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**Preconditioning Communication-Avoiding Krylov
Methods**

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Krylov subspace projection methods are widely used iterative methods for solving large-scale linear systems of equations. Communication-avoiding (CA) techniques may improve the performance of the Krylov methods on modern computers, where communication has become significantly more expensive compared to arithmetic operations. However, though the CA Krylov methods were originally proposed as s-step methods over thirty years ago, they have not been widely adopted in practice. One reason for this is that, in practice, Krylov methods require preconditioning to accelerate their convergence rate, but it is a challenge to seamlessly precondition a CA method. In this talk, we first outline a domain decomposition framework to introduce a family of preconditioners that are suitable for CA Krylov methods. Our preconditioners do not incur any additional communication and allow the easy reuse of existing algorithms and software for the subdomain solves. We then discuss several extensions to the framework, which can improve the performance of the preconditioners.