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Controlling Chaotic Dynamics in a Simple Electronic Oscillator[1]
KRISTINE CALLAN, STEPHEN HALL, RICHARD WIENER, Pacific University, Forest Grove, OR 97116, THOMAS OLSEN, Lewis & Clark College, Portland, OR 97219 — We built an electronic circuit, described by a third order nonlinear jerk equation, which oscillates at about 1 Hz, either periodically or chaotically depending on values of the two parameters in the equation. We primarily investigated chaotic oscillations in the circuit, both numerically and experimentally. By analyzing return maps, which involve plotting each local maximum against the previous local maximum from a sequence of oscillations, we identified fixed points corresponding to unstable periodic orbits. We tried implementing three control-of-chaos algorithms: Simple Proportional Feedback (SPF), Recursive Proportional Feedback (RPF), and Doubly Recursive Proportional Feedback (DRPF). The first attempt to control oscillations using SPF failed because the system has memory, making the RPF and DRPF algorithms, which take into account previous perturbations, necessary. Both RPF and DRPF controlled the system experimentally and numerically. Once we achieved control of chaos, we investigated if control can be maintained while a parameter drifts. When we implemented a slow drift in one of the parameters in the numeric code we found that both RPF and DRPF were able to maintain control for periods of time before slipping in and out of chaos, but DRPF maintained more robust control throughout the drift.

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