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软件、算法与仿真

基于加权最小二乘的字典学习算法

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摘要：

冗余字典学习是信号稀疏表示理论中的一个重要研究方面。首先,针对各训练样本稀疏表示误差各不相同的现象,建立了误差加权的信号稀疏表示数学模型,根据该模型提出一种基于加权最小二乘的字典学习算法,推导了算法闭式解和讨论了最优加权矩阵的选取。其次,为避免闭式解中矩阵求逆运算,进一步推导了算法的在线计算形式,对训练样本依次学习,每学习一个样本,字典进行一次更新,直至样本结束。此外,对算法收敛性进行了理论分析。最后,分别从信号稀疏表示和已知字典恢复两个方面仿真验证了理论分析的正确性和算法的可行性和优越性。

关键词： 加权最小二乘 信号稀疏表示 冗余字典 字典学习

Dictionary learning algorithm based on weighted least square

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Abstract：

Redundant dictionary learning is an important part of signal sparse representation theory. The mathematical model of signal sparse representation against the differences among training vectors' representation errors is firstly established, and according to this model a novel dictionary learning algorithm based on weighted least square is presented. The closed solution of this novel algorithm is derived and the selection of the optimal weighting matrix is also discussed. Secondly, in order to avoid matrix inverse operation in closed solution, the online calculating form is further derived. Training vectors are learned successively and the dictionary is updated whenever a training vector is finished. Moreover, the detailed steps are presented and algorithm's convergence is analyzed. Finally, simulation results show the theoretic analysis' validity and the algorithm's feasibility and effectiveness from both signal sparse representation and recovery of known redundant dictionary.

Keywords: weighted least square signal sparse representation redundant dictionary dictionary learning

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