A Local Discontinuous Galerkin Finite-Element Method for the Richard's Equation FEF 2017

Yilong Xiao[1], Ethan J. Kubatko (Ph.D)[2] and Gajan Sivandran (Ph.D)[3]

[1,2] Department of Civil, Environmental and Geodetic Engineering
The Ohio State University
Columbus, Ohio 43210, The United States of America
e-mail: [1] xiao.76@osu.edu, [2] kubatko.3@osu.edu

[3] Engineering Science, Loyola University Chicago
1032 W. Sheridan Road, Chicago, Illinois 60660, The United States of America
Email: gsivandran@luc.edu

ABSTRACT

Unsaturated flows in porous media arising from hydraulic conductivity, capillary pressure and gravity are governed by the Richards' equation. Most past numerical Richards' equation solvers were based on finite different or continuous Galerkin finite element methods (CG-FEM). In the context of the latter, the requirement on solution continuity can lead to numerical difficulties when abrupt change occurs in boundary conditions or in hydraulic properties of the porous media. In light of these challenges, a one-dimensional numerical Richards' equation solver is formulated based on the local discontinuous Galerkin finite element method (DG-FEM) – a class of finite element methods that employs piecewise continuous trial spaces and allows discontinuity in solutions, which can better accommodate high-intensity moisture inputs and natural heterogeneities. Soil moisture readings we obtained under controlled laboratory settings, as well as field measurement from the National Oceanic and Atmospheric Administration (NOAA)[1], will be used to test the accuracy of the developed solver, and simulation results will be compared to those of a solver based on the continuous Galerkin finite element method.

REFERENCES

[1] Diamond, H. J., T. R. Karl, M. A. Palecki, C. B. Baker, J. E. Bell, R. D. Leeper, D. R. Easterling, J. H. Lawrimore, T. P. Meyers, M. R. Helfert, G. Goodge, and P. W. Thorne, 2013: U.S. Climate Reference Network after one decade of operations: status and assessment. *Bull. Amer. Meteor. Soc.*, **94**, 489-498. doi: 10.1175/BAMS-D-12-00170.1.