Cauchy noise loss for stochastic optimization of random matrix models via free deterministic equivalents

arXiv:1804.03154, github.com/ThayaFluss/cnl

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Parameter Estimation of Random Matrix Models

Random Matrix Models

- Compound Wishart Model: $W_{\mathrm{CW}}(B) = Z^* B Z$
- Information-plus-noise Model: $W_{\mathrm{IPN}}(A, \sigma) = (A + \sigma Z)^*(A + \sigma Z)$

where Z is a Gaussian random matrix on a probability space $(\Omega, \mathbb{P})$.

Question

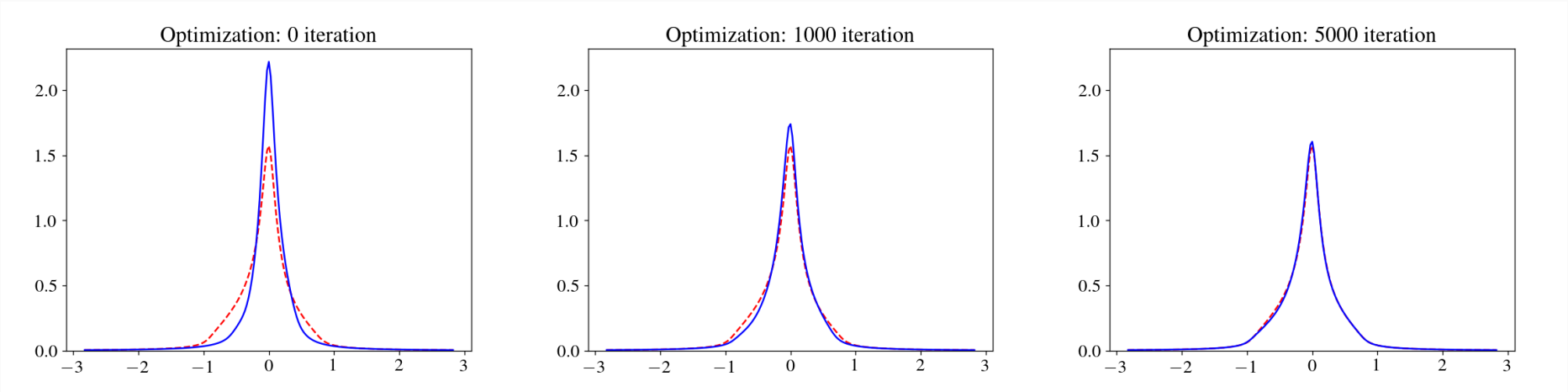
Estimate a parameter ϑ_0 from a single-shot observation $W(\vartheta_0)(\omega), \omega \in \Omega$.

Our method is based on

- Free Probability Theory (FDE, Subordination, Linearization, etc.)
- Stochastic Optimization (Stochastic (online) Gradient Descent)

Example

(CW) A "mollified" spectral distribution of a model $W_{\mathrm{CW}}(B)$ gets close to that of a true model $W_{\mathrm{CW}}(B_0)$ as the iteration progresses;



(IPN) Rank reduction: our algorithm estimated the true rank of the signal part (i.e. rank A) even if the true rank is not low.

More general random matrix models are in the scope of our method.