SOME ADVANCES IN FULLY COUPLED AVERAGING FOR DYNAMICAL SYSTEMS

YURI KIFER

INSTITUTE OF MATHEMATICS
HEBREW UNIVERSITY
JERUSALEM, ISRAEL

ABSTRACT. The averaging setup arises in the study of perturbations of dynamical systems with constants of motion which give rise to a combination of a fast and slow motion. Such problems emerged first in celestial mechanics and they lead to complicated multiscale equations. The averaging principle suggests to simplify the situation by averaging parameters of the slow motion along the fast one. In the most natural from a physical point of view fully coupled setup when both the fast and the slow motions depend on each other this principle not always works and when it does the approximation is valid only in some averaged with respect to initial conditions sense. In the classical framework of perturbations of integrable Hamiltonian systems difficulties with the averaging principle are known to be related to passage through resonances. More recently, perturbations of families of hyperbolic and expanding dynamical systems were studied within the averaging framework. Here fast motions turn out to be slowly changing chaotic systems and new results concerning the probabilistic character of the averaging errors come into the picture. According to the physicist K.Hasselmann such type of results may describe (at least, phenomenologically) climate–weather interactions with climate viewed as a slow and weather as a fast chaotic motion. The discrete time setup leads to difference equations and it provides a wealth of explicit but nontrivial examples considering, for instance, perturbations of simple families of expanding transformations where computer simulations are easy to do but there are still unanswered questions.