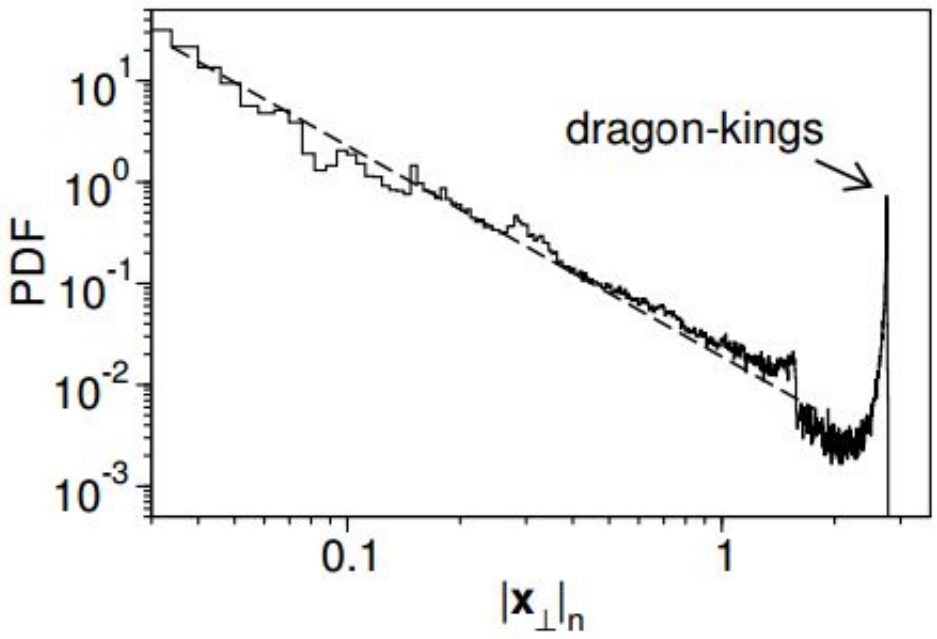
Researchers find a way to predict 'dragon kings' in small circuits

October 30 2013, by Bob Yirka



Appearance of dragon-kings. Bubble event-size probability density function (PDF) for c = 4.4. The dashed line is a fit to a power law. Credit: arXiv:1301.0244 [nlin.CD]

(Phys.org) —A research team with members from Switzerland, the U.S. and Brazil has discovered a way to predict and circumvent "dragon kings" that appear in a synchronized master-slave circuit system that occasionally become unsynchronized. They have uploaded a paper they've written describing their system and results to the preprint server

arXiv—later to be published in the journal *Physical Review Letters*.

Dragon kings (the term came about as a means to describe wealth distribution in medieval times) are large unexpected events that occur in complex systems. Earthquakes, stock-market crashes and even the abnormal population growth of Paris are some common examples. For obvious reasons, scientists and others have been studying such events to try to figure out if they can be predicted, and if so, if some of them at least, can be prevented.

In this latest effort, the researchers weren't studying dragon kings, they were simply trying to better understand a circuit anomaly—a master/slave circuit connected together in a way that was supposed to keep the two synchronized with one another. The problem was, sometimes the two would occasionally go completely out of whack. In studying the circuit they discovered that it was very small occasional misses in the synchronizing process that led to bigger and bigger misses until the circuits became completely unsynchronized. Further study showed that making a minor adjustment to the system just before it went out of whack prevented the big event from occurring. Later analysis of the properties of the big event showed that it followed the definition of a dragon king. This has led the researchers to suggest that if such variables as were found in the circuit system could be identified in other systems, it seems reasonable to conclude that large random fluctuations might be predicted and in some cases prevented, in them as well.

That's a pretty big jump the researchers acknowledge—other systems are not only far more complex but have some variables beyond human control, such as those that lead to earthquakes or the amount of money investors have available to spend. But, because they were able to predict a dragon king in a circuit, it shows it can be done, at least in one system. That alone is enough to offer hope that similar analysis of other systems might lead to the same ability in some others.

More information: Predictability and suppression of extreme events in complex systems, arXiv:1301.0244 [nlin.CD] arxiv.org/abs/1301.0244

Abstract

In many complex systems, large events are believed to follow power-law, scale-free probability distributions, so that the extreme, catastrophic events are unpredictable. Here, we study coupled chaotic oscillators that display extreme events. The mechanism responsible for the rare, largest events makes them distinct and their distribution deviates from a power-law. Based on this mechanism identification, we show that it is possible to forecast in real time an impending extreme event. Once forecasted, we also show that extreme events can be suppressed by applying tiny perturbations to the system.