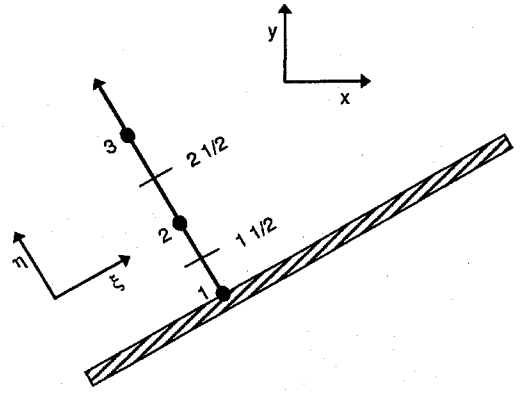

Fig. 2 Generalized curvilinear coordinate system.

solve for the Cartesian velocity components, it is the Cartesian stress tensor components, τ^{xx}, τ^{xy}, ..., that are required in the governing equations. Therefore a transformation of the stress tensor from the ξ–η coordinates to Cartesian coordinates is needed. Sondak and Pletcher proposed a very elaborate procedure for performing this formidable task. In contrast, if one defines the effective viscosity at point $1\frac{1}{2}$ according to

$$\mu_{\text{eff}} \equiv \mu_w \left(\eta_2^+ - \eta_1^+\right) \Big/ \hat{u}_2^+ \tag{8}$$

such that

$$\tau_w = \mu_{\text{eff}} \frac{\hat{u}_2 - \hat{u}_1}{\eta_2 - \eta_1} \tag{9}$$

the Cartesian stress tensor can then be obtained in a straightforward manner from

$$\tau^{ij}_{1\frac{1}{2}} = \mu_{\text{eff}} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_i}{\partial x_j} - \frac{2}{3}\delta_{ij} \frac{\partial u_k}{\partial x_k} \right) \tag{10}$$

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Reply by the Authors to P. G. Huang

Douglas L. Sondak*
United Technologies Research Center, East Hartford, Connecticut 06108
and
Richard H. Pletcher†
Iowa State University, Ames, Iowa 50011

THE authors would like to thank P. G. Huang for his comments on our article. He had stated that the method of Huang and Coakley (HC) is identical to that described in the article but is easier to implement. For cases in which the grid is orthogonal to the wall, the methods are indeed the same. When modeling complex geometries, however, it is often difficult to maintain grid orthogonality at solid surfaces. The method of Sondak and Pletcher (SP) was developed to handle skewed grids, eliminating one source of error.

In their current forms, neither method accounts for the buffer region. The SP method could be extended to include the buffer region, given a suitable means of deducing the shear stress in that region. Once the shear stress is known, no special treatment would be required. The HC method would require special logic for the buffer region, since both turbulent and molecular viscosities are important.

The authors believe that the simplest solution is the most appropriate solution for a given problem, and for many cases, this would lead toward the HC method. Further testing is required to evaluate differences between the two methods for cases with complex geometries, particularly when a nonorthogonal grid is employed at solid boundaries.

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*Research Engineer.

†Professor, Department of Mechanical Engineering and Computational Fluid Dynamics Center.