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General Solutions of Unsteady Stokes Equations D. PALANIAPPAN, Texas A&M University at Qatar, P.O. Box 5825, Doha, Qatar — The linearized viscous flow at low-Reynolds numbers is described by a pair of partial differential equations connecting the velocity with the pressure field. Many years ago, Lamb proposed an infinite series representation of the general solution for oscillatory flow in terms of three independent scalar functions. On the other hand, spherical geometry provides the most widely used framework for representing small particles and obstacles embedded within a viscous, incompressible fluid characterizing transient creeping flow. In the interest of producing differential representations similar to Papkovich-Neuber and Boussinesq-Galerkin, a general solution in terms of two scalar functions A and B is proposed here for the unsteady Stokes equations. New formulae connecting the differential representation and other solutions describing unsteady viscous flow are provided. In particular, it is shown that the Lamb's general solution follows from the differential representation by a suitable choice of the scalar functions. The connections to other representations are briefly discussed. Another differential representation suitable for bounded flows constrained by plane wall is also given. This general representation is shown to generate solution forms that are suitable for studying oscillatory motions of disks at low Reynolds numbers. The unified approach presented here further demonstrates an important link between oscillatory flows and flow through porous media using Brinkman models.

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