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

Nick A. Petrovsky 1, Eugene V. Rybenkov 2, Alexander A. Petrovsky 3

2017
Department of Computer Engineering, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus

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.
