INTERACTION OF VORTEX SHEET ROLL-UP AND SURFACE TENSION

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ABSTRACT

In this talk, we consider the evolution of the vortex sheet with surface tension. When surface tension is present in the vortex sheet, the sheet motion has complex dynamic interactions of break-up of singularity, spiral roll-up and capillary force. The stiffness from surface tension makes numerical computations of the sheet very difficult. Existing numerical methods are too complicated to implement.

We propose two simple and efficient numerical methods for the vortex sheet with surface tension: the standard point vortex method and a modified Pullin method. The standard point vortex method has been known to be unstable due to spurious growth of high modes. For the first time, we show that the standard vortex method is able to calculate the vortex sheet motion with surface tension by applying a Fourier filtering. The modified Pullin method is highly accurate and free from the aliasing instability, unlike previous numerical methods. A stability analysis for the numerical methods is also given.

We present results for the long-time evolution of the vortex sheet and investigate the dynamics of the sheets for a wide range of Weber numbers. The sheets demonstrate a variety of rich behaviors such as dispersive waves, fingering and pinch-off.

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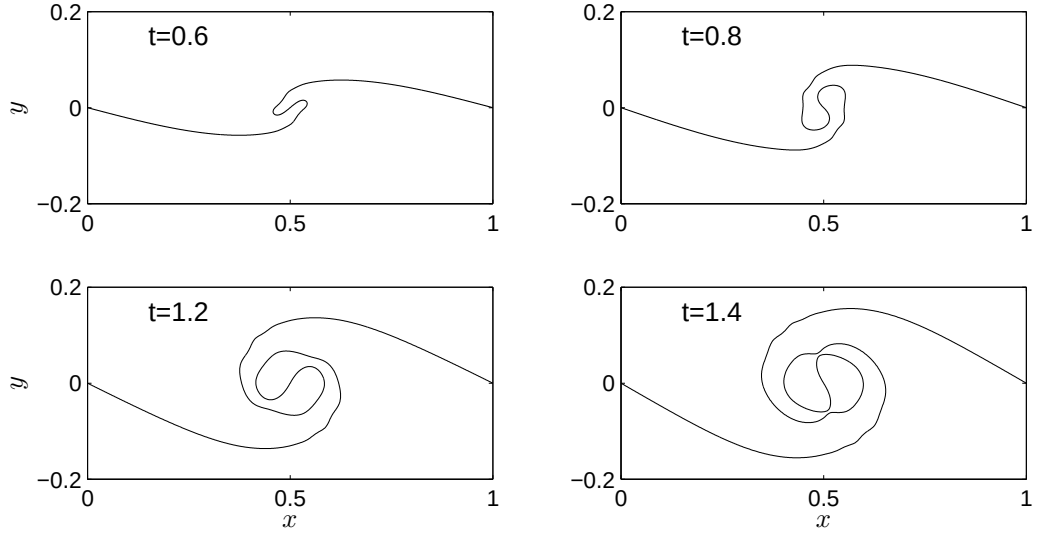

Figure 1. Evolution of the vortex sheet for We $= 200$.

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