**CRUNCH Seminars at Brown, Division of Applied Mathematics**

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# Physics-Informed Neural Networks for Elliptic Partial Differential Equations on 3D Manifolds

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**Motivated by recent research on Physics-Informed Neural Networks (PINNs), we make the first attempt to introduce the PINNs for numerical simulation of the elliptic Partial Differential Equations (PDEs) on 3D manifolds. PINNs are one of the deep learning-based techniques. Based on the data and physical models, PINNs introduce the standard feedforward neural networks (NNs) to approximate the solutions to the PDE systems. By using automatic differentiation, the PDEs system could be explicitly encoded into NNs and consequently, the sum of mean squared residuals from PDEs could be minimized with respect to the NN parameters. In this study, the residual in the loss function could be constructed validly by using the automatic differentiation because of the relationship between the surface differential operators $\nabla S$ /$\Delta S$ and the standard Euclidean differential operators $\nabla / \Delta$. We first consider the unit sphere as surface to investigate the numerical accuracy and convergence of the PINNs with different sizes of width and depth. Another examples are provided with different complex manifolds to verify the robustness of the PINNs.**