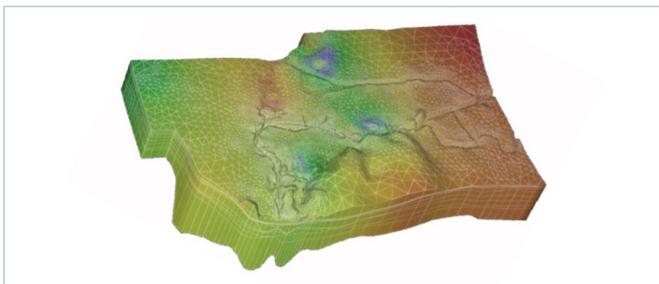


# SAMG-Oil: a fast and robust solver for various kinds of reservoir simulations

## One AMG solver for full Jacobians (FIM/AIM)

SAMG-Oil handles linear systems with all relevant physical unknowns, and the coupling between them, in a robust and efficient manner via the SAMG-Coupled module. Only minimal additional information about the underlying physics are required. This is what reservoir simulators need: In fully and adaptive implicit simulations, the linear systems arising involve different, yet coupled types of unknowns with different physics behind them.



*Exemplary reservoir, to which SAMG-Oil is applied.*

Thus, SAMG-Oil makes the outstanding performance of multigrid approaches easily available to reservoir simulations, including compositional, thermal, and coupled mechanics.



**SAMG-Oil, together with the SAMG-Constraints module, was perfectly able to handle our challenging linear systems from simulations that couple sub-surface flow with geomechanics of 3D fractured rock masses."**

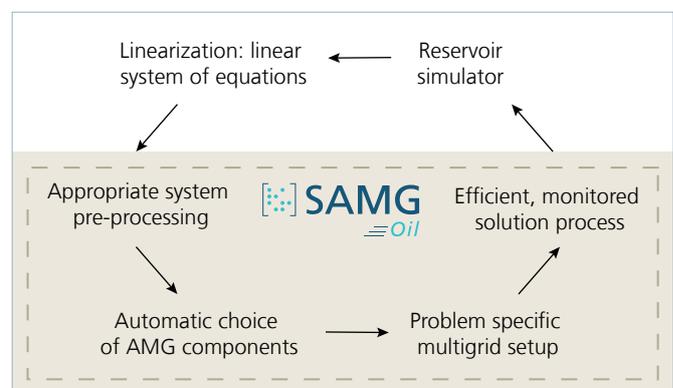
Imperial College Geomechanics Simulator Team

Internally, it makes use of the well-established SAMG solver and its variety of features. SAMG-Oil also supports any parallel flavor of SAMG (MPI, OpenMP).

