PURDUE UNIVERSITY | Purdue Quantum Science and Engineering Institute

# PURDUE QUANTUM SCIENCE AND ENGINEERING INSTITUTE

Innovating quantum technologies

## Special PQSEI Seminar

## *Designing a NISQ Reservoir with Maximal Memory Capacity for Volatility Forecasting*

**Samudra Dasgupta, *Oak Ridge National Lab***

**Wednesday, August 5, 4:30 – 5:30 p.m.:** meet.google.com/ryw-ftmn-vvk

**SAMUDRA DASGUPTA** obtained his B.Tech in Electronics and Electrical Engineering from IIT-Kharagpur '06, followed by M.S. in Engineering and Applied Sciences from Harvard '08 and an M.B.A. from Indian School of Business '12; He has over 10 years of work experience in various financial organizations in different capacities, including in Goldman Sachs (Vice President, Liquidity Risk Management), McKinsey and Company, (Engagement Manager, Banking and Finance), Bank of America (Assistant Vice President, Corporate Investments Group) and Higher Moment Capital (Research Analyst at Quant Hedge Fund). He is currently an entering Ph.D. candidate at the Oak Ridge National Laboratory's Quantum Computing Institute and the Bredesen Center U. Tenn. - Knoxville and during the past year, he has also been a Research Associate with Purdue Univ and ORNL. His current research interest is on the applications of quantum algorithms and NISQ in the prediction and mitigation of financial problems.

**ABSTRACT:** Quantitative risk management, particularly volatility forecasting, is critically important to traders, portfolio managers as well as policy makers. In this paper, we applied quantum reservoir computing for forecasting VIX (the CBOE volatility index), a highly non-linear and memory intensive 'real-life' signal that is driven by market dynamics and trader psychology and cannot be expressed by a deterministic equation. As a first step, we lay out the systematic design considerations for using a NISQ reservoir as a computing engine (which should be useful for practitioners). We then show how to experimentally evaluate the memory capacity of various reservoir topologies (using IBM-Q's Rochester device) to identify the configuration with maximum memory capacity. Once the optimal design is selected, the forecast is produced by a linear combination of the average spin of a 6-qubit quantum register trained using VIX and SPX data from 1990 onwards. We test the forecast performance over the subprime mortgage crisis period (Dec 2007 - Jun 2009). Our results show a remarkable ability to predict the volatility during the Great Recession using today's NISQs.

PURDUE UNIVERSITY Discovery Park