Universality in Polytope Phase Transitions and Message Passing Algorithms

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Place **Campus Kirchberg, room B04**

We consider a class of nonlinear mappings F in $\mathbb{R}^N$ indexed by symmetric random matrices A in $\mathbb{R}^{N\times N}$ with independent entries. Within spin glass theory, special cases of these mappings correspond to iterating the TAP equations and were studied by Erwin Bolthausen. Within information theory, they are known as "approximate message passing" algorithms. We study the high-dimensional (large N) behavior of the iterates of F for polynomial functions F, and prove that it is universal, i.e. it depends only on the first two moments of the entries of A, under a subgaussian tail condition. As an application, we prove the universality of a certain phase transition arising in polytope geometry and compressed sensing. This solves – for a broad class of random projections – a conjecture by David Donoho and Jared Tanner.