# Modified RASPEN and Its Application to Discontinuous Galerkin Discretisation for Richards Equation in Porous Media Flow

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**Abstract:** Nonlinear systems of equations arising from the discretisation of the partial differential equations are typically solved by Newton's method. In this study, we propose a nonlinear preconditioner for Newton's method for solving the (nonlinear) system of equations which is the modification of RASPEN (Restricted Additive Schwarz Preconditioned Exact Newton). We employ an inexact inner solves and different Partition of Unity (PU) operators. The basic idea of RASPEN is to use fixed-point iteration to produce a new nonlinear system which has the same solution as the original system and solve it using Newton's method. The additive Schwarz method is used as a non-linear preconditioner and enables parallel computation by division into subproblems. An application of modified RASPEN to Discontinuous Galerkin (DG) discretisation for Richards equation in porous media flow is provided and compared to RASPEN. Moreover, we focus on the numerical investigation of robustness with respect to Newton's method.

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