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论文与报告

基于前向后向算子分裂的稀疏性正则化图像超分辨率算法

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摘要

提出了一种新的基于稀疏表示正则化的多帧图像超分辨凸变分模型, 模型中的正则项刻画了理想图 像在框架系统下的稀疏性先验, 保真项度量其在退化模型下与观测信号的一致性, 同时分析了最优解条件. 进一步, 基于前向后向算子分裂法提出了求解该模型的不动点迭代数值算法, 每一次迭代分解为仅对保真项的前向(显式)步与仅对正则项的后向(隐式)步, 从而大幅度降低了计算复杂性; 分析了算法的收敛性, 并采取序贯策略提高收敛速度. 针对可见光与红外图像序列进行了数值仿真, 实验结果验证了本文模型与数值算法的有效性.

关键词 超分辨率 稀疏表示 前向后向分裂算法 邻近算子 阈值收缩

分类号

Sparsity Regularized Image Super-resolution Model via Forward-backward Operator Splitting Method

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Abstract

A convex variational model is proposed for multi-frame image super-resolution with sparse representation regularization. The regularization term constrains the underlying image to have a sparse representation in a proper frame. The fidelity term restricts the consistency with the measured image in terms of the data degradation model. The characters of the optimal solution to the model are analyzed. Furthermore, a fixed-point numerical iteration algorithm is proposed to solve this convex variational problem based on the proximal forward-backward splitting method for monotone operator. At every iteration, the forward (explicit) gradient step for the fidelity term and the backward (implicit) step for regularization term are activated separately, thus complexity is decreased rapidly. The convergence of the numerical algorithm is studied and a continuation strategy is exploited to accelerate the convergence speed. Numerical results for optics and infrared images are presented to demonstrate that our super-resolution model and numerical algorithm are both effective.

Key words Super-resolution sparse representation forward-backward splitting proximal operator threshold shrinkage

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