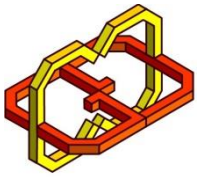

Technion-Israel Institute of Technology

Computer Science Department

Center for Graphics and Geometric Computing

CGGC Seminar – M.Sc. Talk

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2D Simulation and Mapping using the Cauchy-Green Complex Barycentric Coordinates

Conformal maps are especially useful in geometry processing for computing shape preserving deformations, image warping and manipulating harmonic functions. The Cauchy-Green coordinates are complex-valued barycentric coordinates, which can be used to parameterize a space of conformal maps from a planar domain bounded by a simple polygon. In this work, we use the Cauchy-Green coordinates to simulate 2D potential flow with interactive control, and to construct conformal maps between planar domains.

The Hele-Shaw flow describes the slow flow of a viscous liquid between two parallel plates separated by a small gap. In some configurations such a flow generates instabilities known as Saffman-Taylor fingers, yielding intricate visual patterns which have been an inspiration for artists, yet are quite difficult to simulate efficiently. Formulating the equations with our framework allows us to efficiently simulate the flow and to provide the user with interactive control over the behavior of the fingers. Additionally, we show that the Cauchy-Green coordinates are applicable to the exterior of the domain, and use them for simulating two fluids with different viscosities.

The Riemann mapping theorem guarantees that there exists a conformal map between any two simply connected planar domains, yet computing this map efficiently is challenging. One of the main challenges is finding the boundary correspondence between the two domains. We use the Cauchy-Green coordinates for parameterizing the space of conformal maps from the source domain, and propose an alternating minimization algorithm for constructing a boundary-approximating conformal map, which implicitly finds a boundary correspondence. We enrich the space of solutions by generalizing the setup to quasi-conformal maps, and allow the user to interactively control the result using point-to-point and stroke-to-stroke constraints. Finally, we show applications to stroke based deformation and constrained texture mapping.

The lecture will be held on Sunday, 05.06.2016, at 13:30, Taub 701

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