Abstract Submitted
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New algorithms for the direct numerical simulation of turbulent flows past compliant bodies ANISH KARANDIKAR, THOMAS BEWLEY, MAE, UCSD — This work develops an efficient and accurate new method for the DNS of laminar and turbulent flow past a circular cylinder with a deformable (compliant) surface. We study the interaction of the incompressible flow with the compliant cylinder. From the outset, this is defined as an optimization problem, in which we seek to minimize aeroacoustic noise generated by dipole sound sources on the compliant surface at low Mach numbers. We build on a unique method developed in our lab for simulating turbulent flow in a channel with compliant walls. This method is accurate and efficient for large surface deformations. We adapt this method for the cylindrical polar coordinate system to study flow past a compliant cylinder. In this method, a time-dependent coordinate transformation is used to map the deformed flow domain to a regular computational domain. The governing Navier Stokes equations are formulated in the cylindrical polar form and not the contravariant form, as the latter is computationally expensive to simulate. The compliant surface is modeled by a simple spring-mass-damper system. As surface compliance is increased, a decrease in the peak lift coefficient for the compliant cylinder is observed both in the laminar 2D case at $Re = 80$, as well as the turbulent 3D case at $Re = 300$. On the other hand, the frequency of vortex shedding and the time-average drag both increase with surface compliance.

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