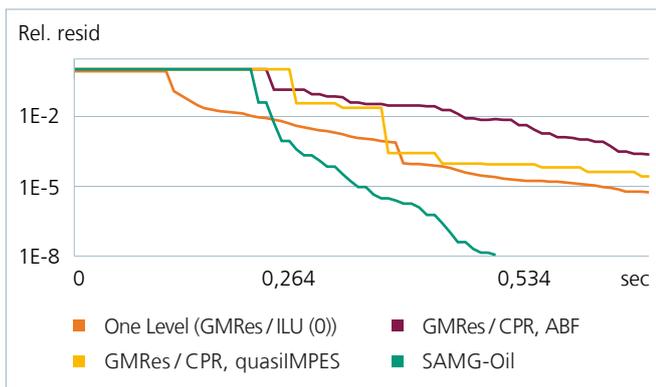
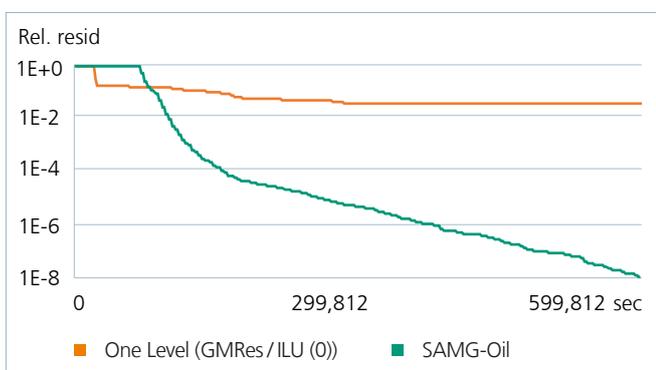
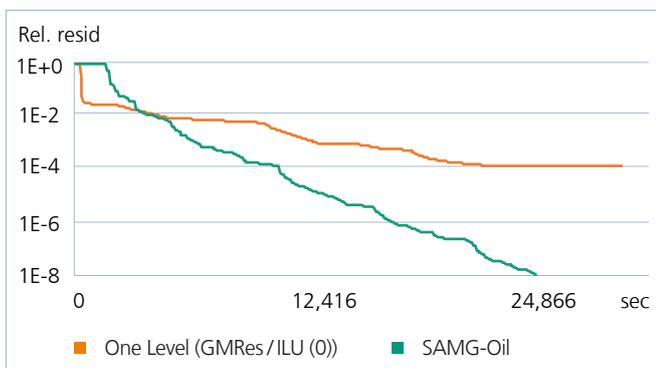
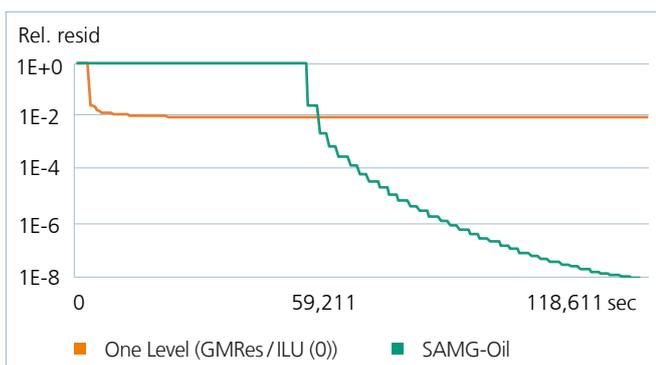
## Encapsulating the full linear solution process

SAMG-Oil can cope with various simulation approaches: from Black-Oil over compositional up to thermal and, together with SAMG-Constraints, coupled mechanical applications. The underlying framework facilitates a demand-driven adaptation also to new, not-yet supported simulation approaches.

Internally, SAMG-Oil selects an appropriate matrix pre-processing, based on the supplied information about the background physics. It adjusts the algebraic multigrid components to what is needed for the individual type of simulation. Within the solution process, the convergence quality can be monitored. The process is adjusted when necessary.



*SAMG-Oil workflow: Encapsulating all of the solver*

*Well-conditioned black-oil problem**Ill-conditioned compositional VBF case**Thermal: steam flood case**Coupled geomechanics, case without fractures*

SAMG-Oil converges towards the solution much faster and more robust than classically used solvers.

This makes SAMG-Oil the fastest solver, including the initial setup overhead. In difficult cases it often is the only iterative solver that converges.

### Applicable to a variety of simulation types

SAMG-Oil exploits typically available background information and internally adjusts SAMG to ensure a robust and efficient application.

This is supported for different types of reservoir simulations, including:

#### Black-oil

With different types of well models and also in cases with phase disappearance.

#### Compositional

Both natural variable and volume balance formulations are supported, also with varying phases and components per cell.

#### Thermal

Where beneficial, efficient multigrid solution is applied to the temperature as well. The entire process considers pressure-temperature couplings.

#### Coupled geomechanics

##### [Combined with SAMG-Constraints module]

Differences in scale and the underlying grids are approached within SAMG-Oil. Solver approaches for different ways of modelling fractures are available – from network models to xFEM.

#### Contact

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