

特约稿

压缩感知及其应用：从稀疏约束到低秩约束优化

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摘要:

压缩感知(或称压缩采样)是国际上近期出现的一种信息理论。其核心思想是只要某高维信号是可压缩的或在某个变换域上具有稀疏性,就可以用一个与变换基不相关的测量矩阵将该信号投影到一个低维空间上,然后通过求解一个最优化问题以较高的概率从这些少量的投影中重构出原始信号。压缩感知理论突破了香农定理对信号采样频率的限制,能够以较少的采样资源,较高的采样速度和较低的软硬件复杂度获得原始信号的测量值。该理论已经被广泛应用于数字相机、医学成像、遥感成像、地震勘探、多媒体混合编码、通讯、结构健康监测等领域。本文归纳了压缩感知研究中的关键问题,探讨压缩感知从稀疏约束到低秩约束优化的发展历程,对压缩感知在遥感、地震勘探等几个相关领域的应用研究进行了综述。

关键词: 压缩感知; 稀疏约束; 低秩约束; 遥感; 地球物理勘探; 视频编码

Compressive Sensing and its Application: from Sparse to Low-rank Regularized Optimization

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Abstract:

Compressive sensing/compressive sampling (CS) is a novel information theory proposed recently. CS provides a new sampling theory to reduce data acquisition, which says that sparse or compressible signals can be exactly reconstructed from highly incomplete random sets of measurements. CS broke through the restrictions of the Shannon theorem on the sampling frequency, which can use fewer sampling resources, higher sampling rate and lower hardware and software complexity to obtain the required measurements. CS has been used widely in many fields including digital cameras, medical imaging, remote sensing, seismic exploration, multimedia hybrid coding, communications and structural health monitoring. This article firstly summarizes some key issues in CS, and then discusses the development process of the optimization algorithms in CS from the sparsity constraints to low rank constraints. Lastly, several related applications of CS in remote sensing, seismic exploration are reviewed.

Keywords: Compressive sensing sparsity constraints low-rank constraints remote sensing geophysical exploration video coding

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