Particles almost in contact: the general method of reduced functionals in 2D and 3D

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The analysis of the forces and torques on two moving solid particles suspended in a fluid and almost in contact with each other (or on a particle almost in contact with a wall) traces back at least to Brenner and Cox in the late 1960's by using lubrication theory. It was fully justified in a series of works by Hillairet et al. I will explain the general method of reduced functionals we recently developed for complex geometries and several points of contacts. The construction is easier in 2D since the stream function is a scalar potential. In a general 3D setting, one needs to play with a vector potential. While the stream function is defined up to a constant in 2D, the vector potential in 3D is defined up to a gradient. I will show that by choosing an ad-hoc gauge, one can find the optimal potential by solving the dual formulation of the resulting Euler-Lagrange equation. This allows to compute (and fully justify) the asymptotics of the Stokes resistance matrix. Applications to Stokesian dynamics and global existence for the motion of particles in a Navier-Stokes flow will be discussed.

The talk is based on joint works with Hillairet-Patriarca-Sperone (2D) and Bocchi-Hillairet (3D).