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Exotic Fixed Points of the Belief Propagation Algorithm

Belief Propagation Algorithm, proposed by Judea Pearl, is a useful tool in the problem of inference in different mathematical structures (e.g. random Markov fields, Bayesian networks). BP Algorithm defines dynamics of so-called "beliefs", which, in fact, are numbers connected with every node of considered structure. If BP algorithm reaches its fixed point it allow one to calculate the marginal probabilities for the considered structure. Wide range of important problems in statistical physics, computer science and engineering are equivalent to calculation of the marginal probabilities of the relevant structure. Thus, BP algorithm provides a useful (and fast!) tool for solving such problems. It is also interesting, that in that case flow of knowledge from physics to social science runs in the opposite direction. A model, which appears sociological provides very efficient technique in physics and computer science. In the talk we will present the basic facts about BP algorithm and our last results connected with exotic fixed points for the BP algorithm on random Markov field which results from the 2D-toral lattice Ising model. We named those points exotic because they are neither of the two states in the ferromagnetic case of considered Ising model.