JOURNAL OF COMPUTATIONAL PHYSICS 91, 246 (1990)

Corrigendum

Volume **83**, Number 1 (1989), in the article "Asymptotic Solutions of Numerical Transport Problems in Optically Thick, Diffusive Regimes II," by Edward W. Larsen and J. E. Morel, pp. 212–236:

Equations (4.16b) and (4.16c) on p. 226 should read

$$\frac{1}{2}\Phi_{1/2} = \sum_{\mu_n > 0}\left[(1-\alpha_1)\frac{1}{\gamma}\mu_n + (1+\alpha_1)\frac{3}{2}\mu_n^2\right] f_n w_n, \tag{4.16b}$$

$$\frac{1}{2}\Phi_{J+1/2} = \sum_{\mu_n < 0}\left[(1-\alpha_J)\frac{1}{\gamma}\mu_n + (1+\alpha_J)\frac{3}{2}\mu_n^2\right] g_n w_n, \tag{4.16c}$$

where

$$\alpha_j = \frac{3(1-\theta)\,\sigma_{Tj} h_j \sigma_{Aj} h_j}{4 - 3(1-\theta)\,\sigma_{Tj} h_j \sigma_{Aj} h_j}, \qquad j = 1, J. \tag{4.16d}$$

This alters some of the conclusions of the paper. In particular, for $\theta = 1$, two desirable things happen: the asymptotic diffusion equation (4.16a) reduces to a robust equation with a one-point removal term, and the above boundary conditions reduce to the Eqs. (4.16b) and (4.16c) in the original paper, which are extremely accurate. For the conventional value $\theta = \frac{1}{3}$, two undesirable things happen: the asymptotic diffusion equation (4.16a) has a three-point removal term that can cause unphysical oscillations for $\sigma_{Tj} h_j \sigma_{Aj} h_j$ sufficiently large, and the above boundary conditions become inaccurate. In fact, as $\sigma_{Tj} h_j \sigma_{Aj} h_j$ increases to the value 2.0, $\alpha_j \to \infty$, so the asymptotic boundary conditions cease to exist, and the asymptotic diffusion equation (4.16a) collapses from a three-point to a completely unphysical one-point differencing scheme. Our theory therefore strongly suggests that for optically thick cells, $\theta = 1$ is very accurate and $\theta = \frac{1}{3}$ should be avoided unless one is certain that $\sigma_{Tj} h_j \sigma_{Aj} h_j \ll 2$. All the numerical calculations presented in the original paper were generated with $\theta = \frac{1}{3}$, but none exhibit the unphysical errors because we used $\sigma_{Tj} h_j \sigma_{Aj} h_j \ll 2$ in the optically thick regions. (For $\sigma_{Tj} h_j \sigma_{Aj} h_j \geqslant 2$, each cell is greater than two diffusion lengths in thickness, so the exact diffusion solution can vary by over an order of magnitude across each cell width. Under these conditions, the numerical diffusion solution is not properly resolved, and one cannot expect a differencing scheme to perform well. For this reason, the calculations in the original paper were performed with $\sigma_{Tj} h_j \sigma_{Aj} h_j \ll 2$.) We have run problems using $\theta = \frac{1}{3}$ and suitably large values of $\sigma_{Tj} h_j \sigma_{Aj} h_j$, and we do observe the unphysical behavior predicted by our theory.

We are grateful to M. L. Adams of the Lawrence Livermore National Laboratory for pointing out the error.

0021-9991/90 $3.00