Key features of SAMG:
- State-of-the-art AMG performance – applicable for structured and unstructured meshes
- Optimized solver control including automated-setup-reuse and switching between different solvers
- Supports both multi-core and multi-node systems

Advantages for MODFLOW:
- Usable as black box
- High resolutions: Allows increased modeling accuracy for both structured and unstructured models (as in MODFLOW-USG), while keeping computing times low
- Handles strongly heterogeneous and unstructured models where standard solvers have problems
SAMG is a very efficient core solver library for accelerating industrial applications. SAMG is based on algebraic multigrid (AMG) and supports both serial and multi-core computations on single PCs, workstations or compute nodes.

LMG is an interface linking the SAMG library to MODFLOW. There are three versions of LMG: LMG-2kx supports MODFLOW-2000 and MODFLOW-2005, LMG-USG supports MODFLOW-USG and LMG-6 supports MODFLOW 6. An LMG version for transport codes like MODFLOW-USG-Transport is currently being evaluated.

The graph shows computing times for the MODFLOW 6 model test007_751x751 with roughly 600,000 grid-cells. While PCG is very sensitive to the relaxation factor used, LMG does not need additional parameters set by the user. LMG achieves a speed-up of 5.1 on a single core and a speed-up of 11.8 on 4 cores compared with PCG. Hence, the total runtime with LMG is reduced by a factor of 3.4 on a single core and a factor of 5.1 on 4 cores compared with the total runtime using PCG. The runtime of SAMG grows only linearly with the number of equations. For this reason, the speed-up of LMG compared to PCG will increase for bigger models.

User Comments

“[SAMG] provided optimal runtime speed compared to public-domain solvers evaluated....” – GeoHydroScience LLC

“In general, the SAMG solver is the fastest MODFLOW solver that [we] have used. I have seen multiple models where the SAMG solver was not only faster but more stable than the standard MODFLOW solvers” – Aquaveo LLC

Commercial references:

The following companies offer SAMG in their groundwater simulation software:

- Aquaveo LLC
- DHI-WASY GmbH
- Environmental Simulations Inc.
- ITASCA Denver Inc.
- Waterloo Hydrogeologic
- HydroAlgorithmics

The graph shows computing times for the MODFLOW 6 model test007_751x751 with roughly 600,000 grid-cells. While PCG is very sensitive to the relaxation factor used, LMG does not need additional parameters set by the user. LMG achieves a speed-up of 5.1 on a single core and a speed-up of 11.8 on 4 cores compared with PCG. Hence, the total runtime with LMG is reduced by a factor of 3.4 on a single core and a factor of 5.1 on 4 cores compared with the total runtime using PCG. The runtime of SAMG grows only linearly with the number of equations. For this reason, the speed-up of LMG compared to PCG will increase for bigger models.