Singularities in 2D flows: The Tale of Two Branch Points

Sergey Dyachenko

State University at Buffalo, NY

Abstract

We consider a classical problem of 2D fluid flow with a free boundary. Recent works strongly suggest that square--root type branch points appear naturally in 2D hydrodynamics. We illustrate how the fluid domain can be complemented by a "virtual" fluid, and the equations of motion are transplanted to a branch cut (a vortex sheet) in the conformal domain. A numerical and theoretical study of the motion of complex singularities in multiple Riemann sheets is suggested. Unlike preceding work for dynamics of singularities: the short branch cut approximation, and the study of viability of meromorphic solutions in fluid dynamics, the present approach neither simplifies the equations of fluid flow, nor uses local Laurent expansions. Instead the new approach is based on analytic functions and allows construction of global solutions in 2D hydrodynamics. A natural extension of the approach considers fluid flows described by many pairs of square--root branch points.