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Numerical simulation, prediction and experimental control of the dynamic behavior of a rotating magnetic particle chain YANG GAO, Eindhoven University of Technology, TAE GON KANG, School of Aerospace and Mechanical Engineering, MARTIEN HULSEN, Eindhoven University of Technology, JAAP DEN TOONDER, Eindhoven University of Technology and Royal Philips Electronics — A simple and fast numerical method is developed capable of accurately determining the 3D rotational dynamics of magnetic particle chains in an infinite fluid domain. The focus is to control the alternating breakup and reformation of the bead chains which we believe is essential to achieve effective fluid mixing at small scales. The numerical scheme makes use of both the magnetic and hydrodynamic interactions between the particles. It is shown that the inclusion of hydrodynamic interaction between the particles is crucial to obtain a true description of the particle dynamics. A small error of deviation is observed when benchmarking the numerical scheme against the direct simulation method. The numerical results are compared with experiments showing good agreement both qualitatively and quantitatively. In addition, a dimensionless number is derived as the sole control parameter for the rotational bead chain dynamics.

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