Mougin, G.; **Magnaudet, J.**

The generalized Kirchhoff equations and their application to the interaction between a rigid body and an arbitrary time-dependent viscous flow. (English) Zbl 1137.76687

Int. J. Multiphase Flow 28, No. 11, 1837-1851 (2002).

Summary: Recent numerical and analytical studies have demonstrated that added-mass effects acting on bluff bodies moving in viscous, time-dependent flows are independent of the Reynolds number, acceleration strength and steady/unsteady nature of the flow field. We discuss the origin of this crucial result and show how it can be used to derive the equations governing the motion of a non-deformable body moving freely in an arbitrary time-dependent, viscous flow. Then we show how these equations can be employed in conjunction with the Navier-Stokes equations to solve numerically the coupled problem in which the presence of the body modifies the surrounding flow which itself determines the trajectory of the body. Numerical tests of this coupling are presented. We finally apply the coupled set of equations to analyze the path instability of ellipsoidal bubbles rising at high Reynolds number. We show that numerical results recover the main experimental trends, an agreement suggesting that path instability is primarily driven by the instability of the wake which is itself crucially dependent on the curvature of the bubble surface.

MSC:

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