Abstract

In fluid dynamics, flow behavior is analyzed using experimental, analytical or numerical methods. Though experiments give physically realistic results, they are expensive in terms of time and cost, and are less flexible. On the other hand, analytical solutions of most flows occurring in practical applications are either unavailable or computationally inefficient. Numerical methods are therefore largely used in obtaining solutions of most fluid flows. A major challenge in numerical methods is the discretization error. Due to the discretization error, numerical solutions of fluid flow problems are approximate solutions. The magnitude of this error varies from one numerical method to another. Even within the same numerical method, the magnitude of the discretization error is dependent upon the interpolation scheme used. An interpolation scheme that minimizes this error would give results that are closest to experimental results. In this study, the finite volume discretization method has been coupled with three linear interpolation schemes namely the Hybrid scheme, the Upwind Differencing Scheme and Central Difference Scheme in obtaining the flow field for a convection-diffusion turbulent flow in a cavity. The dependent variables present in the differential equations have been decomposed into mean and fluctuating components and averaged, so as to minimize the enormous scales which characterize a turbulent flow regime. The closure problem is solved using SST-k-w turbulence model since it well mimics flow behavior in the entire cavity. The discrete equations were solved using a segregated algorithm which is pressure-based. The numerical results have been compared using experimental results. (Ampofo & Karayiannis, 2003). Results revealed that the Central Difference Interpolation Scheme generated temperature profiles that well matched the experimental results and was therefore the recommended linear interpolation scheme for use with the Finite Volume Method in analyzing temperature fields in confined environments. The results further revealed that linear interpolation schemes are not adequate in analyzing velocity fields for confined convection-diffusion turbulent flows since they generated results that were not consistent with experimental results. The results provide a scientific basis of formulating appropriate solution algorithm for analyzing profiles of specified field variables in a flow regime