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Stability of discrete fractional systems under random perturbations and lifespan distribution of living species

Mark Edelman

Abstract: Various features of the development of individual living species, including individual humans, are programmed. Is death also programmed, and if yes, how is it implemented and what can be the underlying mechanism providing the inevitability of death? The hypothesis presented in this paper is based on the similarity of the human evolution to the evolution of simple discrete nonlinear fractional (with power-law memory) systems. Caputo fractional/fractional difference logistic map is a simple discrete system with power-/asymptotically power-law memory and quadratic nonlinearity. In the area of parameters where the fixed point is unstable, its evolution starts as the evolution of a system with a stable fixed point but then this fixed point becomes unstable, suddenly breaks, and turns into a period two point. Considered under various types of random perturbations, the time spans of the evolution as a fixed point before the break (lifespans) obey the Gompertz-Makeham law, which is the observed distribution of the lifespans of live species, including humans. The underlying reason for modeling the evolution of humans by fractional systems are the observed power law in human memory and the viscoelastic nature of organ tissues of living species. Models with power-law memory may explain the observed decrease at very large ages of the rate of increase of the force of mortality and they imply limited lifespans.

[1)] Mark Edelman, Professor: Yeshiva University, Courant Institute, BCC CUNY, 6629 Broadway Apt. 4D, Bronx, NY 10471, United States (US), edelman@cims.nyu.edu, the author presented this contribution at the conference in the special session: "A special session dedicated to Prof. Miguel A.F. Sanjuán on the occasion of the celebration of his 60th anniversary" organized by J. Awrejcewicz.