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Complex Analysis and Dynamics of Polynomial Hele-Shaw Cells.

In this talk, I will discuss a fluid flow in varying regions. In particular, we are interested in the effect that suction or injection of fluid has on the free boundary. One may think of this as oil being sucked from the ground by an oil rig. This setup is known as a **Hele Shaw Cell** and is modelled mathematically by the so-called *Polubarinova-Galin equation*:

$$\mathrm{Re}[\dot{f}(\zeta,t)\overline{\zeta f'(\zeta,t)}] = -\frac{Q}{2\pi}, \qquad \zeta = e^{i\theta}.$$

We will discuss the development of this equation from Complex Analysis and present some explicit polynomial and rational solutions to this equation. Finally we will discuss some open questions related to this model and look at how it can be applied in the future to planar biological structures and to the medical field. (Received September 20, 2007)