# Mathematics of molecular motor dynamics: Cellular morphogenesis and tug-of-war

**Dietmar Oelz**[1]

[1] University of Queensland, Brisbane

Intracellular transport is driven by molecular motors which pull cargo vesicles along cytoskeletal filaments. I will present the outcomes of two research projects which rely on the formulation of mathematical models for their dynamics.

In a collaborative study combining experiments and Brownian Dynamics simulations we investigate cellular morphogenesis of neuron cells, namely establishment and growth of axons and dendrites, which is both driven by kinesin and dynein motors. We find that the growth of cellular processes depends critically on dynamical instability, i.e. alternating growing and shrinking, of microtubule fibres.

Related to this project (and if time permits), I will also present a mathematical study of tug-of-war between antagonistic molecular motors. It relies on the formulation of a Markov process to describe the fluctuations of motor proteins as a random walk in what appears to be a double-well-potential. The mathematical analysis of expected hitting times allows us to derive a closed form expression for the mean run-length and run-time of cargo between random switches of direction and to predict how the effective diffusion rate in intra-cellular transport depends on key model parameters.