Probing the edge of chaos

February 27 2014

The edge of chaos—right before chaos sets in—is a unique place. It is found in many dynamical systems that cross the boundary between a well-behaved dynamics and a chaotic one. Now, physicists have shown that the distribution—or frequency of occurrence—of the variables constituting the physical characteristics of such systems at the edge of chaos has a very different shape than previously reported distributions. The results, by Miguel Angel Fuentes from the Santa Fe Institute in New Mexico, USA, and Universidad del Desarrollo, Chile, and Alberto Robledo from the National Autonomous University of Mexico, Mexico City, are published in *EPJ B*. This could help us better understand natural phenomena with a chaotic nature.

In probability theory, the central limit theorem was first developed by an 18th century French mathematician named Abraham de Moivre. It applies to independent random physical quantities or variables, each with a well-defined expected value and well-defined way of varying. This theorem states that once iterated a sufficiently large number of times, these variable physical quantities will be approximately distributed along a central limit—also referred to as the attractor. In chaotic and standard random systems, such distribution is in the shape of a bell curve.

Now, new central limit theorems are emerging for more complex physical processes, such as natural phenomena. In this study, the authors took existing knowledge of the specific position of the attractor at the edge of chaos. To do so, they employed a mathematical formula called the logistic map as a particular example of the dynamic system under study. They found that the distribution of physical properties of such

dynamic systems at this specific point at the edge of chaos has a fractal structure not previously known.

More information: *European Physical Journal B*, DOI: 10.1140/epjb/e2014-40882-1

Provided by Springer

Citation: Probing the edge of chaos (2014, February 27) retrieved 10 April 2024 from https://phys.org/news/2014-02-probing-edge-chaos.html