

THE UNIVERSITY



OF HONG KONG

*Institute of Mathematical Research  
Department of Mathematics*

## Numerical Analysis Seminar

### Complete Solution to the Most General Nonlinear Filtering Problems with the Capability of Overcoming the Curse of Dimensionality

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#### Abstract

The famous filtering problem of estimating the state of a stochastic dynamical system from noisy observations is of central importance in engineering, and high-dimensional nonlinear filtering is still a challenging problem. This problem is reduced to solving the Duncan-Mortensen-Zakai (DMZ) equation which is satisfied by the unnormalized conditional density of the state given the observation history. For general nonlinear filtering problems, we leverage the representation ability of recurrent neural networks and provide a computationally efficient and optimal framework for nonlinear filter design based on the Yau-Yau algorithm and recurrent neural networks. Theoretically, it can be proved that the size of the neural network required in this algorithm only increases in polynomial (rather than exponentially) with respect to the dimension, which implies that the Yau-Yau algorithm based on the recurrent neural network has the capability to overcome the curse of dimensionality. This solves a century old nonlinear filtering problem.

Date: Dec. 8, 2023 (Friday)

Time: 4:30pm – 5:30pm

Venue: Room 210, Run Run Shaw Building  
HKU

*All are welcome*