

算法研究

基于稀疏贝叶斯学习的联合平移不变子空间压缩采样

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摘要:

针对一类特殊的有效核函数 (active kernel) 未知的联合平移不变子空间 (Union of Shift-Invariant Subspaces, USI) 信号, 构建了一种压缩采样模型, 将信号的重构过程看作一个线性回归问题, 利用稀疏贝叶斯学习 (sparse bayesian learning, SBL) 算法求得该回归模型中的权值参数的最优估计, 根据权值参数向量集的支持集实现信号的稀疏重构. 理论分析表明, 对于由M个核函数 (kernel) 以T为周期平移生成的平移不变空间 (Shift-Invariant Spaces, SI), 若M个核函数中至多有K (1≤K≤M/2) 个且未知哪K个有效时, 本文构建的压缩采样模型最低采样率能够达到2K/T, 这也是利用稀疏度K所能达到的理论上的最低采样率. 仿真结果表明, 构建的压缩采样模型能够有效降低这类信号的采样率.

关键词: 联合平移不变子空间; 压缩采样; 稀疏重构; 稀疏贝叶斯学习

Compressed Sampling in Union of Shift-Invariant Subspace Based on Sparse Bayesian Learning

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Abstract:

For the signals in a special union of shift-invariant subspaces (USI) when the active kernel functions are unknown, a concrete compressed sampling scheme is proposed. We regard the process of signal reconstruction as a linear regression model and acquire the optional weights by sparse bayesian learning, then the signal can be reconstructed accurately from the support of weight vector set. For a continuous-time sparse signal in shift-invariant spaces which is generated by M kernels with period T, however, there are only K out of the M kernels are active and we do not know which K are chosen, we can sample the signal at 2K/T rate by the sampling scheme, which is the minimal sampling rate with exploiting sparsity K. Simulation results are presented to show that our compressed sampling scheme can reduce the sampling rate effectively.

Keywords: union of shift-invariant subspaces; compressed sampling; sparse reconstruction; sparse bayesian learning

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