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Migration and Interaction of two Conducting Particles Freely Immersed in a Liquid Metal

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We determine the rigid-body motions of two solid and conducting particles $\mathcal{P}_1$ and $\mathcal{P}_2$ freely suspended in a liquid metal of uniform viscosity μ and conductivity $\sigma_l > 0$ when subject to uniform ambient electric and magnetic fields $\mathbf{E}$ and $\mathbf{B}$. The translational and angular velocities $\mathbf{U}^{(n)}$ and $\mathbf{\Omega}^{(n)}$ of the particle $\mathcal{P}_n$ with uniform conductivity $\sigma_n \geq 0$ are obtained without calculating the disturbed electric field and the liquid metal flow in the unbounded fluid domain. The advocated approach solely resorts to a few boundary-integral equations on the entire surface of the cluster. The work will successively establish the relevant boundary-integral equations and both propose and implement a suitable numerical strategy. Numerical results will be presented and discussed for a few two-sphere clusters of equal or inequal spheres for several settings $(\mathbf{E}, \mathbf{B})$ and $(\sigma_1/\sigma_l, \sigma_2/\sigma_l)$.

View the extended summary