Title: Weak imposition of essential boundary conditions in isogeometric analysis of depth averaged advection dispersion equation

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Abstract: The “depth averaged advection dispersion” equation is the governing equation in two-dimensional (2D) modelling of contaminant transport in shallow open channel flows. Isogeometric analysis (IGA) is a good method used for accurate geometrical modeling and approximation of the solution space. So, the aim of this study is to conduct the IGA of the depth averaged advection dispersion equation. Due to the non-interpolatory nature of NURBS basis functions the properties of Kronecker Delta are not satisfied, thus imposition of the essential BCs needs special treatment. Therefore, in order to improve the accuracy of the IGA in solution of depth averaged advection dispersion equation, the essential BCs are imposed in three weak forms, including: The Least Square Method (LSM), Lagrange Multiplier Method (LM) and the Penalty Method (PM). For this purpose, the numerical modeling is initially developed and the lateral diffusion problem is solved for a rectangular straight channel and the results of three models are compared with each other. Results indicate that the LSM has the best accuracy while the PM has the poorest. Likewise, despite accurate results, the system of the equation suffers from dimensional enlargement in LM which requires more calculation time. Moreover, in the case of skew advection, adapting the LM produces lower RMSE value and thus more accurate results in contrast to the strong enforced essential BCs in classical FEA and IGA solutions.