This scattering kernel for argon reflected from a silver surface is now used to calculate the effect of incident angle and velocity on reflected density as given in Eq. (1). Figure 1a gives the theoretical results for the experimental conditions of Calia and Oman[3] mentioned above where θ and ϕ are in-plane and out-of-plane reflection angles as illustrated in Fig. 1 of Ref. 1. Figure 1b illustrates the effect of incident angle. The ratio of maximum density in the plane of incidence and that 30° out-of-plane is approximately 29 and 8.2 for incident angles of $-50°$ and $-20°$, respectively. Figures 1c and 1d show the effect of incident energy. The ratio of maximum density in plane to that 30° out of plane for incident energies of 2.14 ev, 0.21 ev and 0.02 ev are 29, 1.78 and 1.31, respectively. The relative amount of out-of-plane scattering varies by over a factor of 20 with only an order-of-magnitude change in incident velocity, and a factor of over 3 with a change in incident angle of 30° for fixed incident speed. These results certainly disprove Oman's statement that "In Kinslow's model there can be no variation in relative amount of out-of-plane scattering with energy or incident angle,..."

Notice also that the reflected density lobe is subspecular for the lower incident energy, becomes specular and then supraspecular as incident energy is increased. Also it should be noted that at low incident energy the reflected distribution is broad and diffuse, while at higher energies it is narrow and more specular in nature.

All of the aforementioned characteristics of the proposed scattering kernal are in agreement with the experimental observations. This example refutes the statement of Oman that "Kinslow's model would appear to require that there be no significant memory of the incident energy,..." The product scattering kernel as developed in Ref. 1 is certainly not the ultimate kernel. However, based upon comparison with experimental results from the thermal through structural scattering regime, it appears to be the best analytical model so far developed. Without question the model proposed by Oman in Eq. (1) of his comment is more general and includes the present model. However, there are doubts as to whether or not it could be developed into a useful model.

To ascertain whether or not the assumption of a product of individual kernels is justified, it is necessary to have experimental determination of the scattering kernel, not just moments such as intensity, density, or velocity as has been previously presented. I know of no results either experimental or from numerical modeling which give the basic scattering kernel. I would agree with Oman in his statement that absolute measurements are needed both in and out of the plane of incidence.

References

[1]Kinslow, M., "A Mathematical Description of Gas-Surface Interactions Based on Reciprocity," *AIAA Journal*, Vol. 14, Oct. 1976, pp. 1358-1361.

[2]Moran, J. P., "Experiments on Scattering of Mono-Energetic Argon Beams of Heated Platinum," Ph.D. dissertation, Feb. 1968, Dept. of Aeronautics and Astronautics, MIT, Cambridge, Mass.

[3]Calia, V.S. and Oman, R.A., "Scattering Cross-Section Measurements for Epithermal AR on Ag (111) Surfaces," *Journal of Chemical Physics*, Vol. 52, 15 June 1970, pp. 6184-6188.

Errata

Prediction of Turbulent Boundary Layers at Low Reynolds Numbers

Richard H. Pletcher
Iowa State University, Ames, Iowa

AIAA J. **14** 696-698 (1976)

IN the second line above Eq. (7) on page 698, $\ell/\delta<0.089$ should be replaced by $\ell/\delta>0.089$.

Received Dec. 20, 1976.
Index category: Boundary Layers and Convective Heat Transfer—Turbulent.

Quasilinearization and Optimal Control Problems with Control Bounds

B.P. Yeo
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[AIAA J., **14**, 963-966 (1976)]

EQUATION (2) should be replaced by

$$u_{\min} \leq u \leq u_{\max} \tag{2}$$

The original version of Eq. (2) resulted from a clerical error.

Received Dec. 17, 1976.
Index category: Navigation, Control, and Guidance Theory.

Quasi-Steady Gas Phase Assumption for a Burning Droplet

Josette Bellan and Martin Summerfield
Princeton University, Princeton, N. J.

[AIAA J., **14**, 973-975 (1976)]

THE definition of τ_g should be

$$\tau_g = \frac{D_g}{(u_g)^2_{\mathrm{ref}}}$$

and the convection term in Eq. (1) should read

$$\frac{u_g}{R\beta}\frac{\partial\theta_g}{\partial y}$$

Equation (2) should read

$$\frac{u_g}{R\beta} >> 1$$

and Eq. (4) should read

$$\tau_p >> \tau_d(p/334)$$

The relationship after Eq. (5) should read

$$\frac{D_g}{[R(t=0)]^2} = \frac{1}{2\tau_d[\ell n(1+B)](\rho_g/\rho_d)}$$

Equation (6) should read $\tau_p >> (\tau_d/3) \times 10^{-3}$.
Equation (7) should read $\tau_p >> (\tau_d p/3) \times 10^{-3}$.

