J. Fluid Mech. (2015), *vol.* 769, *pp.* 725–728. © Cambridge University Press 2015
doi:10.1017/jfm.2015.155

CORRIGENDUM

Stabilization of a hypersonic boundary layer using an ultrasonically absorptive coating – CORRIGENDUM

A. Fedorov, A. Shiplyuk, A. Maslov, E. Burov and N. Malmuth

doi:S10.1017/S0022112002003440, Published by Cambridge University Press, 31 March 2003

1. Error in the complex representation of the porous-coating model

The authors are grateful to Mr R. C. Tritarelli and Professor S. K. Lele for highlighting a significant error in their analysis of the stabilization effect of felt-metal coatings on hypersonic boundary layers (Fedorov *et al.* 2003).

As discussed in Tritarelli *et al.* (2015), the complex representation of the porous-coating model used in Fedorov *et al.* (2003) was in discordance with the time convention used in the normal-mode ansatz of the linear stability analysis. The numerical results from Fedorov *et al.* (2003) are hereby negated.

For the sake of completeness, the corrected equations, which were already presented and discussed in Tritarelli *et al.* (2015), are repeated in this corrigendum. For a detailed discussion we refer to Tritarelli *et al.* (2015).

The equations describing the felt-metal porous-coating model in Fedorov *et al.* (2003), i.e. equations (4.34)–(4.36), have to be substituted by

$$\widetilde{\rho} = a_\infty \left[1 + \frac{g(\lambda_1)}{\lambda_1}\right], \quad \widetilde{C} = \gamma - \frac{\gamma - 1}{1 + g(\lambda_2)/\lambda_2}, \tag{1.1a,b}$$

$$g(\lambda) = \sqrt{1 + \frac{4 a_\infty \mu_w^* \lambda}{\sigma^* \phi\, r_p^{*2}}}, \tag{1.2}$$

$$\lambda_1 = -\mathrm{i} a_\infty \rho_w^* \omega^* / (\phi \sigma^*), \quad \lambda_2 = 4 Pr \lambda_1. \tag{1.3a,b}$$

Additionally, the boundary conditions need to be replaced in order to be consistent with the time convention used. This implies that (4.31)–(4.33) should be reformulated as follows:

$$y = 0: \quad u = w = \theta = 0, \quad v = A_y p, \tag{1.4a,b}$$

$$A_y = -\frac{\phi}{Z_0} \tanh(\Lambda h), \tag{1.5}$$

$$Z_0 = \frac{\sqrt{\widetilde{\rho}/\widetilde{C}}}{M_e \sqrt{T_w}}, \quad \Lambda = -\frac{\mathrm{i}\omega M_e}{\sqrt{T_w}} \sqrt{\widetilde{\rho}\,\widetilde{C}}. \tag{1.6a,b}$$

