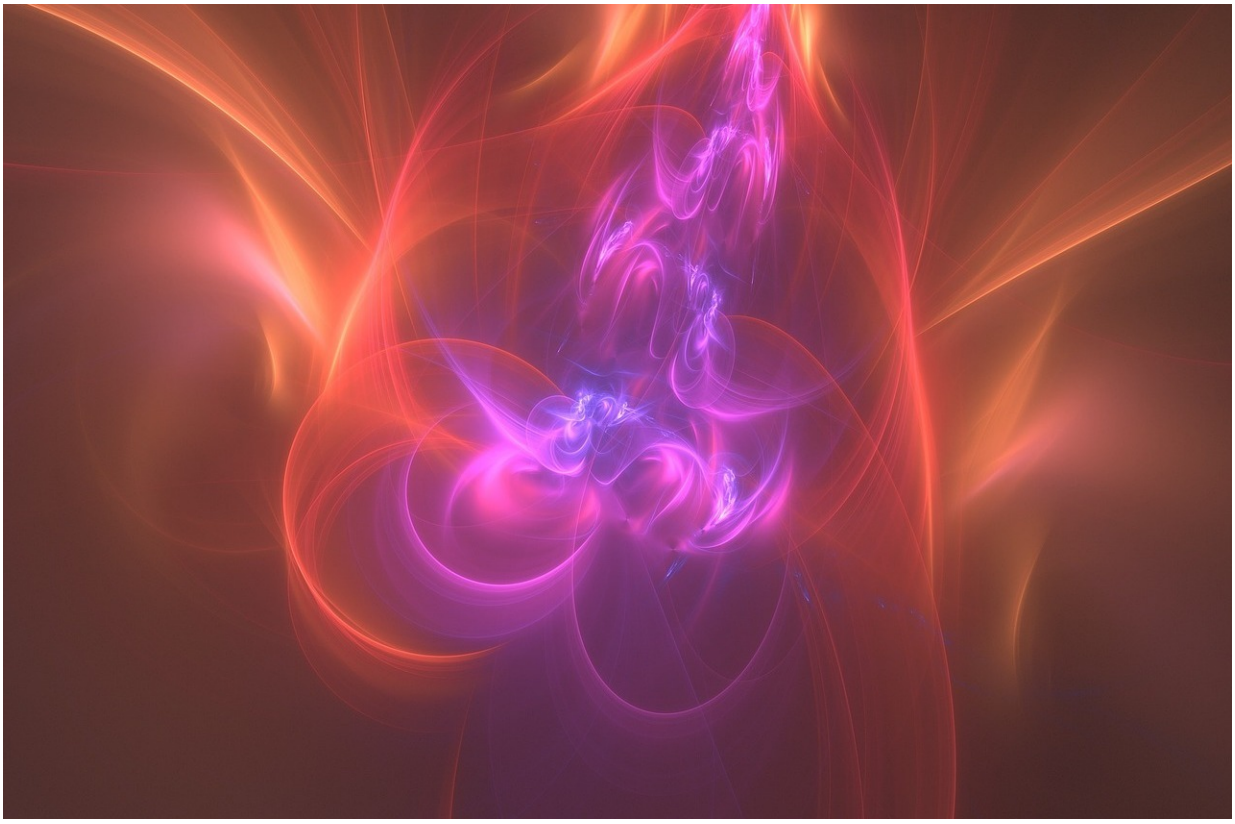
Chaos could provide the key to enhanced wireless communications

August 23 2016



Credit: CC0 Public Domain

Chaos, somewhat ironically, has one clear attribute: random-like, apparently unpredictable, behavior. However recent work shows that that unpredictable behavior could provide the key to effective and efficient

wireless communications.

A team of researchers at the Xian University of Technology in China and the University of Aberdeen in the United Kingdom have demonstrated that chaos can, in fact, be used to transmit information over a wireless physical channel offering wide-ranging advantages from enhanced communications security. The researchers explain their findings this week in *Chaos*.

Wireless communication is the fastest growing segment of the communication industry. But the physical constraints of wireless physical media, such as multi-path propagation, complex ambient noises and interference, prevent quick transmission of information and at a low error rate.

Chaotic signals are aperiodic, irregular, broadband spectrum, easy to generate and difficult to predict over time, making them desirable for communication, sonar and radar applications. While much of the previous research focused on the use of chaos in conventional wired communications, H.P. Ren at the Xian University of Technology in China and a team of researchers sought to demonstrate numerically and experimentally that chaotic systems can be used to create a reliable and efficient wireless communication system.

"We showed that the information transmitted over a wireless channel in a chaotic signal is unaltered even though the received chaotic communication signal is severely distorted by the wireless channel constraints," Ren said. "We also demonstrated that it can be decoded to provide an efficient framework for the modern communication systems."

Chaos is very dependent on the initial conditions; therefore, when controlling the circuit to produce an encoding wave signal, even tiny

mistakes in the control instrumentation drives the circuit to states where the wave signal does not encode the information for transmission. This research shows how to control the circuit using an optimal set of perturbations that minimally disturb the natural dynamics of the circuit, yet create the desired encoding signal, despite its chaotic and unpredictable nature.

The research team ran into a pleasant surprise when they found that the chaotic signal they used as a basis for their communication system (generated by an electronic device) can encode any binary source of information in an energy efficient way.

The next step is to utilize these ideas and methods to develop prototypes for real world wireless communication systems, demonstrating that chaos can provide the backbone for future communication systems that offer benefits like enhanced security.

More information: "Experimental Validation of Wireless Communication with Chaos," *Chaos*, August 23, 2016, DOI: 10.1063/1.4960787

Provided by American Institute of Physics