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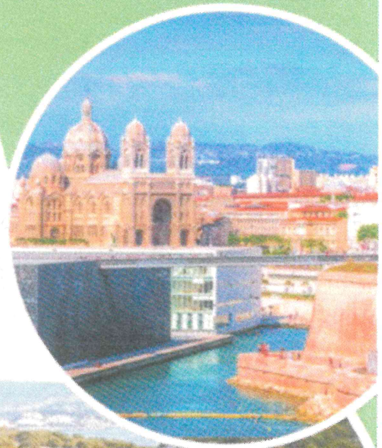

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Periodic Behavior of an Anisotropic Trumbbell Settling Under Gravity

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We will present a study of a V-shaped rigid conglomerate of three spherical particles of the same radii (trumbbell), which settles under gravity in a viscous fluid. The side spheres have equal masses, but the middle sphere has a different mass and touches the other ones. The configuration of the trumbbell is parametrized by the apex angle α (generally, the side spheres do not touch each other).
Previous studies (1) shows that a trumbbell with equal masses orients itself towards a stable stationary configuration. However, recent results regarding natural sediment flocs(2) as well as the settling process of a rigid U-shaped disk (3) under gravity show that an anisotropic mass distribution might lead to quasi-periodic evolution of the system.

In our case, translational **U** and rotational Ω velocities of the rigid conglomerate are linear functions of the total force **F** acting on the conglomerate:
U =$\underline{\mu}$^{tt} · **F**, Ω = $\underline{\mu}$^{rt} · **F**
where **U** is the velocity of the conglomerate center-of-mass, and the mobility tensors $\underline{\mu}$^{tt} and $\underline{\mu}$^{rt} are calculated in the CMS frame of reference in which torque vanishes. For
theta = ϕ = ψ =0, $\underline{\mu}$^{tt} is the diagonal 3×3 matrix and only non-zero components of $\underline{\mu}$^{rt} are μ^{rt}_{yx} = - μ_a as well as μ^{rt}_{xy} = μ_b. The hydrodynamic interactions are essential in this problem, and we find the components of the mobility tensor using precise HYDROMULTIPOLE codes for the multipole expansion (4) with the truncation at L=8.

We find that trumbbells with the anisotropic mass distribution show qualitatively different long-time dynamics than those with equal masses. When μ_a · μ_b < 0, the system shows instability towards the long-time periodic motion.

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