

Viscous flow over a sphere with fluctuations in the free-stream velocity

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Abstract: The problem of viscous flow over a sphere with fluctuations in the free-stream velocity is considered. The governing conservation equations are expressed terms of the stream function and vorticity and solved using the series truncation method where the stream function and vorticity are approximated using finite series of Legendre and first associated Legendre functions. The effects of the Reynolds number, Strouhal number, and the amplitude of the fluctuations on the flow characteristics are studied. Results are presented for periodic variation of the drag coefficient, surface vorticity and pressure distributions for Reynolds numbers ranging from 5 to 100, Strouhal numbers ranging from $\pi/4$ to π , and amplitude of fluctuations from 0.0 to 0.5. The time variation of the velocity field during one complete cycle is presented in the form of streamline and equi-vorticity patterns. The periodic variation of the angle of separation as well as the length of the separation region are also presented.