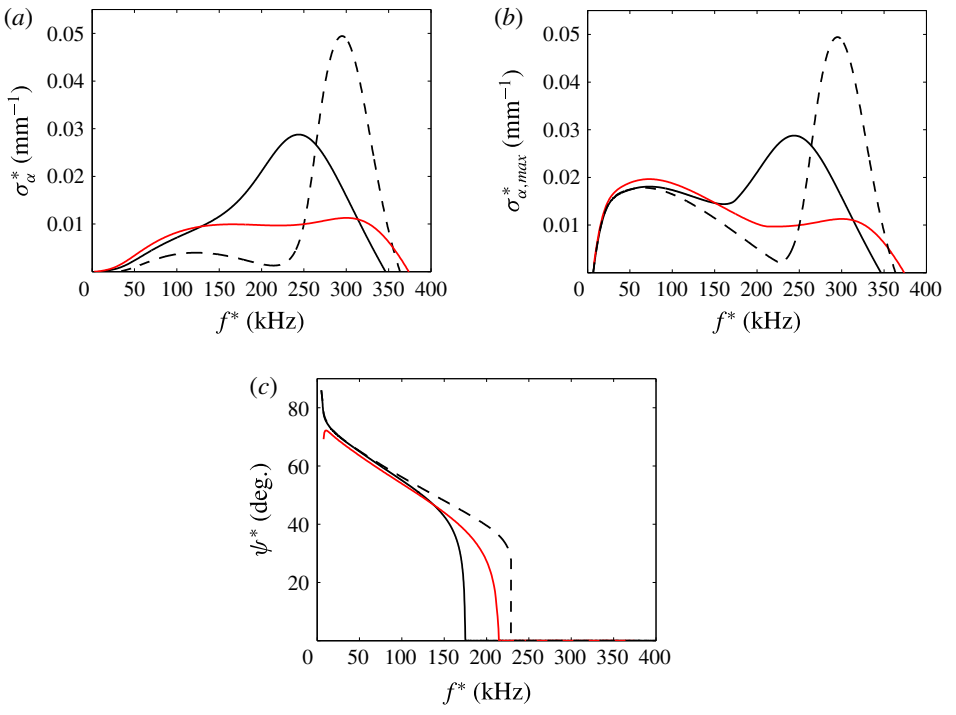

FIGURE 1. (Colour online) (*a*) Growth rate of two-dimensional disturbances versus frequency at $x^* = 200.1$ mm ($R = 1761.2$); locally parallel approximation. (*b*) Maximum growth rate of three-dimensional disturbances versus frequency at $x^* = 200.1$ mm ($R = 1761.2$); locally parallel approximation. (*c*) The wave angle $\psi^* = \arctan(\beta/\alpha_r)$ of the most unstable three-dimensional waves versus frequency at $x^* = 200.1$ mm ($R = 1761.2$); locally parallel approximation. Dashed lines: solid wall; solid black lines: porous wall with the corrected boundary condition; solid red lines: erroneous porous-wall result as presented in Fedorov *et al.* (2003). Correction of figure 13 of Fedorov *et al.* (2003) as presented in Tritarelli, Lele & Fedorov (2015) in combination with the original erroneous results.

The corrected version of the figures of Fedorov *et al.* (2003), which is presented in Tritarelli *et al.* (2015), is partially reprinted in figures 1–3 in combination with the original erroneous results in order to show the impact of the corrected boundary conditions. Figures 1–3 present the corrected versions of figures 13, 14 and 17 of the original paper. For the correction of figures 15 and 16 we refer to Tritarelli *et al.* (2015). The physical interpretations of the new results regarding the effect of felt-metal coatings on hypersonic boundary layers are discussed in Tritarelli *et al.* (2015). In addition to the erroneous complex representation of the porous-coating model, several typographical errors existed in the original work, which are partially corrected in appendix A.

Appendix A. Typographical errors in Fedorov *et al.* (2003)

In this appendix several typographical errors in Fedorov *et al.* (2003) are corrected. The typographical errors listed in this appendix do not represent the totality of typographical errors present in Fedorov *et al.* (2003).

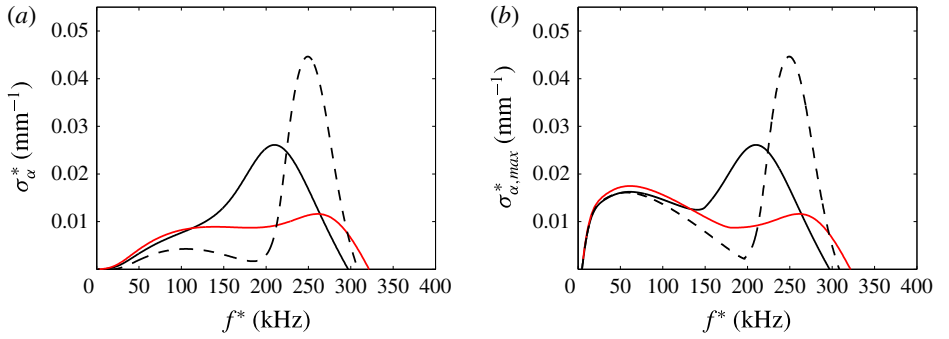

FIGURE 2. (Colour online) (*a*) Growth rate of two-dimensional disturbances versus frequency at $x^* = 283.2$ mm ($R = 2095$); locally parallel approximation. (*b*) Maximum growth rate of three-dimensional disturbances versus frequency at $x^* = 283.2$ mm ($R = 2095$); locally parallel approximation. Dashed lines: solid wall; solid black lines: porous wall with the corrected boundary condition; solid red lines: erroneous porous-wall result as presented in Fedorov *et al.* (2003). Correction of figure 14 of Fedorov *et al.* (2003) as presented in Tritarelli *et al.* (2015) in combination with the original erroneous results.

