Faster Multigrid Using Generalized Locally Toeplitz Framework

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Conclusion

GLT-MG – faster and scales better.

Benchmark Test

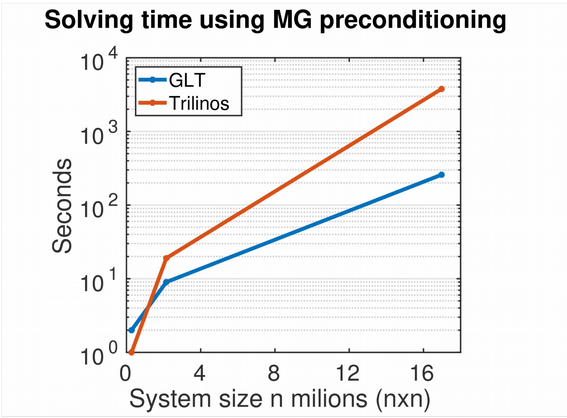
GLT-MG against Trilinos AMG solving 3D discrete Laplace equation.

GLT-MG (Generalized Locally Toeplitz Multigrid)

Standard MG: A hierarchy of increasingly coarser grids/levels

- Restrictors (R)
- Prolongators (P)
- Smoothers (S)
- Coarse mesh matrices

GLT-MG: All ingredients are based on an analytic function – the symbol.

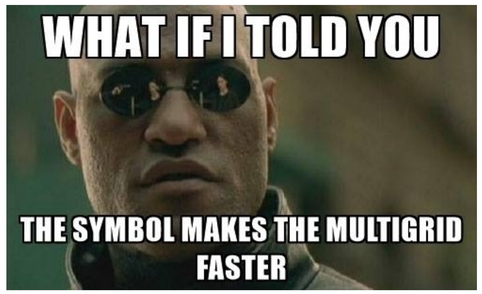


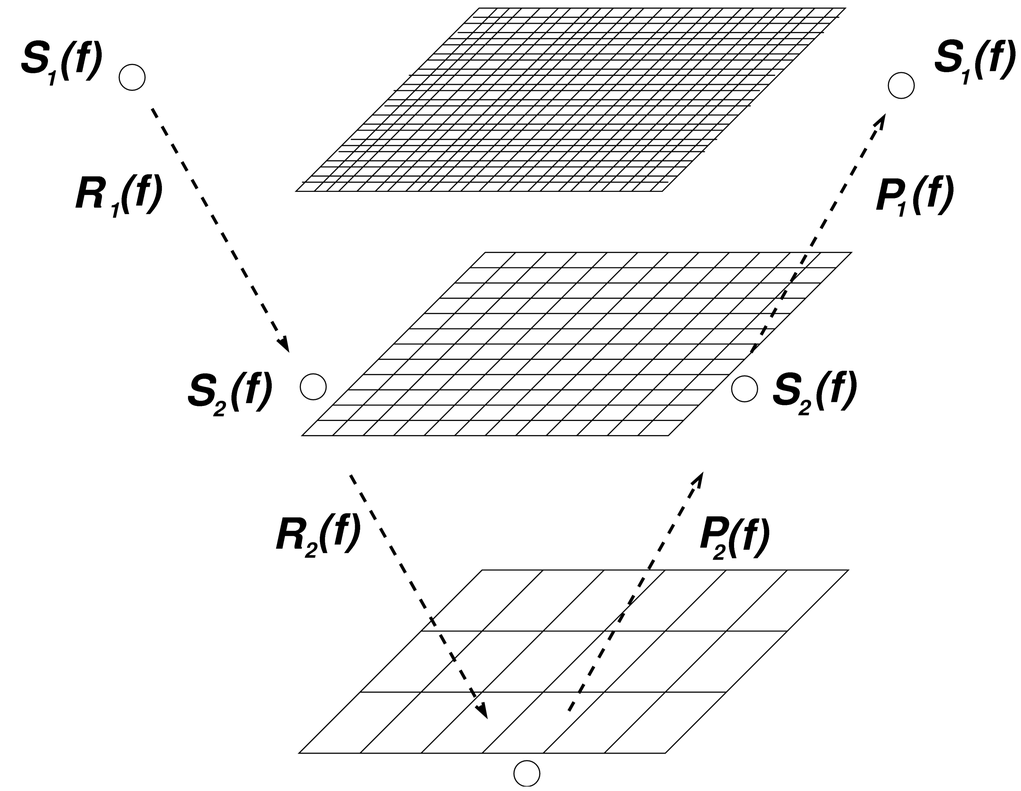
Applications

GLT-MG applies to matrices of generalized block Toeplitz form. These types of matrices arise from discrete PDE problems.

GLT-MG can be used to make faster simulations for more accurate physics and faster real-time rendering such as in computer games.

Multigrid in action: (borrowed)





$$f(\theta_1, \theta_2, \theta_3) = \frac{h}{9}(\epsilon_1 f_1(\theta_1, \theta_2, \theta_3) + \epsilon_2 f_2(\theta_1, \theta_2, \theta_3) + \epsilon_3 f_3(\theta_1, \theta_2, \theta_3))$$

Implementation

Based on C++ and deal.ii and Trilinos sci. libraries

Future Work

Use of the symbol to:

- reduce memory demand
- increase computations

to get a better suitability for modern computer platforms.