# Matrix free multigrid preconditioner for high order Discontinuous Galerkin discretization - based on low order discretization on sub cell grid

Johannes Kasimir[1]     Robert Klöfkorn[2]    Philipp Birken[3]

Motivated by unsteady compressible flow applications in three dimensions, our goal is the construction of matrix free preconditioners for high order Discontinuous Galerkin (DG) discretizations. Problems of this type are usually stiff and require implicit time integration. We present a matrix free preconditioning strategy for Newton-Krylov (NK) methods applied to solve algebraic problems arising from the implicit time stepping. The preconditioner is based on a multigrid method constructed for a first order Finite Volume (FV) discretization defined on a subgrid of the DG grid. Several test cases are presented to investigate the effectiveness of this approach. The implementation was done using the `DUNE-fem` software package.

References:

[1] https://www.scipedia.com/public/Kasimir_et_al_2021

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[1]Lund University, Centre for Mathematical Sciences, Lund
   `johannes.kasimir@math.lu.se`

[2]Lund University, Centre for Mathematical Sciences, Lund
   `robertk@math.lu.se`

[3]Lund University, Centre for Mathematical Sciences, Lund
   `philipp.birken@na.lu.se`