Dynamics of freely moving plates connected by a shallow liquid bridge[1] AMIR GAT, Caltech, HOMAYUN NAVAZ, Kettering University, MORTEZA GHARIB, Caltech — We study the dynamics of freely moving solid bodies connected by a shallow liquid bridge via analytic and experimental methods. The gap between the solid bodies is used as a small parameter within a lubrication approximation, reducing the problem to an Abel equation of the second kind. Analysis of the governing differential equation yields two novel physical phenomena: (1) An impulse-like peak in the force applied by the liquid bridge on the solid bodies, obtained from a uniform asymptotic solution for small Capillary numbers. (2) Both linear and non-linear oscillations of the system for the case of surfaces with low wettability, obtained from small perturbations of the system around the equilibrium point. An experimental setup examining the motion of freely moving solid bodies was constructed, yielding experimental data which compared favorably with the analytic results and specifically displayed the predicted oscillations and impulse-like peak of the applied force. The application of the current analysis to the micro-manipulation of solid bodies and possible future research directions are discussed.

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