Scientific Program

EFMC12

Vienna, September 9–13, 2018

TU WIEN IST EUROPEAN MECHANICS SOCIETY

The 12th European Fluid Mechanics Conference

Session 7

Wednesday, September 12, 14:30–16:30

	Instability 6 **Audimax** Chair: *P. Luchini*	**Interfacial flows 3** **Practicum Hall** Chair: *H. Steinrück*	**Biological flows 5** **Vortmann Hall** Chair: *T. Kowalewski*	**Drops and bubbles 7** **Informatics Hall** Chair: *P. Peñas*
14:30	WITHDRAWN	A shear stress driven rotary wave in a cylindrical container: stability of higher order modes and experimental results *H. Steinrück, A. Maly*	Experimental and Numerical Investigation of Dean and Lyne-type Vortices under Physiological Inflow Conditions *C. Cox, M.R. Najjari, M.W. Plesniak, M. Leftwich*	Autocatalytic bubble-laden thermals in supersaturated liquids *P. Peñas, O. Enríquez, J. Rodríguez-Rodríguez*
14:45	A novel technique for triggering bypass transition in internal flows based on the receptivity to forcing. *F. Picella, M.A. Bucci, J.-C. Robinet, S. Cherubini*	Investigation on the turbulence in the vicinity of the interface in liquid-liquid flow using LES and PIV experiment *M. Saeedipour, S. Puttinger, S. Pirker*	Phototactic swimming of multicellular microalgae *H. De Maleprade, F. Moisy, R.E. Goldstein*	Visualisation and Quantification of Transient Cavitating Flows using X-ray Phase Contrast Imaging and LES *I. Karathanassis, P. Koukouvinis, H. Naseri, Y. Gao, J. Wang, M. Gavaises*
15:00	Control of unsteady Görtler vortices by steady ones *V. Borodulin, A. Ivanov, Y. Kachanov, D. Mischenko*	Damping of sloshing waves by confinement or surface dissipation *F. Viola, F. Gallaire, B. Dollet*	Three-dimensional fluid-structure interaction simulation of human pulmonary cilia with the periciliary liquid layer *S. M. Vanaki, D. Holmes, P.G. Jayathilake, S. Saha, Z. Ristovski, R. Brown*	Optical manipulation of micron-sized droplets for studies of collisional dynamics under gravity *K. Chang, M. Ivanov, G. Magnusson, C.-J. Karlsson, B. Mehlig, D. Hanstorp*
15:15	The flow dynamics in a short Taylor-Couette configuration with asymmetric end-wall boundary conditions: influence of radii ratio *E. Tuliszka-Sznitko, T. Mullin*	Axial sloshing of liquid hydrogen in compensated gravity conditions with non-isothermal boundary conditions *M. Dreyer*	Highly flexible filaments in an oscillatory microchannel flow *S. Pawlowska, F. Pierini, T.A. Kowalewski*	Experimental determination of the deformation retardation time of viscoelastic polymer solutions *G. Plohl, G. Brenn*
15:30	Localized structures and solitary states in a vertical Taylor-Couette system with a radial temperature gradient *C. Kang, A. Prigent, I. Mutabazi*	Rotating polygons : Numerical and experimental study of the base flow. *W. Yang, I. Delbende, Y. Fraigneau, L. Martin Witkowski*	Shape transition and migration of 3D vesicles in a confined Poiseuille flow *J. Lyu, P.G. Chen, G. Boedec, M. Jaeger, M. Leonetti*	Dynamic interaction between a coated microbubble and a rigid wall: Trapping vs Divergence *M. Vlachomitrou, N. Pelekasis*
15:45	Secondary instability of rotating plane Couette flow revisited *M. Nagata, D. Wall, T. Noguchi*	Influence of boundary conditions on instabilities in free surface rotating flows *A. Faugaret, L. Martin Witkowski, Y. Duguet, Y. Fraigneau*	Flow structure and mixing processes for a confined cannula flow *J. Lemétayer, L. Fuchs, M. Broman, L. Prahl Wittberg*	Dissolution of a train of bubbles in microchannels *J. Rivero-Rodriguez, B. Scheid*
16:00	Wrinkling instability on microcapsule in elongation flow *K. Xie, C. de Loubens, F. Dubreuil, M. Jaeger, M. Leonetti*		Properties of supraglottal flow structures during voiced speech *L. Schickhofer, M. Mihaescu*	Collective dissolution of microscopic bubbles *S. Michelin, E. Lauga*
16:15	A global stability analysis approach to study turbulent flows around airfoil near stall *D. Busquet, O. Marquet, F. Richez, D. Sipp, M. Juniper*			Production of monodisperse microbubbles avoiding microfluidics *E. S. Quintero, Á. Evangelio, J.M. Gordillo Arias De Saavedra*

Highly flexible filaments in an oscillatory microchannel flow

S. Pawłowska[a], F. Pierini[a], T.A. Kowalewski[a]

Recently, we demonstrated possibility to produce hydrogel in a form of nanofilaments[1], the supreme geometry for conducting targeted material delivery to regenerate aligned tissues or perform DNA transport. Hence, in the following we analyse transport properties of such objects conveyed by oscillating flow simulating typical extracellular environment. Due to the nanometre size of our nanofilaments both hydrodynamic interactions and Brownian fluctuations have to be considered.

The problem has analogy to exhaustive studies of DNA flow dynamics, though the coarse filaments material allows for limiting problem description to purely hydrodynamic interactions, neglecting complex molecular and electrostatic interactions. We report for the first time ever the use of hydrogel nanofilaments as an alternative to model flow dynamics of molecular chains. Fluorescently labelled hydrogel nanofilaments were prepared by co-axial electrospinning of two immiscible polymers. After removal of their shells, hydrogel nanofilaments suspended in water solution were introduced into the PDMS microchannel using a syringe micro-pump.

The microchannel was equipped with two additional pre-chambers used to collect nanofilaments and to introduce the selected one into the observation area. In-house designed squeeze-tube micro-pump was used to produce sinusoidal oscillating flow within the channel. The velocity amplitude varied from 100 μm/s to 900 μm/s, flow oscillations frequency was set around 0.1 Hz. Nanofilaments were imaged using epifluorescence microscope and recorded using a high-gain EM-CCD camera with typical frame rate of 15 Hz. The mechanical properties of our nanofilaments such as persistence length and bending stiffness were evaluated from their Brownian shape deformations. Selected for the experiment nanofilaments were characterized by flexural modulus of 2 kPa, typical radius of about 50 nm, and contour length of several micrometres.

Performed experimental investigations demonstrated presence of lateral migration of nanofilaments, and their complex bending dynamics, being characteristic for long biomolecules. Experimental data are compared with hydrodynamic wormlike beads model of fibres conveyed by shear flow[2], confirming predicted fibre tumbling and lateral migration.

Acknowledgments: NCN grant 2015/17/N/ST8/02012

---

[a] Dep. Biosystems and Soft Matter, IPPT PAN, Warszawa, Poland

[1] P. Nakielski et al., *PLOS ONE* **10**(6):e0129816 (2015).
[2] S. Pawlowska et al., *PLOS ONE* **12**(11):e0187815 (2017).