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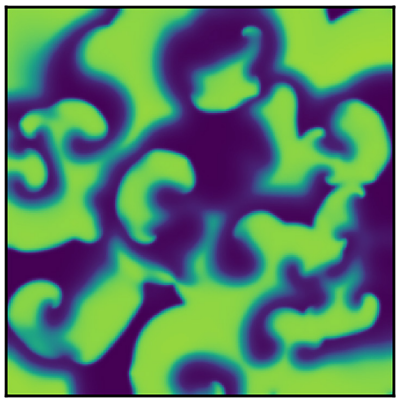
Though chaotic dynamics are ubiquitous, they are often unwanted and potentially detrimental, and the ability to terminate them quickly is a necessity.



Chaotic dynamics – both transient and persistent – play a major role in many real-life systems. In many cases, transient chaos is not desirable, for example in cases like cardiac arrhythmias, where it can be a matter of life and death. With the precise tuning of a small number of perturbations, Thomas Lilienkamp and Ulrich Parlitz showed that transient chaotic dynamics can be overcome by pushing the system into a state that terminates more quickly.

Because individual perturbations to the system can effectively act as shortcuts toward the desired state, a control scheme can strategically pick single perturbations in a sequential way to reduce the transient time. In testing this method, the authors were able to control the transient chaos with less than 10 perturbations on 100 different initial conditions, with some cases terminating with as few as three perturbations.

The control scheme algorithm works by testing different possible perturbations on the system, and picking the ones that come closest to the desired state within a fixed evolution period, then repeating the process iteratively until the system reaches an appropriate resting state.

To apply this to systems like cardiac arrhythmias, additional work – potentially aided by machine learning – is required to learn how to generate more complex perturbation patterns.

“The challenge for future real-life systems is to develop a rule or simplified mechanism or algorithm to find the specific perturbations which terminate the dynamics efficiently,” Lilienkamp said. “Furthermore, if in a specific real-life system such perturbations are found, there needs to be a way to apply those perturbations experimentally.”

Source: “Terminating transient chaos in spatially extended systems,” by Thomas Lilienkamp and Ulrich Parlitz, *Chaos* (2020). The article can be accessed at https://doi.org/10.1063/5.0011506.