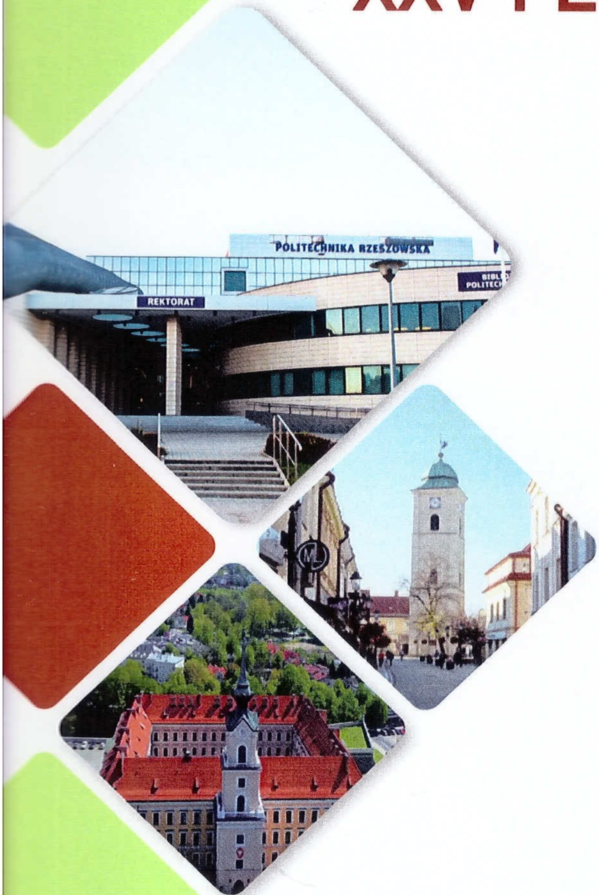
2022 FMC

RZESZOW UNIVERSITY OF TECHNOLOGY

XXV FLUID MECHANICS CONFERENCE

Rzeszów, Poland
7-9 September 2022



BOOK OF ABSTRACTS

Editors: M. Kmiotek, A. Kordos

Short-time dynamics of elastic fibers in a shear flow

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Abstract. Dynamics of elastic fibers in a shear flow of a viscous fluid are investigated numerically and experimentally [1]. Fibers are initially straight at different orientations. We focus on short times of the order of a few Jeffery periods that characterize rotation of the fibers. We show that buckling of a fiber along its whole length appears only for very short times not exceeding half of the Jeffery period, and is limited to a small range of the initial fiber orientations.

Keywords: fluid dynamics, Stokes flows, particulate flows, hydrodynamic interactions, bending

1. Methods

We report the results published in [1]. We use the bead model of an elastic fiber [2] and the multipole expansion of the Stokes equations, with the lubrication correction to speed up the convergence, to account for the hydrodynamic interactions between the beads, implemented in the Hydromultipole numerical codes [3]. We provide a qualitative comparison with the results of video recording of the experiments [1].

2. Results

We analyze bending and dynamics of moderately flexible fibers in a shear flow. We focus on time scales smaller than half of the effective Jeffery period. Fibers are initially straight at different orientations. They are stiff enough to bend and then straighten again in the flow-vorticity plane. We observe a temporal order of almost straight fibers, and explain it by a typical characteristic of the Jeffery orbits. We also observe that fibers bend significantly in a short time. We identify two different mechanisms of bending: buckling [4, 5] and local deformation originating from the fiber ends [6]. The buckling of fibers has been found in both experiments and numerical simulations. In the numerical simulations, we determined the dependence of the buckled shapes on the bending stiffness ratio, i.e. the ratio of the elastic bending forces to the forces exerted by the fluid flow. We also provided the range of the initial orientations and of the bending stiffness ratio for which the buckling appears [1].

Acknowledgments

P.S. and M.E.J. were supported in part by the National Science Centre under grant UMO-2018/31/B/ST8/03640. N.X., J.K.N. and H.A.S. acknowledge support from NSF grant CMMI-1661672. The authors acknowledge the use of Princetons Imaging and Analysis Center, which is partially supported through the Princeton Center for Complex Materials (PCCM), a National Science Foundation (NSF)-MRSEC program (DMR-2011750). We benefited from the ITHACA project PPI/APM/2018/1/00045 financed by the Polish National Agency for Academic Exchange.

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