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Erratum

Higher Mean-Flow Approximation for a Solid Rocket Motor with Radially Regressing Walls

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IN A recent study leading to an exact solution of the Navier–Stokes equations [1], a mistake in calculating a simple constant propagates into several equations. The error first appears in Eq. (29) of the subject paper, where the coefficient of the third derivative at order ε must be a "4" instead of a "3." To confirm this correction, we consider the case for which the porous walls are not regressing (i.e., $\alpha = 0$); in this context, we recognize the importance of recovering the model equation obtained by Yuan and Finkelstein [2], which is further confirmed by Terrill and Thomas [3]. This will be the case only when the proper constant 4 is used. In what follows, each equation affected by this oversight is listed in its amended form. Note that graphical results in [1] remain accurate representations of the solution because of the small discrepancy that this change brings to bear on the model.

$$\varepsilon\left[2\eta\frac{\mathrm{d}^4F}{\mathrm{d}\eta^4}+(2\alpha\eta+4)\frac{\mathrm{d}^3F}{\mathrm{d}\eta^3}+4\alpha\frac{\mathrm{d}^2F}{\mathrm{d}\eta^2}\right]+F\frac{\mathrm{d}^3F}{\mathrm{d}\eta^3}-\frac{\mathrm{d}F}{\mathrm{d}\eta}\frac{\mathrm{d}^2F}{\mathrm{d}\eta^2}=0 \tag{29}$$

$$\sin\theta\frac{\mathrm{d}^3F_1}{\mathrm{d}\theta^3}-\cos\theta\frac{\mathrm{d}^2F_1}{\mathrm{d}\theta^2}+\sin\theta\frac{\mathrm{d}F_1}{\mathrm{d}\theta}-\cos\theta\,F_1 = \left(\frac{2}{\pi}\alpha\theta+4\right)\cos\theta+\frac{4}{\pi}\alpha\sin\theta-2\theta\sin\theta \tag{32}$$

$$-K_0'\sin^2\theta-K_1'(2\sin^2\theta+\theta\cos\theta\sin\theta)-K_2'\cos\theta\sin\theta = [(2\alpha/\pi)\theta+4]\cos\theta+(4\alpha/\pi)\sin\theta-2\theta\sin\theta \tag{39}$$

$$K_0=(\alpha/\pi)[-\theta\csc\theta+3\ln\tan\tfrac{1}{2}\theta+(\cos\theta-\theta\sin\theta)] -2\csc\theta-\sin\theta-\theta\cos\theta-S(\theta)+C_0 \tag{40}$$

$$K_1=(\alpha/\pi)(\theta\csc\theta-3\ln\tan\tfrac{1}{2}\theta)+2\csc\theta+S(\theta)+C_1 \tag{41}$$

$$K_2=(\alpha/\pi)[3S(\theta)-\theta\cos\theta-\sin\theta-\theta^2\csc\theta] -\cos\theta+\theta\sin\theta-2\theta\csc\theta-S_1(\theta)+C_2 \tag{42}$$

$$F=\sin\theta+\varepsilon\{(\alpha/\pi)[3(\sin\theta-\theta\cos\theta)\ln(\tan\tfrac{1}{2}\theta)-2\theta] -3+(\theta\cos\theta-\sin\theta)S(\theta)+[3(\alpha/\pi)S(\theta)-S_1(\theta)]\cos\theta +C_0\sin\theta+C_1\theta\cos\theta+C_2\cos\theta\} \tag{45}$$

$$C_1=-6/\pi+2\alpha/\pi^2-1-S(\tfrac{1}{2}\pi)(6\alpha/\pi^2+1)+(2/\pi)S_1(\tfrac{1}{2}\pi) \tag{46}$$

$$C_0=\alpha+3+S(\tfrac{1}{2}\pi),\qquad C_2=3 \tag{47}$$

$$P_\eta=-[\varepsilon F_\eta+\alpha\varepsilon F+\eta^{-1}(F/2)^2]_\eta \tag{50}$$

$$\Delta p_z\equiv p(\eta,z)-p(\eta,0) =\tfrac{1}{2}z^2\{\varepsilon[2\eta F_{\eta\eta\eta}+2(1+\alpha\eta)F_{\eta\eta}+2\alpha F_\eta]+FF_{\eta\eta}-(F_\eta)^2\} \tag{52}$$

References

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