Computer Science > Information Theory

Message-Passing Estimation from Quantized Samples

Ulugbek Kamilov, Vivek K. Goyal, Sundeep Rangan

(Submitted on 31 May 2011 (v1), last revised 20 Nov 2011 (this version, v2))

Estimation of a vector from quantized linear measurements is a common problem for which simple linear techniques are suboptimal -- sometimes greatly so. This paper develops generalized approximate message passing (GAMP) algorithms for minimum mean-squared error estimation of a random vector from quantized linear measurements, notably allowing the linear expansion to be overcomplete or undercomplete and the scalar quantization to be regular or non-regular. GAMP is a recently-developed class of algorithms that uses Gaussian approximations in belief propagation and allows arbitrary separable input and output channels. Scalar quantization of measurements is incorporated into the output channel formalism, leading to the first tractable and effective method for high-dimensional estimation problems involving non-regular scalar quantization. Non-regular quantization is empirically demonstrated to greatly improve rate-distortion performance in some problems with oversampling or with undersampling combined with a sparsity-inducing prior. Under the assumption of a Gaussian measurement matrix with i.i.d. entries, the asymptotic error performance of GAMP can be accurately predicted and tracked through the state evolution formalism. We additionally use state evolution to design MSE-optimal scalar quantizers for GAMP signal reconstruction and empirically demonstrate the superior error performance of the resulting quantizers.

Comments:	12 pages, 8 figures
Subjects:	**Information Theory (cs.IT)**; Statistics Theory (math.ST)
Cite as:	**arXiv:1105.6368 [cs.IT]**
	(or **arXiv:1105.6368v2 [cs.IT]** for this version)

Submission history

From: Vivek Goyal [view email]
[v1] Tue, 31 May 2011 19:31:47 GMT (29kb)
[v2] Sun, 20 Nov 2011 05:01:25 GMT (36kb)