

# Lectures on Fractional Differential Equations

Göttingen, September 5-8, 2016.

## Lecture 1:

- The heat equation, Brownian motion, Einstein's model and Gaussian random walks.
- Are all diffusion processes of this form? What are the alternatives?
- Anomalous diffusion - the fractional version: sub-diffusion and super-diffusion.
- The random walk and fractional calculus models.
- Fractional calculus.

## Lecture 2:

- Fractional differential equations; some standard initial value problems.
- Existence, uniqueness and regularity results.
- Representation theorems and the maximum principle.
- Differences from the standard (parabolic equation) situation.

## Lecture 3:

- Inverse problems for time fractional derivative problems; what this says about the new physics of fractional diffusion.
- Inverse problems for space fractional derivative problems; what we know and the many, many things we don't know.
- Open problems - things that might be achieved sooner than later.