Approaches in Filtering Theory for optimizing Physics-informed Neural Networks

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Dr. B.P.W. Fernando, earned a First Class Honours Bachelor of Science in Mathematics from the University of Colombo. He then pursued a Master of Science at the Korea Advanced Institute of Science and Technology (KAIST), followed by a Ph.D. in Applied Mathematics from the University of Wyoming. His doctoral research, focusing on the "Stochastic Navier-Stokes equation with Ito-Levy noise," laid the foundation for his expertise. He served as a Postdoctoral Associate and Researcher at the University of Leoben in Austria and as an NRC Research Associate at the Naval Postgraduate School in the United States. His scholarly work encompasses Stochastic Analysis, Filtering Theory, PDE Theory, and Fluid Dynamics. A dedicated educator, Dr. Fernando has held a position as a Senior Lecturer at the University of Sri Jayewardenepura since 2018. He is a Guest Professor at the University of Wuppertal in Germany, where he conducted graduate-level courses on Stochastic Differential Equations and Risk Theory.

ABSTRACT: "The application of machine learning (ML) to solve Partial Differential Equations (PDEs) for boundary value problems represents a paradigm shift in data-driven techniques in physics. Techniques like Physics-Informed Neural Networks (PINNs) have gained prominence for their ability to seamlessly integrate physical laws and data. However, a fundamental challenge arises from the spectral bias of neural networks, which inherently favor learning low-frequency functions. Input encoding filters, such as Fourier Feature Networks become indispensable for ML optimization, enabling accurate and efficient solutions. Beyond input encoding, filtering concepts are applied in the loss function and optimization dynamics. The speaker will provide a hitch-hickers guide towards considerations for applying filtering theory in PINNs. "