Zhou, Xueling; Ling, Bingo Wing-Kuen; Dam, Hai Huyen; Teo, Kok-Lay

Optimal design of window functions for filter window bank. (English) [Zbl 07394134]

Summary: This paper considers the designs of the periodic window functions in the filter window banks. First, the filter window bank with the constant synthesis periodic window functions is considered. The total number of the nonzero coefficients in the impulse responses of the analysis periodic window functions is minimized subject to the near perfect reconstruction condition. This is an $L_0$ norm optimization problem. To find its solution, the $L_0$ norm optimization problem is approximated by the $L_1$ norm optimization problem. Then, the column of the constraint matrix corresponding to the element in the solution with the smallest magnitude is removed. Next, it is tested whether the feasible set corresponding to the new $L_0$ norm optimization problem is empty or not. By repeating the above procedures, a solution of the $L_0$ norm optimization problem is obtained. Second, the filter window bank with the time varying synthesis periodic window functions is considered. Likewise, the design of the periodic window functions in both the analysis periodic window functions and the synthesis periodic window functions is formulated as an $L_0$ optimization problem. However, this $L_0$ norm optimization problem is subject to a quadratic matrix inequality constraint. To find its solution, the set of the synthesis periodic window functions is initialized. Then, the set of the analysis periodic window functions is optimized based on the initialized set of the synthesis periodic window functions. Next, the set of the synthesis periodic window functions is optimized based on the found set of the analysis periodic window functions. Finally, these two procedures are iterated. It is shown that the iterative algorithm converges. A design example of a filter window bank with the constant synthesis periodic window functions and a design example of a filter window bank with the time varying synthesis periodic window functions are illustrated. It is shown that the near perfect reconstruction condition is satisfied, whereas this is not the cases for the nonuniform filter banks with the conventional samplers and the conventional block samplers.

MSC:
58F15 Hyperbolic structures (expanding maps, Anosov systems, etc.) (MSC2000)
58F17 Geodesic and horocycle flows (MSC2000)
53C35 Differential geometry of symmetric spaces

Keywords:
filter bank design; window design; incompatible nonuniform filter bank; nonuniform block filter bank; $L_0$ norm optimization; $L_1$ norm optimization problem

Full Text: DOI

References:


[12] B. W. K. Ling; C. Y. F. Ho; J. Cao; Q. Dai, Necessary and sufficient condition for a set of maximally decimated integers to be incompatible, Necessary and Sufficient Condition for a Set of Maximally Decimated Integers to Be Incompatible, 9, 564-566 (2013)


[27] Z. Xiong; K. Ramchandran; C. Herley; M. T. Orchard, Flexible tree-structured signal expansions using time-varying wavelet packets, IEEE Transactions on Signal Processing, 45, 335-345 (1997)


This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.