信号处理 2012, 28(6) 799-805 DOI: ISSN: 1003-0530 CN: 11-2406/TN

论文与技术报告

基于压缩感知的自适应卡尔曼滤波

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摘要：

针对稀疏流信号，提出了一种自适应卡尔曼滤波恢复方法，该算法基于压缩感知AIC结构，用有限长的窗口对信号进行观测，利用前后窗内信号之间的相关性，建立信号的状态转移方程，并与压缩感知获得的观测方程共同构成信号的状态空间模型，进而利用降阶的卡尔曼滤波算法近似得到信号的最小均方误差估计。信号重构阶段通过卡尔曼滤波迭代逐渐得到精确的支撑集，与以往仅用起始阶段的恢复结果获得支撑集的方法相比，本算法对起始阶段恢复支撑集的算法的精确程度要求不高，从而降低了整个算法的复杂度和要求的观测维度。仿真结果显示，这种自适应的卡尔曼滤波算法在宽带流信号的恢复中可以有效地降低所需观测维度，且最终结果可近似地收敛到信号的最小均方误差估计。

关键词： 压缩感知；流信号；卡尔曼滤波

Adaptive Kalman filtered compressed sensing for streaming signals

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Abstract:

In this paper, we propose an adaptive Kalman filter based on compressed sensing for the reconstruction of streaming signals. The Analog Information Converter (AIC) structure is implemented for streaming compressive sampling while the signal is observed from a sliding window of finite length. Then we use the correlations between the signals of two continuous windows to model the process in the state-space form so that the Kalman Filter can be implemented to obtain the MMSE estimation of the streaming signals. A simple algorithm with low complexity is proposed to estimate the support at the beginning of every recursion and the estimation that will be refined during the whole operation. As such, the proposed method doesn’t need an accurate initial estimation which always demands more observations and higher complexity. The simulation results show that the proposed adaptive Kalman filter can greatly reduce the observation dimensions based on compressed sensing and converge to the ideal Kalman filter with low complexity.

Keywords: compressed sensing streaming signals Kalman filter

收稿日期 2012-01-04 修回日期 2012-05-15 网络版发布日期 2012-06-25

DOI:

基金项目:

NSFC-广东联合自然基金(U1035001);国家重大专项2012ZX03003006;国家“973”项目2009CB320400;教育部重要高校科研基金BUPT2009CR0107

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