Stochastic resonance in a ferroelectric liquid crystal

M. Gosak, M. Perc, S. Kralj
Faculty of Natural Sciences and Mathematics
University of Maribor, Koroska 160, 2000 Maribor, Slovenia

We study the impact of static and dynamic disorder on the phenomenon of stochastic resonance (SR) in a representative soft matter system. Due to their extreme susceptibility to weak perturbations soft matter systems appear to be excellent candidates for the observation of SR. Indeed, we derive generic SR equations from a polymer stabilized ferroelectric liquid crystal (LC) cell, which is a typical soft matter representative constituting one of the basic components in several electro-optic applications. We generalize these equations further in order to study an even broader class of qualitatively different systems, especially disclosing the influence of different types of static disorder and interaction ranges amongst LC molecules on the SR response. We determine the required conditions for the observation of SR in the examined system, and moreover, reveal that a random field type static disorder yields qualitatively different responses with respect to random dilution, random bond and spin glass universality classes. In particular, while the latter three decrease the level of dynamic disorder (Gaussian noise) warranting the optimal response, the former evokes exactly the opposite effect, hence increasing the optimal noise level that is needed to resonantly fine-tune the system's response in accordance with the weak deterministic electric field. These observations are shown to be independent of the system size and range of interactions, thus implying their general validity and potentially wide applicability also within other similar settings. We argue that soft matter systems might be particularly adequate as a base for different SR-based sensitive detectors and thus potent candidates for additional theoretical as well as experimental research in the presently outlined direction.

References

(1) M. Perc, M. Gosak, S. Kralj, *Soft Matter,* 2008, 4, 1861.