Triple-Matrix Product based 2-D Systolic Implementation of Discrete Fourier Transform

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Abstract- Realization of N-point Discrete Fourier Transform (DFT) using one-dimensional or two-dimensional systolic array structures have been developed for power of two DFT sizes. DFT algorithm, which can be represented as a triple -matrix product, can be realized by decomposing N into smaller lengths. Triple matrix product form of representation enables to map the N- point DFT on a 2-D systolic array. In this work, an algorithm is developed and is mapped to a 2-dimensional systolic structure where DFT size can be non-power of two. The proposed work gives flexibility to choose N for an application where N is a composite number. The total time required to compute N-point DFT is $2(N_1-1)+N_2+N$ for any $N=N_1N_2$. The array can be used for matrix-matrix multiplication and also to compute the diagonal elements of triple-matrix multiplication for various other applications. The proposed architecture produces in-order stream of DFT sequence at the output avoiding need for reordering buffer. Large sized DFT can be computed by repeatedly using the proposed systolic array architecture.