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On the delay formulation of some physiologically structured population models

The classical formulation of continuously structured population models consists in partial differential equations of the transport type with nonlocal terms and nonlocal nonlinear boundary conditions. Most of these are quasilinear pdes and even when they are linear (which happens in the case of age-dependent population dynamics), the nonlinearity at the boundary prevents a standard semilinear formulation and makes difficult, if possible, to prove the linearized stability principle, let alone to prove theorems around bifurcations and existence of invariant manifolds. The alternative formulation using renewal equations, being equivalent to a semilinear formulation via sun-dual perturbations, allows proving the mentioned theorems in a natural and biologically meaningful setting.

We will see some examples and the difficulties that arise in the case of distributed states at birth (for instance in the case of cell populations) or infinite dimensional interaction variables (for instance in the case of hierarchical competition).

Joint work with Silvia Cuadrado and Philipp Getto.