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应用

基于序列锥规划方法的群延时约束等纹波有限冲激响应数字滤波器优化设计

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摘要：

有限冲激响应数字滤波器（FIR）的优化设计理论，一般是使设计的FIR滤波器频率响应与期望滤波器频率响应之间的误差最小并通过优化技术进行求解。但是已有的这些方法大都关注于通带和阻带内的幅频特性，而对于非线性群延时约束考虑较少，因此对于群延时要求较高的应用场合，这些方法是不适用的。该文提出了一种群延时约束的等纹波有限冲激响应数字滤波器设计新方法，该方法主要思想是采用泰勒级数近似将带有非线性群延时约束条件的原等纹波滤波器优化设计问题在好的初始迭代点附近转化为序列二阶锥规划子问题进行求解，较好的解决了对群延时要求较高的问题。仿真结果表明，该方法可以有效的减小滤波器群延时误差，最小化通带和阻带纹波，提高了滤波器的优化设计性能。

关键词： 有限冲激响应数字滤波器； 等纹波； 群延时； 序列锥规划； 二阶锥规划

Optimal Design of Equiripple FIR Digtal Filter with Group Delay Constraint Using Sequential Cone Programming

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Abstract:

The design theory of FIR filter is mostly about the amplitude frequency response performance of passbands and stopbands, which makes the errors between practicality and expectation minimum, such as the one-norm, two-norm and so on. Nonlinear group delay constraint is rarely taken into consideration in most research papers. Therefore, above-mentioned methods can not be applied in the situation of high level with nonlinear group delay constraint. This correspondence presents a new method for equiripple FIR digital filter design with group delay constraint. The main idea of this paper adopts Taylor approximation to transform the original equiripple filter optimal design problem with nonlinear group delay constraint into sequential second-order cone programming framework at the good initial interative point. The problem of group delay constraint could be effectively solved by the proposed method in this paper. Simulations are presented to illustrate the minimal ripple of the passbands and the stopbands, the significant reduction of group delay error and the good performance of the optimal filter design. The final results are consistent with the theoretical analysis. Simulations results also compare the design performance with two methods of SOCP algorithm and Sequential Cone Programming algorithm, and the results verify the usefulness of the algorithm.

Keywords: FIR digital filter equiripple group delay sequential cone programming;second-order cone programming

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