combustion of hydrogen in a scramjet combustor. Combustion characteristics at supersonic speed are defined by intensity of turbulent mixing processes, rate of chemical reactions in a flow and influence of gas-dynamic effects accompanying heat release.
The results of numerical simulation of hydrogen combustion in a supersonic air flow are given. The supersonic hydrogen jets ($T_2=254\ K^0$, $M_1= 1.8$) injected to supersonic air flow($M_2=3.63$, $T_2=1270\ K^0$, $\boldsymbol{n=1,1}$, $\boldsymbol{Y^0_{O_2}=0,266}$, $\boldsymbol{Y^0_{H_2O}=0,256}$, $Y^0_{N_2}=0,478$) at different angles ($\alpha=0$; 30^0). The turbulent mixing and combustion are governed by time averaged and parabolized Navier-Stokes equations using two-parametrical "k - l"- turbulent model and detailed kinetic mechanism of hydrogen oxidation.

The behavior of supersonic hydrogen combustion are considered and investigated in tasks:
1) a system of flat thin hydrogen supersonic jets are injected parallel into supersonic flow and at differernt angles (Figure 1 and 2);
2) a system of round or elliptic hydrogen supersonic jets injected into supersonic flow;
3) a system of round or elliptic hydrogen supersonic jets injected into supersonic flow with subsonic zones.
The influence of fuel and oxidiant parameters on completeness of hydrogen combustion were estimated.



Pressure a), concentration OH b) and temperature c) fields,
$M_1 = 1{,}8$; $M_2 = 3{,}6$; $T_1 = 254\ K^0$; $T_2 = 1270\ K^0$; $n = 1{,}1$; $\alpha = 0$;
$Y^0_{O_2} = 0{,}266$; $Y^0_{H_2O} = 0{,}256$; $Y^0_{N_2} = 0{,}478$.
Figure 1.



a)

b)

c)

Pressure a), concentration OH b) and temperature c) fields,

$M_1 = 1{,}8$; $M_2 = 3{,}6$; $T_1 = 254\ K^0$; $T_2 = 1270\ K^0$; $n = 1{,}1$; $\alpha = 30^0$;

$Y^0_{O_2} = 0{,}266$; $Y^0_{H_2O} = 0{,}256$; $Y^0_{N_2} = 0{,}478$.

Figure 2.