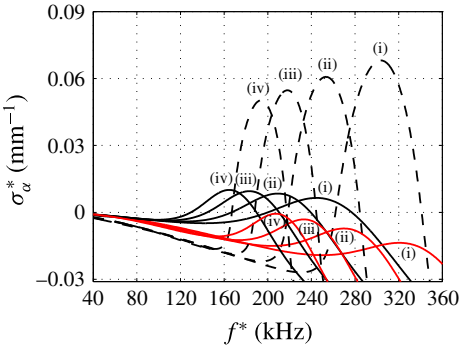

FIGURE 3. (Colour online) Growth rate of two-dimensional disturbances as a function of frequency f^* at various x^*, $T^*_w = 2T^*_e$, $Re^*_{1e} = 10^7$ m^{-1}; locally parallel approximation; (i) $x^* = 206.35$ mm, (ii) $x^* = 298.72$ mm, (iii) $x^* = 406.05$ mm, (iv) $x^* = 515.79$ mm. Dashed lines: solid wall; solid black lines: porous wall with the corrected boundary condition; solid red lines: erroneous porous-wall result as presented in Fedorov *et al.* (2003). Correction of figure 17 of Fedorov *et al.* (2003) as presented in Tritarelli *et al.* (2015) in combination with the original erroneous results.

The statement on p. 103 that the cone was rolled around its X-axis was erroneous. The cone was rolled around its axis of symmetry in order to measure transverse distributions.

The position of the leading edge of the porous surface given on p. 104 was erroneous and should be replaced by $x^* = 187$ mm.

The definition of the non-dimensional Sutherland constant S on p. 109 was erroneous and should be replaced by $S = 110.4/T^*_e$.

Furthermore, equations (4.19) and (4.20) of Fedorov *et al.* (2003) are erroneous and F_{0j} should be replaced by F_{1j}, with $j \in \{1, 3, 4, 5, 7\}$, in those equations.

In line 11 of p. 113 the definition of the frequency parameter should read $F = \omega^* \nu_e^* / U_e^{*2} = \omega^* l^* / (U_e^* R) = 1.2385 \times 10^{-4}$.

In addition, a typographical error was observed in the definition of Λ in equation (4.33) of Fedorov *et al.* (2003), which reads

$$\Lambda = \frac{\mathrm{i}\omega M_e}{\sqrt{T_w}} \sqrt{\widetilde{\rho}/\widetilde{C}}, \tag{A 1}$$

but does not correspond to the actual value used for numerical computations, i.e.

$$\Lambda = \frac{\mathrm{i}\omega M_e}{\sqrt{T_w}} \sqrt{\widetilde{\rho}\,\widetilde{C}}. \tag{A 2}$$

Likewise, the expression for r_p^* in equation (4.39) of the original paper was erroneous and should be replaced by

$$r_p^* = 2b^*/(1 + \pi d^*/4b^*). \tag{A 3}$$

In line 17 of p. 117 the units of the felt-metal resistivity need to be corrected and should read $\sigma^* = (1.66 \pm 0.21) \times 10^5$ kg m^{-3} s^{-1}.

In addition to the fact that the results for the porous-wall case in figures 15 and 16 were erroneous, the labels of these two figures were inaccurate. The corrected figures with the correct labels are presented in Tritarelli *et al.* (2015).

REFERENCES

FEDOROV, A., SHIPLYUK, A., MASLOV, A., BUROV, E. & MALMUTH, N. 2003 Stabilization of a hypersonic boundary layer using an ultrasonically absorptive coating. *J. Fluid Mech.* **479**, 99–124.

TRITARELLI, R. C., LELE, S. K. & FEDOROV, A. 2015 Stabilization of a hypersonic boundary layer using a felt-metal porous coating. *J. Fluid Mech.* **769**, 729–739.