DORiE – a versatile discontinuous Galerkin Richards solver

Lukas Riedel (1,2), Dion Häfner (1), Ole Klein (2), Kurt Roth (1,2)

(1) Institute of Environmental Physics, Heidelberg University, Heidelberg, Germany, (2) Interdisciplinary Center for Scientific Computing, Heidelberg University, Heidelberg, Germany

We present the DUNE Operated Richards Equation Solving Environment (DORiE), a software suite for solving Richards equation. It primarily features a PDE solver written in C++, which is based on the Distributed and Unified Numerics Environment (DUNE). DORiE implements a discontinuous Galerkin (dG) discretisation scheme on structured rectangular and unstructured rectangular or simplex grids in two and three spatial dimensions. The solver routine is encapsulated by Python modules for program setup and control, output analysis, and system tests.

Modern computer architectures and recent advances in software development allow for both highly performant and flexible solver applications. DORiE focuses on an accurate representation of the simulated physical domain by supporting irregularly shaped grids, spatially heterogeneous parameterisations, and varying boundary conditions on segmented boundaries. Solver efficiency is ensured by time step control and adaptive local grid refinement.

The project aims for merging the expertise of physicists, mathematicians, and computer scientists in a continuously improved and expanded, modular software environment. DORiE is highly precise, yet efficient and adaptable. It is provided as Docker application, can be controlled entirely via configuration files, and its usage requires no programming expertise.