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Overcompensatory dynamics in integrodifference equations

We consider integrodifference equations (IDEs), which are of the form

$$N_{t+1}(x) = \int K(x-y)F(N_t(y))dy,$$

where K is a probability distribution and F a growth function. It is already known that for monotone growth functions, solutions of the IDE will have spreading speeds and are sometimes in the form of travelling waves. We are interested in studying the case where F is a function with overcompensatory dynamics, i.e. p-point cycles can appear for certain parameter values, eventually leading into chaos. Such is the case for the Ricker function. This topic was first introduced in [Kot, 1992]. It was claimed that when F manifests a stable two-point cycle, the solution of the IDE alternates between two profiles, all the while moving with a certain spreading speed. However, simulations revealed that not only do the profiles alternate, but the solution is a succession of two travelling objects with different spreading speeds. Using the theory from [Weinberger, 1982], we can prove this and establish the theoretical formulas for the spreading speeds that exist within the different parts of the solution. Those results can then be compared with numerical simulations. The existence of successive travelling objects within a solution will also allow us to relate to the theory of dynamical stabilization in continuous systems.

[Kot, 1992] M.Kot. Discrete-time traveling waves: Ecological examples. *Journal of Mathematical Biology*, 30:413-436, 1986.

[Weinberger, 1982] H.F. Weinberger. Long-time behavior of a class of biological models. *SIAM Journal on Mathematical Analysis*, 13:353-396, 1982.