A GPU Implementation of the Successive QR Factorizations

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Abstract

We present a GPU implementation of the successive QR factorization for fast generation of a Cholesky factor sequence or stream, followed by fast calculation of weight vectors, in space-time adaptive sensing systems. Specifically, a Cholesky factor sequence $\{C_k\}$ is generated quickly as a sequence of $m \times n$ data matrices $\{A_k\}$, $m > 3n$, is provided in stream, where $A_{k+1}$ is essentially the forward shift of $A_k$ with the last row containing the most recent data. The underlying algorithm is advantageous in comparison to the conventional algorithms for the same computation problem. It reduces the number of arithmetic operations per factorization to $\gamma \sqrt{mn}$ with a modest constant $\gamma$. At the same time, it has a great potential in parallel implementation within each factorization as well as across successive factorizations. We present the particular version of the algorithm using Householder reflections and its implementation on the GPU architecture, which promises an architectural acceleration factor in addition to the algorithmic one.

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