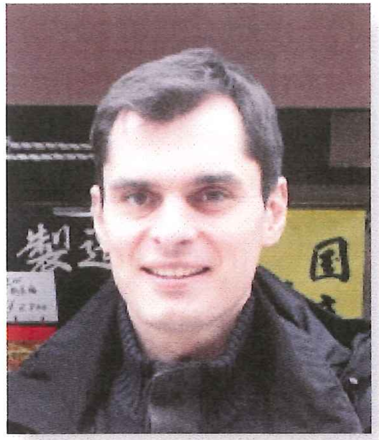
21st I^2plus Seminar



Schedule: 11:00 ~, 22nd March 2017

Place: ME Meeting Room (2F, Bldg #2)

Speaker: Dr. G. F. DIETZE (CNRS/Univ. Paris-Sud, France)

On the Kapitza instability and the generation of capillary waves

Abstract: We revisit the classical problem of a liquid film falling along a vertical wall due to the action of gravity, i.e. the Kapitza paradigm (Kapitza, Zh. Eksp. Teor. Fiz., vol. 18, 1948, pp. 3–28). The free surface of such a flow is typically deformed into a train of solitary pulses that consists of large asymmetric wave humps preceded by small precursory ripples, designated as 'capillary waves'. We set out to answer four fundamental questions. (i) By what mechanism do the precursory ripples form? (ii) How can they travel at the same celerity as the large-amplitude main humps? (iii) Why are they designated as 'capillary waves'? (iv) What determines their wavelength and number and why do they attenuate in space? Asymptotic expansion as well as direct numerical simulations and calculations with a low-dimensional integral boundary-layer model have yielded the following conclusions. (i) Precursory ripples form due to an inertia-based mechanism at the foot of the leading front of the main humps, where the local free-surface curvature is large. (ii) The celerity of capillary waves is matched to that of the large humps due to the action of surface tension, which speeds up the former and slows down the latter. (iii) They are justly designated as 'capillary waves' because their wavelength is systematically shorter than the visco-capillary cutoff wavelength of the Kapitza instability. Due to a nonlinear effect, namely that their celerity decreases with decreasing amplitude, they nonetheless attain/maintain a finite amplitude because of being continuously compressed by the pursuing large humps. (iv) The number and degree of compression of capillary waves is governed by the amplitude of the main wave humps as well as the Kapitza number. Large-amplitude main humps travel fast and strongly compress the capillary waves in order for these to speed up sufficiently.

Contact: I^2plus (i2plus@rs.tus.ac.jp), Dr. Ueno (ich@rs.tus.ac.jp)

Organizer: International Research Div. of Interfacial Thermo-Fluid Dynamics (I^2plus), RIST, TUS

RIST Research Institute for Science and Technology