# Multigrid Preconditioning Techniques for Geophysical Electromagnetics

Hisham bin Zubair Syed [1]

Electromagnetic surveys are one of many techniques used for geophysical exploration for hydrocarbon reservoirs and ore deposits. While these techniques are commonplace in industry, current algorithms still fall short of taking full advantage of the data collected in real-world surveys. The focus of this talk is on improving algorithms for the forward simulation of electromagnetic data. This forward model is naturally expressed in terms of Maxwell's equations in the frequency domain, where the electrical field is then further decomposed into a vector potential and a solenoidal part. A suitable finite-element discretization uses Nedelec (edge) elements for the vector potential, and Lagrange (nodal) elements for the solenoidal part, leading to a complex-valued block-structured matrix system for the the two solution components. In this talk, we consider block-structured multigrid preconditioners for the equivalent real form of the discretization matrix. In particular, we propose a block-diagonal preconditioner, which treats the curl-curl parts of the system using the Auxiliary-space Maxwell Solver (Hiptmair-Xu) algorithm, and the solenoidal parts by applying algebraic multigrid to a suitable approximate Schur complement. We highlight the construction of the problem as well as the preconditioner and present results which demonstrate the efficacy of the proposed solution technique.

[1]Memorial University of Newfoundland, Canada (hbinzubair@gmail.com)