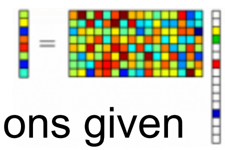
Optimal functional representations using weighted regularization

Scientific Achievement

We reconstruct data from sparse coefficients $c \in \mathbb{R}^{N \times l}$ from measurements $u \in \mathbb{R}^{m \times l}$ and basis $A \in \mathbb{R}^{m \times N}$:

$$u \approx Ac$$



- Possible to design optimal representations given limited number of measurements: $m \ll N$.
- Capable of both sparse and joint sparse optimization of data

Significance and Impact

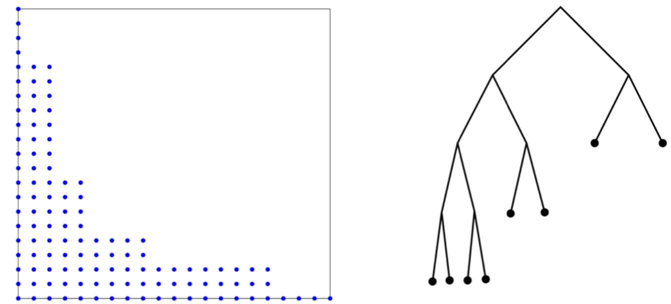
Demonstrate superior compression of data using optimal weighted regularization, exploiting sparsity structures in high dimensional approximation.

Research Details

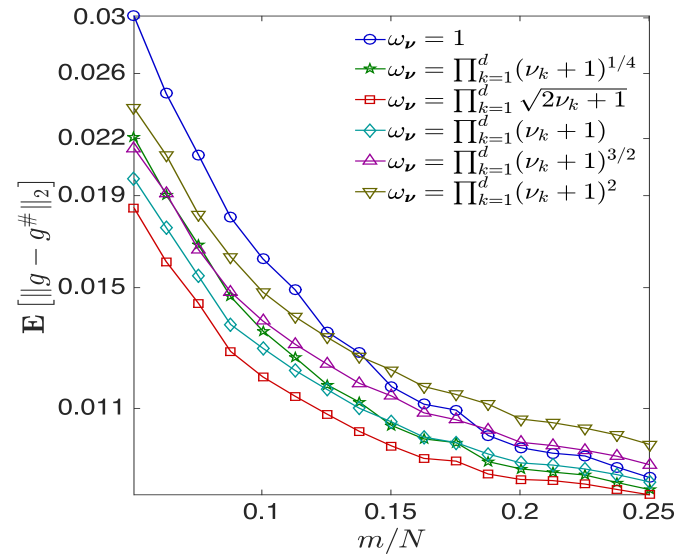
Recovery via regularizations enforcing sparsity:

$$c = \text{argmin } R(z) \quad \text{subject to} \quad u \approx Az$$

$$R(z) = \|z\|_{\omega,1} \text{ with } \omega_j = \max |A_{:,j}|$$



Data from UQ and imaging applications often possess downward closed and tree structure.



A comparison of weighted l_1 minimization with different choices of weights

A. Chkifa, N. Dexter, H. Tran, and C. Webster, *Polynomial approximation via compressed sensing of high-dimensional functions on lower sets*. **Math. Comp.** (2017) https://doi.org/10.1090/mcom/3272

Work was performed at ORNL

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