Received Nov. 3, 1976.
Index category: Combustion in Heterogeneous Media.

Equation (11) should read

$$\frac{p(0)}{T(0)\rho_g C_{pg}} << \frac{u_g}{R\beta}$$

The relationship after Eq. (11) should read

$$\frac{p(0)}{T(0)\rho_g C_{pg}} = \ldots$$

Equation (15) should read $\tau_p >> \tau_d \times 10^{-3}$.
The lines in Fig. 1 are now: $\tau_p = 10^{-6}/p$, $\tau_p = 3\times 10^{-3} p$ and $\tau_p = 9\times 10^{-3}$.
Thus, the quasi-steady domain is defined as follows:

for $p \leq 1.1\times 10^{-4}$, $\tau_p >> 10^{-6}/p$

for $1.1\times 10^{-4} \leq p \leq 3$, $\tau_p >> 9\times 10^{-3}$

for $p \geq 3$, $\tau_p >> 3\times 10^{-3} p$

Technique for Determining Local Heat-Transfer Coefficients

H. J. Sternfeld and J. Reinkenhof
DFVLR, Lampoldshausen, Germany

[AIAA J. **15**, 105-109 (1977)]

EQUATION (11) should read

$$\alpha = -\sum_{(i)}\sum_{(j)} (a_{ij} i x_0^{i-1} t^j) \cdot \frac{\sum_{(\mu)} [b_\mu (\sum_{(i)}\sum_{(j)} a_{ij} x_0^i t^j)^\mu]}{\sum_{(k)} a_k t^k - \sum_{(i)}\sum_{(j)} a_{ij} x_0^i t^j} \tag{11}$$

Equation (12) should read

$$A_0 \alpha (T_\delta - T_w) - A_0 \left(\frac{x_1}{x_0}\right)^\epsilon \left[-\lambda \frac{\partial T}{\partial x}\right]_{x=x_1} = \frac{\mathrm{d}}{\mathrm{d}t}\int_{x_0}^{x_1} A_0 \left(\frac{x}{x_0}\right)^\epsilon \rho c T \,\mathrm{d}x \tag{12}$$

Received March 8, 1977.
Index categories: Heat Conduction; Nozzle and Channel Flow; Liquid Rocket Engines.

Equation (13) should read

$$\alpha(t) = \frac{A-B}{C}$$

$$\min\{t_n\} \leq t \leq \max\{t_n\} \tag{13}$$

Equation (14) should read

$$A = \frac{\mathrm{d}}{\mathrm{d}t}\int_{x_0}^{x_1} \rho c T x^\epsilon \mathrm{d}x \tag{14}$$

Acoustic Thermometric Measurements of Propellant Gas Temperature in Guns

E.M. Schmidt, E.J. Gion, and D.D. Shear
U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, Md.

[AIAA J, **15**, 222-226 (1977)]

IN the footnote on page 222, the correct paper number for the paper presented at the AIAA/SAE 12th Propulsion Conference is AIAA Paper 76-643.

Received Feb. 22, 1977.
Index categories: Combustion in Heterogeneous Media; Nozzle and Channel Flow; Reactive Flows.

Structure of Turbulent Shear Flows: A New Look

A. Roshko
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[AIAA J., **14**, 1349-1357(1976)]

ON p. 1355, second column, line 8, reference 31 should be changed to reference 34; on line 49, reference 37 should be 36; and on line 63, reference 38 should be 37. On p. 1356, first column, line 4, references 39, 41 should be 39, 40, and 41; on line 36, legth should be length. On p. 1353, second column, line 9, it should read $y/x = -0.095$. On p. 1354, first column, line 4, 1-M should read *UM*. On Fig. 2, second line, $L_1 L/\mu_1$ should read $U_1 L/\mu_1$.

Received Jan. 12, 1977.
Index categories: Jets, Wakes, and Viscid-Inviscid Flow Interactions; Boundary Layers and Convective Heat Transfer—Turbulent.