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Sum of Tensor Trace Invariants for Spin Glass Landscapes Optimisation

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Spin glass models have been a interesting research subject due to the multiple valuable insights it brought to various fields such as statistical physics and machine learning. The spherical p-spin glass model in particular has been proven an excellent candidate to investigate the landscape of such models. On the other side, theoretical tools for the study of random tensors have been developed in the field of high energy physics by Razvan Gurau, Vincent Rivasseau and their collaborators. These tools have been successfully been used to address some questions related to the spherical p-spin glass. They have been used in (Evnin, 2020) to study the ground state of the spherical p-spin glass Hamiltonian. Subsequently, (Gurau, 2020) provided a theoretical study on a function based on an infinite sum of tensorial trace invariants for studying the p-spin glass with a planted spike. This function allows the detection of the presence of the planted spike above a given threshold. However, evaluating it involves computing an integral over a n-dimensional space, which may not be possible in a polynomial time. [Ouerfelli et al., 2024] showed that random tensor theory techniques can also provide a general framework for computationable algorithms. In this talk, we investigate an approach based on the random tensor theory framework that aims to progress towards the theoretical study of [Gurau, 2020] by studying the optimal way to sum tensor trace invariants in order to find local maxima of this landscape. This is based on a joint work with Parham Radpay, Mohamed Tamaazousti and Vincent Rivasseau.

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