



The phenomenon of pre-bifurcation noise amplification as diagnostics tools for retrieving bifurcations in observed data

E. Surovyatkina (1), Ju. Kurths (2)

(1) Space Research Institute, Russian Academy of Sciences, Moscow, Russia, (2) Institute of Physics, Potsdam University, Germany (selena@iki.rssi.ru / Fax: +70957440436)

This paper studies the fundamental phenomenon of pre-bifurcation noise amplification which could be observed in geophysical systems near the threshold of bifurcation. The phenomenon of pre-bifurcation noise amplification is proposed to consider as a new indicator (“noisy precursor”) of bifurcations in observed data of geophysical systems.

Analytical estimates of pre-bifurcation noise amplification are presented both for linear and nonlinear approximations for two cases: period doubling bifurcations [1] and pitchfork bifurcations [2]. It is shown that in the saturation regime the fluctuation variance is proportional to the square root of the external noise variance, whereas the fluctuation variance in the linear regime is proportional to the noise variance. Similar regularities are expected to be valid also for other kinds of bifurcations but the character of noise amplification depends on the type of bifurcations.

Obtained characteristic features of this pre-bifurcation noise amplification are of great practical importance since it can be utilized for the choice of inferring dynamical models from observed data. A new method for detecting of retrieving bifurcations in observed data is proposed.

[1] Yu. A. Kravtsov, E. D. Surovyatkina, Nonlinear saturation of pre-bifurcation noise amplification, *Phys. Lett. A* 319, 348 (2003).

[2] E. D. Surovyatkina, Yu. A. Kravtsov and J. Kurths, Fluctuation growth and saturation in nonlinear oscillator on the threshold of bifurcation of spontaneous symmetry breaking. *Phys.Rev.E*, 72, 046125 (2005).