Bifurcation and chaos in coupled ratchets exhibiting synchronized dynamics

O. Akinlade, A. N. Njah

Department of Physics, University of Agriculture, PMB 2240, Abeokuta, Ogun State, Nigeria

U. E. Vincent

Department of Computer Science, University of Agriculture, PMB 2240, Abeokuta, Ogun State, Nigeria

Abstract

The bifurcation and chaotic behavior of unidirectionally coupled deterministic ratchets is studied as a function of the driving force amplitude (a) and frequency (ω). A classification of the various types of bifurcations likely to be encountered in this system was done by examining the stability of the steady state in linear response as well as constructing a two-parameter phase diagram in the (a-ω) plane. Numerical explorations revealed varieties of bifurcation sequences including quasiperiodic route to chaos. Besides, the familiar period-doubling and crises route to chaos exhibited by the one-dimensional ratchet were also found. In addition, the coupled ratchets display symmetry-breaking, saddle-nodes and bubbles of bifurcations. Chaotic behavior is characterized by using the Lyapunov exponent spectrum; while a perusal of the phase space projected in the Poincaré cross section confirms some of the striking features.