Non-stationary simulations of continuous forming processes.

Free surface flows which arise in continuous forming processes are characterized by a predominating tangential velocity on the free surface.
We propose a numerical scheme to handle this situation with good stability properties and accuracy. The scheme is based on a method of characteristics applied to the the hyperbolic equation describing the motion of the surface.
This approach in merged into a Arbitrary Lagrangian Eulerian formulation of the Navier-Stokes equations in a moving domain.
Numerical 2D and 3D Finite Element computations will be presented to illustrate the robustness of the algorithm.

In a second part, we will address the problem of energy balance for free surface flow computations: is it possible to ensure that the evolution of the sum of the kinetic, potential, and superficial energies balances the viscous dissipation ?
It will be shown that, although the indefiniteness of the discrete normal vector to a surface prevents us from getting satisfying theoretical results, a good numerical energy balance can be obtained for simple test cases.