Guest Lecture Report

Title: Harnessing AI for Earth Observation Applications

Date: 4th September 2024 (Wednesday)

Mode: Online

Speaker: Dr. Jaydeo K. Dharpure, Post Doctoral Scholar, Byrd Polar and Climate Research Center, The Ohio State University

The online guest lecture on **Harnessing AI for Earth Observation Applications** was conducted by **Dr. Jaydeo K. Dharpure**, a postdoctoral scholar at **The Ohio State University**. Known for his extensive expertise in remote sensing, glacio-hydrology, and hydro-climatic data assimilation, Dr. Dharpure provided a comprehensive look at how artificial intelligence and machine learning are revolutionizing Earth observation applications.

Key Highlights of the Lecture

Dr. Dharpure structured his lecture to first establish foundational knowledge before delving into advanced machine learning techniques and specific case studies.

1. Introduction to Earth Observation Concepts

Dr. Dharpure began with an introduction to core Earth observation principles, discussing:

- **Satellites and Measurement Techniques**: Explained how satellites measure data via electromagnetic sensors, highlighting the significance of the atmospheric window and spectral signatures for identifying specific materials on Earth.

- **Types of Resolution**:

  - **Spatial Resolution:** Defines the level of detail visible in satellite imagery.

  - **Spectral Resolution:** Refers to the ability of a sensor to distinguish different wavelengths.

  - **Radiometric Resolution:** Determines the sensitivity of the sensor in detecting slight energy variations.

- **Temporal Resolution:** Pertains to the frequency with which data is captured over the same area.

- **Geospatial Data Types:** Provided an overview of the different types of geospatial data collected, such as vector and raster data, and their importance in environmental monitoring.

2. Machine Learning Approaches in Earth Observation

Dr. Dharpure then transitioned to machine learning, categorizing methods based on their learning paradigms:

- **Supervised, Unsupervised, and Reinforcement Learning**: Defined each approach and discussed their respective applications in analyzing and predicting environmental phenomena.

- **Algorithmic Techniques:** Explained some of the key algorithms and models used:

- **Random Forest and Support Vector Machines (SVM):** Used for classification tasks in remote sensing data.

- **Artificial Neural Networks (ANN) and Convolutional Neural Networks (CNNs):** Key for image-based analysis, especially for identifying land cover.

- **Long Short-Term Memory Networks (LSTMs) and Transformer Models:** Highlighted as powerful tools for analyzing time-series data, such as climate or flood prediction.

3. Case Studies

To contextualize these technologies, Dr. Dharpure presented real-world applications:

- Case 1: Snow Cover Variability on the Tibetan Plateau

Analyzed snow cover variability using satellite data and machine learning to assess seasonal and long-term changes in snow patterns.

- Case 2: Urban Heat Island Effect in Ahmedabad City

Utilized satellite imagery and AI models to map temperature variations across the city, examining how urbanization impacts local climate.

- Case 3: Automated Mapping of Glacial Lakes

Showcased an automated pipeline using CNNs for detecting and monitoring glacial lakes. This is critical for understanding glacial melt and potential hazards.

4. Advanced Techniques and Challenges

Dr. Dharpure discussed advanced topics like bridging gaps in time-series data, crucial for long-term environmental monitoring. He also explained how deep learning models are employed for **flood prediction**, enhancing disaster preparedness.

5. Challenges and Future Directions

The lecture concluded with a discussion on the key challenges in using AI for Earth observation, such as:

- **Data Quality and Availability:** The need for high-quality labeled data and challenges in obtaining real-time data.

- **Computational Complexity:** Processing vast amounts of satellite imagery and geospatial data demands significant computational resources.

- **Model Interpretability:** Balancing accuracy with interpretability, especially for critical applications in environmental monitoring.

Dr. Dharpure emphasized the importance of interdisciplinary collaboration to address these challenges, noting the future potential of AI in providing more sustainable and insightful solutions for environmental conservation.

Q&A Session

The lecture was followed by an insightful Q&A session, where Dr. Dharpure addressed inquiries from participants on technical challenges, practical applications, and the career scope in Earth observation and AI. His responses highlighted both the potential and limitations of current technology, providing a balanced perspective on AI's role in environmental sciences.

Conclusion

Dr. Dharpure's lecture was highly informative and inspirational, showcasing the vast possibilities of AI in Earth observation and the impact it can have on understanding and preserving our planet. His in-depth knowledge and clear explanations left participants with valuable insights and motivated them to further explore this impactful field.

A Report By: **Satyartha Shukla (24901321)**