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DESIGN METHODS OF FIR FILTERS WITH SIGNED POWER OF TWO COEFFICIENTS USING A NEW LINEAR PROGRAMMING RELAXATION WITH TRIANGLE INEQUALITIES

Rika Ito

Department of Information Science
Toho University
2-2-1 Miyama, Funabashi, Chiba, Japan
rika@is.sci.toho-u.ac.jp

Tetsuya Fujie

Department of Strategic Management
University of Hyogo
8-2-1, Gakuen-nishimachi, Nishi-ku, Kobe 651-2197, Japan

Kenji Suyama

Department of Electrical Engineering
Tokyo DENKI University
2-2, Kanda-Nishiki-cho, Chiyoda-ku, Tokyo , Japan

Ryuichi Hirabayashi

Faculty of Management
Mejiro University
4-31-1, Nakaochiai, Shinjuku-ku, Tokyo, Japan

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Abstract. *Recently, a semi-definite programming relaxation method (SDP relaxation) for the design problem of FIR filters with SP2 coefficients is proposed. In this paper, we propose a new linear programming relaxation method (LP relaxation) with triangle inequalities based on the SDP relaxation method. Here, the polynomiality of the method is guaranteed by exploiting the interior point methods to solve the LP relaxation problem. We will compare the LP relaxation methods proposed here and the SDP relaxation methods through numerical experiments and show that the quality of the solution for the LP relaxation method is better than that of SDP relaxation method.*
keyword: Digital filter, Optimization, Semi-definite programming, Linear programming, Linear programming relaxation, Signed power of two, Approximation

1. **Introduction.** Recently, many studies on a design method for linear phase FIR filters with discrete coefficients have been published [1]- [6], in which, a numerical representation by a sum of signed power of two (SP2) has been used in several methods. It is a reason that a small number of non-zero digits is often required for a representation of the coefficients in a VLSI implementation of the filters. However, it is difficult to design filters with SP2 coefficients since it results in an integer programming problem (IP) well-known as one of the NP-hard problems which can not be solved in polynomial time [5].