



**SBEL/WACC Brown Bag Seminar  
Thursday, November 20th at 1:30 PM  
In room 4150ME**

**Professor Eftychios Sifakis, Department of  
Computer Science**

**“Multigrid schemes: Performance potential,  
applicability and pitfalls.”**

For a large set of problems in computational science, the algorithmic modules involved in a software solution end up being divided in two categories: (a) Modules where linear (or near-linear) scalability can be achieved with well-known practices, and (b) Solution of large, sparse systems of linear equations. The latter category often ends up being a computational bottleneck, as the most easy-to-implement iterative solvers (that take advantage of sparsity) require a resolution-dependent number of iterations to converge. Multigrid schemes (along with Domain Decomposition methods) are among the numerical algorithms that offer the \*potential\* for resolution-independent convergence rates, and ultimately a linear cost of scaling up problem sizes.

As is often the case, with great potential come great hazards, too. Superficially, the intuition behind the efficacy of multigrid schemes can be very deceptive, leading one to believe that they are applicable to a broader range of problems (e.g. problems where different resolutions capture similar high-level behaviors) than the narrow case of problems where multigrid schemes \*are\* in fact usable for (e.g. problems with strong analytical \*and\* numerical ellipticity). In this mixed-medium presentation (mostly a whiteboard seminar, with visual examples sprinkled in) I will describe the actual prerequisites of multigrid schemes, illustrate cases where such criteria are not met (and discuss some remedies for fixable cases), and explain why such techniques (if applicable) are a very good fit for bandwidth-sensitive platforms.