

# Simulation of Microswimmers using the Fast Multipole Method

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**Abstract:** We use the method of regularized Stokeslets (MRS) to study swimmers at zero Reynolds number where the Stokeslet is the fundamental solution corresponding to the kernel of the single layer potential. Simulating the collective motion of  $N$  micro swimmers using the MRS results in at least  $N^2$  pair-wise interactions. Efficient simulation of a large number of swimmers in free space is observed with the implementation of the kernel-independent fast multipole method (FMM). We illustrate the complexity of the algorithm on a simple test case where we study regularized point forces, showing that the method is  $\mathcal{O}(N)$ . Additionally, we explore accuracy in time for the MRS where the swimmers are modeled as Kirchhoff rods and the kernel-independent FMM is compared to the direct calculation using the standard MRS. We also investigate optimal hydrodynamic efficiency for different configurations of swimmers.

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