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Numerical simulations of time-dependent, fully 3-D viscoelastic flows past bluff bodies DAVID RICHTER, ERIC SHAQFEH, GIANLUCA IACCARINO, Stanford University — With the goal of creating a robust numerical method for simulating three dimensional, time dependent non-Newtonian flows, we have developed an unstructured, finite-volume code to compute a wide variety of viscoelastic flows over a large range of Reynolds (Re) and Weissenberg (Wi) numbers. Our method is based on the FENE-P constitutive model to describe the flow of dilute polymeric solutions, and an implicit time-stepping technique is utilized that properly maintains boundedness of the polymer stresses and extensions even at high flow strengths. We will present the time-dependent, viscoelastic flow past a circular cylinder at moderate Re ($Re \sim O(100)$). Within this range, regular vortex shedding occurs, and the characteristic frequency of this shedding was found to decrease with increasing fluid elasticity. Furthermore, the coefficients of both friction drag and form drag are reduced with increasing Wi, and new qualitative effects have been observed at large polymer lengths where the cylinder drag rises dramatically due to a rapid increase in form drag. Physical mechanisms for this behavior will be proposed and discussed.

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