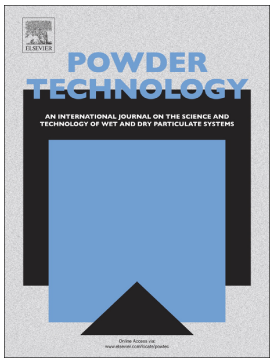

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An immersed lubrication model for the fluid flow in a narrow gap region

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Abstract:

A lubrication model is proposed to correct the solution of the Navier-Stokes equations in a poorly-resolved region between two solid surfaces. In the model, the velocity and pressure fields of fluid in a thin film between two solid surfaces are estimated from the Navier-Stokes equations, and those are modified by incorporating the solution of the Reynolds lubrication equation. This immersed lubrication model also modifies the motion of the solid objects in response to the lubrication pressure distribution. A fluid-film bearing case in 2-D is studied to assess the validity of the proposed lubrication model for the fluid flow in the narrow gap with varying the resolution of the domain, and a head-on collision problem of two spherical particles is investigated to discuss the effectiveness of the lubrication model on the motion of finite-sized particles by modifying the fluid flow in the unresolved area of the inter-particle region. The result shows the proposed lubrication model essentially improves the accuracy of the thin-film flow and the motion of the finite-sized objects via the momentum exchange.

Keywords: Lubrication, Immersed solid method, Direct numerical simulation, Distance