ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

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➢ FRIDAY 20 MAY 2016 - ROOM MA A1 10 - 15h15

Prof. Pavel LUSHNIKOV (The University of New Mexico, Albuquerque, USA) will present a seminar entitled:

"Dynmamics of singularities, wavebreaking and efficient simulations of 2D hydrodynamics with free surface"

Abstract:
2D hydrodynamics of ideal fluid with free surface is considered. A time-dependent conformal transformation is used which maps a free fluid surface into the real line with fluid domain mapped into the lower complex half-plane. The fluid dynamics is fully characterized by the complex singularities in the upper complex half-plane for the conformal transformation and the complex velocity. Efficient simulations of 2D hydrodynamics with free surface are reduced to the study of the motion of these singularities. The structure of complex singularities at each time step is recovered using a version of Pade approximation algorithm [B. Alpert, L. Greengard, and T. Hagstrom, SIAM J. Num.Anal. 37:1138 (2000)] which avoids numerical instabilities. In most cases the found singularities are square root branch points. Pade approximation locates poles along each corresponding branch cut. The quadruple (32 digits) and variable precisions (more than 200 digits) are used to recover the continuous limit of such distribution of poles (jump along branch cuts). In most practical applications high precision is not needed and it is sufficient to use the double precision limiting Pade approximants to have between several tenth and several hundreds of poles. It is shown that the initially flat surface with the initial pole in the complex velocity turns over arbitrary small time into the branch cut connecting two square root branch points. Without gravity one of these branch points approaches the fluid surface corresponding to the formation of the fluid jet. The addition of gravity results in wavebreaking in the form of plunging of the jet into the water surface. We use the additional conformal transformation to numerically resolve the dynamics near branch points which allows to analyze wavebreaking in details.

Lausanne, 11 May 2016/JH/cr
