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Manipulating the Forces on a Sphere Using a Dynamic Roughness Element[1] A.K. NORMAN, B.J. MCKEON, California Institute of Technology — Though the effect of distributed roughness on flow over a sphere has been examined in detail, there have been few observations as to the effect of an isolated roughness element on the forces induced on a sphere that is in uniform flow. In this experimental study, we examine how the forces are altered due to both a stationary and dynamic three-dimensional roughness element in the Reynolds number range of 5×10^4 to 5×10^5. It is found that even a small change to the geometry of the sphere, by adding a cylindrical roughness element with a width and height of 1% the sphere diameter, dramatically alters the drag and lateral forces over a wide range of Reynolds numbers. Of particular interest is that the mean of the lateral force magnitude can be increased by a factor of about seven, compared with a stationary roughness element, by moving the isolated roughness at a constant angular velocity about the sphere. The interaction of the roughness element with the flow is examined to understand the cause of the large forces.

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