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Session P15: General Fluid Dynamics

4:05 PM–6:41 PM, Monday, November 22, 2021

Room: North 129 A

Chair: Hunter King, University of Akron

Abstract: P15.00002 : A Numerical Investigation Of Rolling and Sliding Motion of Spheres in Confinement

4:18 PM–4:31 PM

← Abstract →

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The motion of spheres in fluids is one of the fundamental problems in fluid mechanics. At low Reynolds numbers, the problem is simplified significantly and it is possible to obtain both analytical and numerical solutions in unbounded fluids. Sphere motion in confined environments, however, is a much more elaborate problem as additional boundary conditions are introduced to the system. This problem is particularly interesting because spheres in confined environments are observed to be rolling along the direction of motion or sliding against the direction of motion. The mechanisms for rolling or sliding phenomena have been studied in the literature with several different numerical models but they either lack a direct correlation with the resistive coefficients of motion or the coefficients are not reported completely or accurately. Here we report a more accurate set of resistive coefficients by utilizing a finite element model for spheres rotating inside a cylindrical channel, particularly for near-wall swimming conditions which are critical for the transition from rolling to sliding. The coefficients are utilized in explaining the sliding phenomenon, which is known to occur due to the pressure build-up between the fore and aft of the sphere.