

A STREAMING APPROACH FOR SPARSE MATRIX PRODUCTS AND ITS APPLICATION IN GALERKIN MULTIGRID METHODS*

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Abstract. In this paper, we present a numerical algorithm for computing products of the form RKR^T , where R , R^T , and K are sparse matrices. By reformulating the problem into the simultaneous processing of a sequential data and control stream, cache miss penalties are significantly reduced. Even though the algorithm increases memory requirements, it accelerates sparse matrix products on recent processor architectures by a factor of up to 4 compared to previous approaches. We apply the algorithm to compute consistent system matrices at different resolution levels in a dynamic multigrid elasticity simulation, and we show its efficiency for nested and non-nested mesh hierarchies.

Key words. sparse matrix products, cache-awareness, multigrid, Galerkin update

AMS subject classifications. 65F50, 65M55, 65M60, 65Y20, 68W01, 74B99, 74H15

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