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A fast method to compute triply-periodic Brinkman flows[1]
HOANG-NGAN NGUYEN, KARIN LEIDERMAN, Univ of California, Merced, SARAH OLSON, Worcester Polytechnic Institute — A fast method is developed to efficiently compute three-dimensional Brinkman flows induced by triply-periodic arrays of points forces and regularized forces. For point forces, we decompose the periodic Brinkman velocity into the sum of two series: one in real space and one in Fourier space. To do the splitting, we make use of a regularized solution with special decay properties so that both summands will decay in a Gaussian manner. For regularized forces, the same methodology is used to split the regularized velocity, and again, Gaussian decay of the summands is achieved. When there are N forces (N periodic arrays), the overall complexity is $O(N^2)$. We discuss different ways to reduce the complexity to $O(N^{3/2})$ and to $O(N \log N)$. Finally, we present two sets of numerical results. The first validates the computational complexity of the algorithm and the second illustrates how this method can be used to study microscopic flows of organisms in a porous medium. A simple dumbbell model of swimmers is implemented that exhibits a large scale flow varying as a function of resistance within the porous medium.

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