# Postgraduate Seminar Series

Venue: Graduate Seminar Room
Date & Time: Jan 31, 2026 at 3:00 PM

Speaker Information

Sarfaraz Newaz (Std No. 1018054002) is a full-time Ph.D. student in the Department of CSE, BUET. He completed both his undergraduate and M.Sc. studies from Bangladesh University of Engineering and Technology (BUET) in 2009 and 2018, respectively. His research interest lies in the fields of Machine Learning and Deep Learning. He is currently doing his Ph.D. thesis under the supervision of Dr. A. B. M. Alim Al Islam. He will be speaking about his ongoing research in this talk.
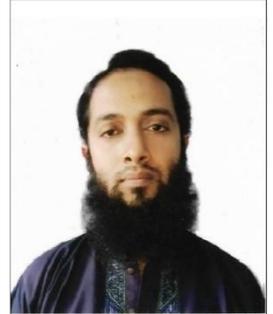
GRAIL: An Adaptive Hybrid Regression Framework for Imputing Missing GRACE Satellite Data

The Gravity Recovery and Climate Experiment (GRACE) satellite mission has revolutionized earth system science by enabling remote sensing of terrestrial mass changes. However, significant data gaps—caused by mission transitions, battery failures, and operational limitations—pose critical challenges to time-series analysis. Conventional imputation techniques, such as Linear and Spline interpolation, often fail to preserve the physical and temporal dynamics of GRACE datasets, leading to suboptimal reconstructions. In this study, we introduce **GRAIL**—an *Adaptive Hybrid Regression Framework* for imputing missing GRACE satellite data. GRAIL dynamically selects the optimal number of temporal neighbors for local regression, minimizing reconstruction error. Furthermore, it integrates a hybrid decision mechanism that adaptively chooses between this optimized regression and **Linear Interpolation** based on point-wise error profiling. While Spline interpolation was also extensively evaluated due to its visual smoothness, quantitative analysis demonstrated Linear interpolation's superior performance in certain scenarios, leading to its inclusion in the final hybrid approach. Extensive experiments were conducted on data extracted from 30 randomly selected 1°×1° grid points across the earth. These experiments, using UTCSR GRACE datasets covering a total duration of 278 months (April 2002 to May 2025) with 245 available data files and 33 missing months, demonstrate that the proposed Hybrid GRAIL method consistently achieves the lowest error rates, providing an error reduction of up to 31% compared to standard Linear interpolation. Our method achieves average RMS errors as low as 0.4375×10^{-07} for 1-month gaps and 2.1164×10^{-07} for 11-month gaps. This significantly outperforms individual baseline interpolation methods (Linear and Spline), Forward Regression, and even advanced methods like LSTM across a variety of missing-data scenarios, including up to eleven consecutive missing months. By preserving geophysical continuity and minimizing error, GRAIL enables more reliable downstream applications such as hydrological trend analysis and earthquake precursor detection in GRACE-based studies.