Physics-informed neural network for 1D Saint-Venant Equations

Giang V. Nguyen*, Xuan-Hien Le**, Sungho Jung***, Giha Lee****

Abstract

This study investigates the capability of Physics-Informed Neural Networks (PINNs) for solving the solution of partial differential equations. Particularly, the 1D Saint-Venant Equations (SVEs) were considered, which describe the movement of water in a domain with shallow depth compared to its horizontal extent, and are widely adopted in hydrodynamics, river, and coastal engineering. The core contribution of this work is to combine the robustness of neural networks with the physical constraints of the SVEs. The PINNs method utilized a neural network to approximate the solutions of SVEs, while also enforcing the underlying physical principles of the equations. This allows for a more effective and reliable solution, especially in areas with complex geometry and varying bathymetry. To validate the robustness of the PINNs method, numerical experiments were conducted on several benchmark problems. The results show that the PINNs could be achieved high accuracy when compared with the solution from the numerical solution. Overall, this study demonstrates the potential of using PINNs and highlights the benefits of integrating neural network and physics information for improved efficiency and accuracy in solving SVEs.

Keywords: Physics-informed, Artificial Neural Network, Saint Venant Equations

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* Ph.D. student, Dept.of Advanced Science and Technology Coverage, Kyungpook National University. E-mail: giangnv@knu.ac.kr

** Ph.D., Disaster Prevention Emergency Management Institue, Kyungpook National University. E-mail: hienlx@knu.ac.kr

*** Ph.D. candidate, Dept.of Advanced Science and Technology Coverage, Kyungpook National University.
E-mail: sh1202@knu.ac.kr

**** Associate Professor, Dept. of Advanced Science and Technology Coverage, Kyungpook National University.
E-mail: leegiha@knu.ac.kr