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Compressive Phase Retrieval via Bethe Free Energy Minimization. Preliminary report.

We recently developed a novel approach to the problem of compressive phase retrieval (PR) based on belief propagation and, in particular, on the generalized approximate message passing (GAMP) algorithm. Numerical experiments suggest that PR-GAMP has state-of-the-art i) sample complexity, ii) computational complexity, and iii) noise robustness. For example, they show PR-GAMP reliably recovering i) K-sparse N-length signals from $M \geq 2K \log_2(N/K)$ phaseless random measurements for $K \ll N$, ii) 6k-sparse 65k-pixel grayscale images from 32k randomly masked and blurred Fourier intensity measurements in under 10 seconds, and iii) noise-corrupted signals at a MSE that is only about 3 dB worse than that of phase-oracle GAMP over a wide SNR range. The original version of PR-GAMP, however, requires knowledge of both noise variance and signal sparsity K. In this work, we describe an extension that learns both the noise variance and the signal sparsity from the phaseless measurements themselves. For this, we interpret the larger inference problem as Bethe Free Energy minimization, and we show how the GAMP iterations can be combined with a few additional steps to tackle this problem and thereby accomplish joint phase retrieval and parameter tuning. (Received January 19, 2015)