Submitted: 27 January 2012
Accepted: 02 March 2012
Published Online: 23 March 2012

Period adding cascades: Experiment and modeling in air bubbling

Chaos **22**, 013135 (2012); https://doi.org/10.1063/1.3695345

Felipe Augusto Cardoso Pereira[1], Eduardo Colli[2], *and* José Carlos Sartorelli[1]

View Affiliations
View Contributors

ABSTRACT

Period adding cascades have been observed experimentally/numerically in the dynamics of neurons and pancreatic cells, lasers, electric circuits, chemical reactions, oceanic internal waves, and also in air bubbling. We show that the period adding cascades appearing in bubbling from a nozzle submerged in a viscous liquid can be reproduced by a simple model, based on some hydrodynamical principles, dealing with the time evolution of two variables, bubble position and pressure of the air chamber, through a system of differential equations with a rule of detachment based on force balance. The model further reduces to an iterating one-dimensional map giving the pressures at the detachments, where time between bubbles come out as an observable of the dynamics. The model has not only good agreement with experimental data, but is also able to predict the influence of the main parameters involved, like the length of the hose connecting the air supplier with the needle, the needle radius and the needle length.

ACKNOWLEDGMENTS

Acknowledgments to the Brazilian agencies FAPESP and CNPq and to Professor Clodoaldo G. Ragazzo for useful discussions.