Hydrodynamics of sedimenting squirmers with rotlet dipole

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The squirmer model is theoretical model introduced to study microorganisms like algae and bacteria. It consists in a spherical particle whose self-propulsion is ensured by a surface velocity field (1).
It is well established in literature that the presence of walls can strongly modify the motion of microorganisms. The bacterium *E. Coli*, indeed, is known to perform clockwise trajectories near a solid boundary (2). On the other hand the gravity force, ubiquitous in nature, represents another factor that can affect the motion of microorganisms (3).
In this work, using the Smoothed Profile Method (4), we combine all of these features studying the dynamics of a sedimenting squirmer under the effect of the gravity force, near a solid boundary taking into account the rotlet dipole term (5).
Computing quantities like the stationary swimming velocity, the stable swimming height, the stationary orientation and curvature radius we are able to characterize the dynamics of the single squirmer.
In case of neutral squirmers and pullers, the gravity causes both of them to sediment to the bottom wall, arresting their motion and reorienting them in a direction perpendicular to the wall. Pushers, instead, exhibit continuous motion with tilted direction.
When the rotlet dipole term is neglected and the "classic" squirmer model is considered, all of types of squirmers swim in straight trajectory. When the rotlet dipole term is introduced, it causes a deviation from the straight path in circular trajectories whose radius of curvature strongly depends by the magnitude of the rotlet dipole term.
After studying the single squirmer, the dynamics of a multitude of squirmers is considered.

References:

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