Coupled pde/ode systems with multiple time scales and applications in medicine and engineering

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Many natural phenomena feature interaction of processes on vastly differing timescales, like growth of a quantity in the span of months and years, driven by something happening in seconds. This makes direct numerical simulation prohibitively costly, since the fastest timescales must be fully resolved over a timespan of the slow scales' order. Under suitable assumptions we can instead solve a limit equation, describing the system's behavior as the difference of timescales approaches infinity.

In this talk we will give an outline of the central concepts and assumptions needed to carry out this idea for so called slow/fast systems, in which the timescales are clearly separated. We focus on equations where the fast dynamic has a periodic limit behavior, leading naturally to the theory of averaging. Motivated by our applications we conclude with analytical and numerical challenges if the fast dynamic is described by a partial differential equation.