CORRIGENDUM

Numerical modelling of supersonic boundary-layer receptivity to solid particulates – CORRIGENDUM

P.V. Chuvakhov, A.V. Fedorov and A.O. Obraz

doi:10.1017/jfm.2018.842, Published by Cambridge University Press, 27 November 2018

Key words: boundary layer receptivity, boundary layer stability, high-speed flow

In our paper Chuvakhov *et al.* (2019), the energy equation (2.6) is written for the gas temperature T as

$$\rho\left[\frac{\partial T}{\partial t}+u_j\frac{\partial T}{\partial r_j}\right]=\frac{1}{PrRe}\frac{\partial}{\partial r_j}\left(\mu\frac{\partial T}{\partial r_j}\right)+(\gamma-1)M_\infty^2\left(\frac{\partial p}{\partial t}+u_j\frac{\partial p}{\partial r_j}\right)+\frac{(\gamma-1)M_\infty^2}{Re}\varPhi \\ +\frac{R_p}{PrRe}\bar{Q}_p\delta(\boldsymbol{r}-\boldsymbol{r}_p)+\underline{R_p^2(\gamma-1)M_\infty^2(u_{pj}-u_j)\bar{F}_{pj}\delta(\boldsymbol{r}-\boldsymbol{r}_p)}, \tag{1}$$

where underlined is the particle-induced source term associated with the drag force. This form is convenient for analyses of receptivity and stability problems (Fedorov 2013). However, in our numerical simulations the energy equation is used in the conservative form

$$\frac{\partial\rho e}{\partial t}+\frac{\partial\rho u_j H}{\partial r_j}=\frac{1}{Re}\frac{\partial}{\partial r_j}\left(\frac{\mu}{(\gamma-1)M_\infty^2 Pr}\frac{\partial T}{\partial r_j}+\tau_{ij}u_j\right) \\ +\frac{R_p}{(\gamma-1)M_\infty^2 PrRe}\bar{Q}_p\delta(\boldsymbol{r}-\boldsymbol{r}_p)+\underline{R_p^2 u_{pj}\bar{F}_{pj}\delta(\boldsymbol{r}-\boldsymbol{r}_p)}, \tag{2}$$

where $e=p/(\rho(\gamma-1))+0.5u_iu_i$ is gas total energy per unit mass, and $H=e+p/\rho$ is total enthalpy per unit mass, and the underlined term represents the power per unit volume which is produced by the particle passing through the gas. In our computations the underlined term of (2) was erroneously replaced by the underlined term of (1). After correcting this error, our computations showed that the disturbance amplitude reduced by 2.7 times; see figure 1 that is the correct version of figure 10 of Chuvakhov *et al.* (2019). Note that the theoretical distributions were not changed.

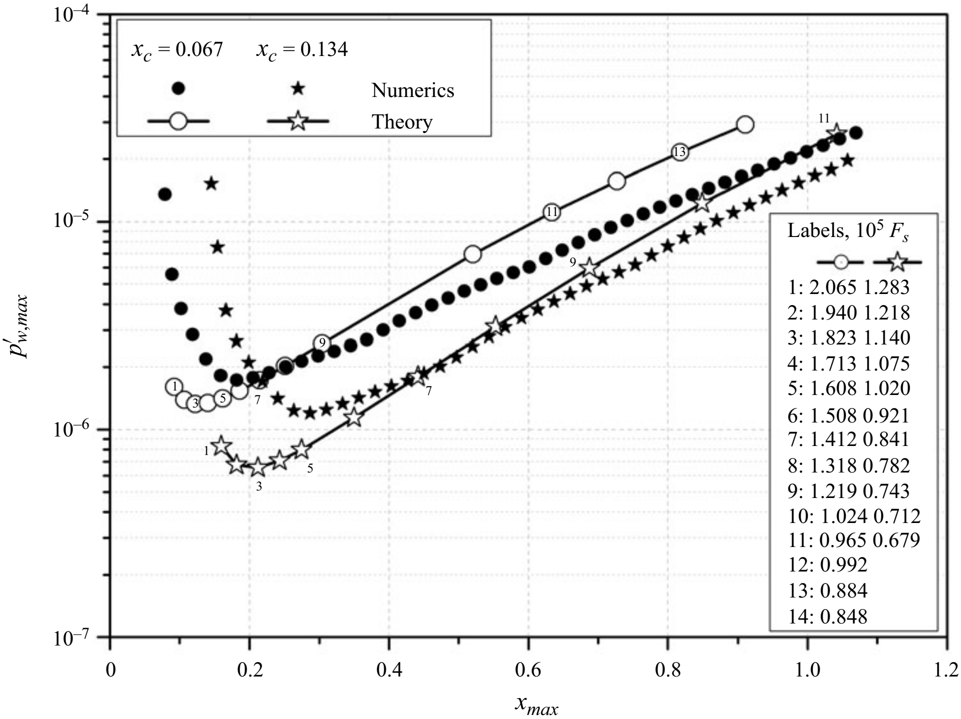

Figure 1. Theoretical (lines with white symbols) and numerical (black symbols) distributions of the hump amplitude $p'_{w,max}(x_{max})$ for the collision points $x_c = 0.067$ (circles) and $x_c = 0.134$ (stars); F_s – frequency parameter of the dominant wave at the observation point x_{max}.

Funding. The work completed to find these corrected findings was carried out in Moscow Institute of Physics and Technology under the support of Russian Science Foundation (project no. 19-79-10132).

References

CHUVAKHOV, P.V., FEDOROV, A.V. & OBRAZ, A.O. 2019 Numerical modeling of supersonic boundary-layer receptivity to solid particulates. *J. Fluid Mech.* **859**, 949–971.

FEDOROV, A.V. 2013 Receptivity of a supersonic boundary layer to solid particulates. *J. Fluid Mech.* **737**, 105–131.