

The Mathematics of Moving Fluids

Fluid dynamics, the study of the motion of liquids and gases, is one of the classical branches of applied mathematics. Sciences such as aerodynamics, hydrodynamics, meteorology and oceanography, to name a few, draw heavily on the mathematics of fluid mechanics for their quantitative underpinnings. The central theme of this class is the development of the mathematics for understanding the basic variables that describe the motion of fluids: flow velocity, pressure and density.

The modelling of fluids applies ideas from ordinary and partial differential equations, complex analysis and a bit of numerical analysis. The core aims for the term are: deriving the equations of motion from basic physical principles, developing differential equation techniques for finding special solutions, and most importantly, interpreting these solutions in the context of understanding fluids. Computer visualization will be an important accompaniment to the lectures and assigned work. The rudiments of numerical computing and graphics will be introduced through the use and modification of downloadable Matlab scripts.

The ultimate goal is to use mathematics to reveal, in a quantitative way, the mysteries of the motions of liquids and gases. Why does water swirl as it drains from the bathtub? Why is there a speed of sound? Why does a baseball pitcher's curve-ball curve?

Background familiarity with elementary differential equations (ODEs & PDEs), complex variables & Matlab computing.

Further information & updates: www.math.sfu.ca/~muraki



The image on the left shows the buckling of a thin stream of poured syrup. It is an illustration of the fluid concept of viscosity. The image on the right is a photograph of a 1969 waterspout seen off the Florida coast. It is an illustration of the fluid concept of vorticity.