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We apply the blinking rotlet model to the analysis of stirring in a Stokes flow in rectangular containers. Specifically, we construct the rigorous analytical solution for the two-dimensional bi-harmonic equation in a rectangular domain $|x| \leq a$, $|y| \leq b$ with a rotlet placed at point $(0,c)$. The solution shows that for a certain position of the rotlet c_0 which depends on a and b, the flow has a stagnation point $(0,-c_0)$ symmetrically placed inside the rectangle. Thus the blinking rotlet model can be constructed for the rectangle in which the rotlet that is off does not disturb the flow. This model seems preferable to the classical blinking vortex flow when discussing chaotic advection by the Stokes flow. When the velocity field is accurately obtained, the detailed study of stirring any passive blob can be done by the adaptive boundary tracking algorithm. Quantitative measurements of stirring are developed and they provide the estimates for the goodness of mixing according to Danckwerts.

Weak Inertia and Mixing Between Rough Surfaces

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Weak inertial effects in flows between two rough surfaces may lead to significant effects in various situations such as fracture flow or micro-fluidic. Recent experimental results have shown that proper surface patterning could produce vortex which are transverse to the longitudinal mean flow and could be used to produce chaotic stirring. The present study concerns the influence of weak-inertia effects produced by a smooth surface patterning on the flow field and the stream-line geometries. We describe an asymptotic treatment of the Navier–Stokes equation that leads to equations describing the inertial corrections to lubrication equations. These equations are solved with a high order spectral method and the results discussed with examples relevant for mixing describing the inertial influence on the flow field properties.