International Journal of Pharmacy and Technology, 2016, vol.8, N4, pages 24467-24476

Statistical analysis of collective phenomena in complex systems

Demin S., Panischev O., Nefedyev Y., Demina N.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016, International Journal of Pharmacy and Technology. All rights reserved.The description of complex system evolution with the unique properties different from the sub-system properties is an important task of modern science. The solution of this problem is complicated not only by the absence of full information about the processes implemented in complex systems, but also by very diverse nature of the interaction between components. In this case, simplification is achieved in those approaches which allow “to abstract” from a studied system organization. Thus, the description of distributed system evolution is performed based on the extraction of information from the signals generated by them. This paper presents the possibilities of statistical analysis methods: the memory function formalism (MFF) and flicker-noise spectroscopy (FNS) during the study of synchronization phenomena. Using the example of a man’s magnetoencephalogram signal analysis (MEG) and radio emission of quasars examined the effects of coordination between the constituent parts of these systems are analyzed. MFF analysis of MEG signals mutual dynamics among healthy subjects led to the conclusion about the processes, compensating the abnormal collective activity of neurons in response to the third-party effects which are not observed in the case of photosensitive epilepsy. The effects of frequency-phase synchronization in the signals of quasar emission at different frequencies discovered within FNS contributed to the establishment of qualitatively distinct mechanisms concerning their disk accretion. The obtained results determine the possible ways of collective phenomena study in complex systems, as well as a key role of coordination effects in their evolution.

Keywords

Collective phenomena, Cross-correlations, Evolution of complex systems, Statistical analysis methods, Synchronization effects