

Unstable attractors and heteroclinic cycles in pulse coupled networks with delay

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We consider networks of pulse coupled oscillators with non-zero delay. The coupling between the oscillators is given by the Mirrollo-Strogatz function. Such networks are used for modelling, for example, the activity in biological neuron networks or the synchronization processes in networks of interacting agents. Because of the non-zero delay the state space of such systems is infinite dimensional. We introduce a metric in the state space in order to study the question of existence of unstable attractors, i.e., of saddle periodic orbits whose stable set has non-empty interior. We prove that for any number of oscillators $n \geq 3$ there is an open parameter region in which the system has unstable attractors. Moreover, in the case of $n = 4$ oscillators we show that there exist unstable attractors with heteroclinic cycles between them. Finally, we show that the flow of the system is discontinuous and we propose a different model with continuous flow. This is joint work with Henk Broer and Easwar Subramanian.

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