Hydrodynamic force on closely arrayed plates in squeezing motion near the plane wall

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This paper is dedicated to the late Professor Isao Imai as a token of gratitude and respect

Abstract

Three-dimensional slow viscous flow due to the squeezing motion of multiple plates with arbitrary planform parallel to an infinite plane is investigated, when the distance between the plate and plane is much smaller than the characteristic dimension of the plate. We focus on the case that the gap between plates has the same magnitude of same order or smaller than the distance between the plate and plane. Asymptotic expansions for the viscous forces and torques on the plates are obtained by using the method of matched asymptotic expansions. Two-dimensional slow viscous flow in a region above infinite plane with two semi-infinite plates, which approximately describes flow near the gap between plates, is analyzed.

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Keywords: Stokes flow; Squeezing motion; Hydrodynamic force; Arrayed plates; Method of matched asymptotic expansions; Dual integral equation

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