Improving numerical continuation for complex delay models of structured populations

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Recently, discretization methods are proposed to reduce delay differential equations coupled with renewal equations to systems of ordinary differential equations (ODEs), [1]. These techniques are particularly useful to treat complex models describing structured populations, where rates like fertility or survival probability depend on external ODEs, which in turns change with model parameters. Continuation tools are then applied to analyze stability and detect bifurcations. We focus on the idea that taking somehow advantage of the structure of the problem – i.e., of solutions to the external ODEs computed for previous values of the parameters – is likely to improve the overall performance. To this aim, we study a prototype problem where the solution of an external ODE, through standard collocation, is included in the continuation framework rather than being obtained externally from scratch. Experimental results so far suggest that this approach can in fact improve the efficiency in terms of computational time.

[1] Breda D., Diekmann O., Gyllenberg M., Scarabel F., Vermiglio R., Pseudospectral discretization of nonlinear delay equations: new prospects for numerical bifurcation analysis, *SIAM Journal on Applied Dynamical Systems* **15**(1):1–23, 2016.