Structurally orthogonal finite precision FPGA implementation of block-lifting-based quaternionic paraunitary filter banks for L2L image coding

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2017

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Keywords:

IEEE Keywords: Quaternions, Image coding, Algebra, Transforms, Transform coding, Clocks, Field programmable gate arrays.

INSPEC: Controlled Indexing channel bank filters, distributed arithmetic, field programmable gate arrays, image coding, linear phase filters, pipeline arithmetic, transforms.

INSPEC: Non-Controlled Indexing orthogonal finite precision FPGA implementation, M-band linear phase paraunitary filter banks, quaternionic algebra, DA block-lifting structure, block-lifting-based quaternionic paraunitary filter banks, L2L image coding, integer-to-integer invertible quaternionic multiplier, pipelined embedded processor, distributed arithmetic, FPGA-based devices, integer-to-integer transform, DA-based 8-channel LP Q-PUFB.

Abstract: This paper presents a systematic design of the integer-to-integer invertible quaternionic multiplier based on the block-lifting structure and pipelined embedded processor of the given multiplier using distributed arithmetic (DA) as a block of M-band linear phase paraunitary filter banks (LP PUFB) based on the quaternionic algebra (Q-PUFB). A bank Q-PUFB based on the DA block-lifting structure reduces the number of rounding operations and has a regular layout, and can be implemented on the FPGA-based devices as integer-to-integer transform. Compared to general-purpose Q-PUFB obtained using lifting factorization, it needs less lifting steps and the given DA-based Q-PUFBs have less number of rounding operations and this property is useful for the lossless-to-lossy (L2L) image coding. Furthermore our DA-based 8-channel LP Q-PUFBs presented superior coding results on the PSNR than the corresponding filter banks, especially for image with relatively strong highpass components.

Published in: Digital Signal Processing (DSP'2017): Proc. 22nd Int. Conf., London, United Kingdom, August 23-25, 2017 / Imperial college London. – London, 2017. – 5 P. – DOI: 10.1109/ICDSP.2017.8096088.

Internet link: http://ieeexplore.ieee.org/document/8096088/.