Machine Learning based system evaluation for the UAV & SAR system

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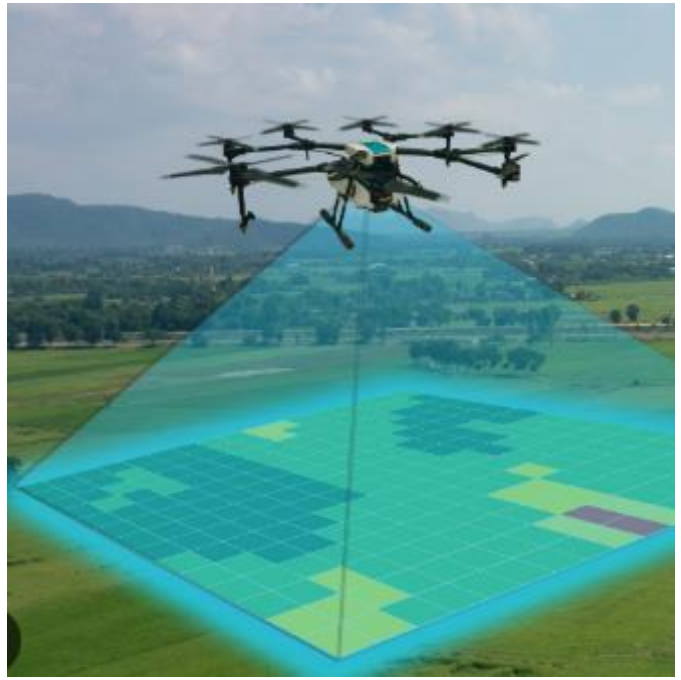
Problem Definition

The objective of this project is to develop and evaluate a machine learning-based framework for assessing the performance of an Unmanned Aerial Vehicle (UAV) equipped with a Synthetic Aperture Radar (SAR) system. UAVs with SAR capabilities are increasingly used for various applications such as **environmental monitoring, disaster response, surveillance, and agricultural assessments**. However, the effectiveness of SAR systems can be influenced by several factors such as **flight conditions, terrain types, and SAR imaging parameters, making it challenging to accurately evaluate their performance**



Objective

The objective of this project is to integrate machine learning with UAV(**Unmanned Aerial Vehicle)**-SAR (**Synthetic Aperture Radar**) systems to enhance the processing, analysis, and evaluation of high-resolution SAR data in real-time. By utilizing deep learning models, the system aims to improve feature extraction, detect terrain changes or anomalies, and optimize operational efficiency during UAV missions. This will be particularly valuable in disaster response, environmental monitoring, and surveillance, where timely, accurate data and decision-making are critical.

Abstract

Unmanned Aerial Vehicles (UAVs) equipped with Synthetic Aperture Radar (SAR) systems have become essential tools in various domains, including environmental monitoring, disaster management, military surveillance, and remote sensing. However, the complex and voluminous nature of SAR data poses significant challenges in real-time analysis, image interpretation, and decision-making. This project proposes the integration of machine learning techniques to enhance the evaluation and operational capabilities of UAV-SAR systems.

By employing **machine learning algorithms**,[SVM,Random forest ,Etc..,] particularly deep learning models, the project aims to automate the processing of SAR data, improving image resolution, noise reduction, and feature extraction. Machine learning will be leveraged to detect changes in terrain, identify anomalies, and classify objects in real-time, significantly reducing the dependency on manual analysis. Furthermore, the adaptability of machine learning allows UAV-SAR systems to optimize their performance across diverse environmental conditions, ensuring accurate results in challenging situations like inclement weather or obscured visibility.

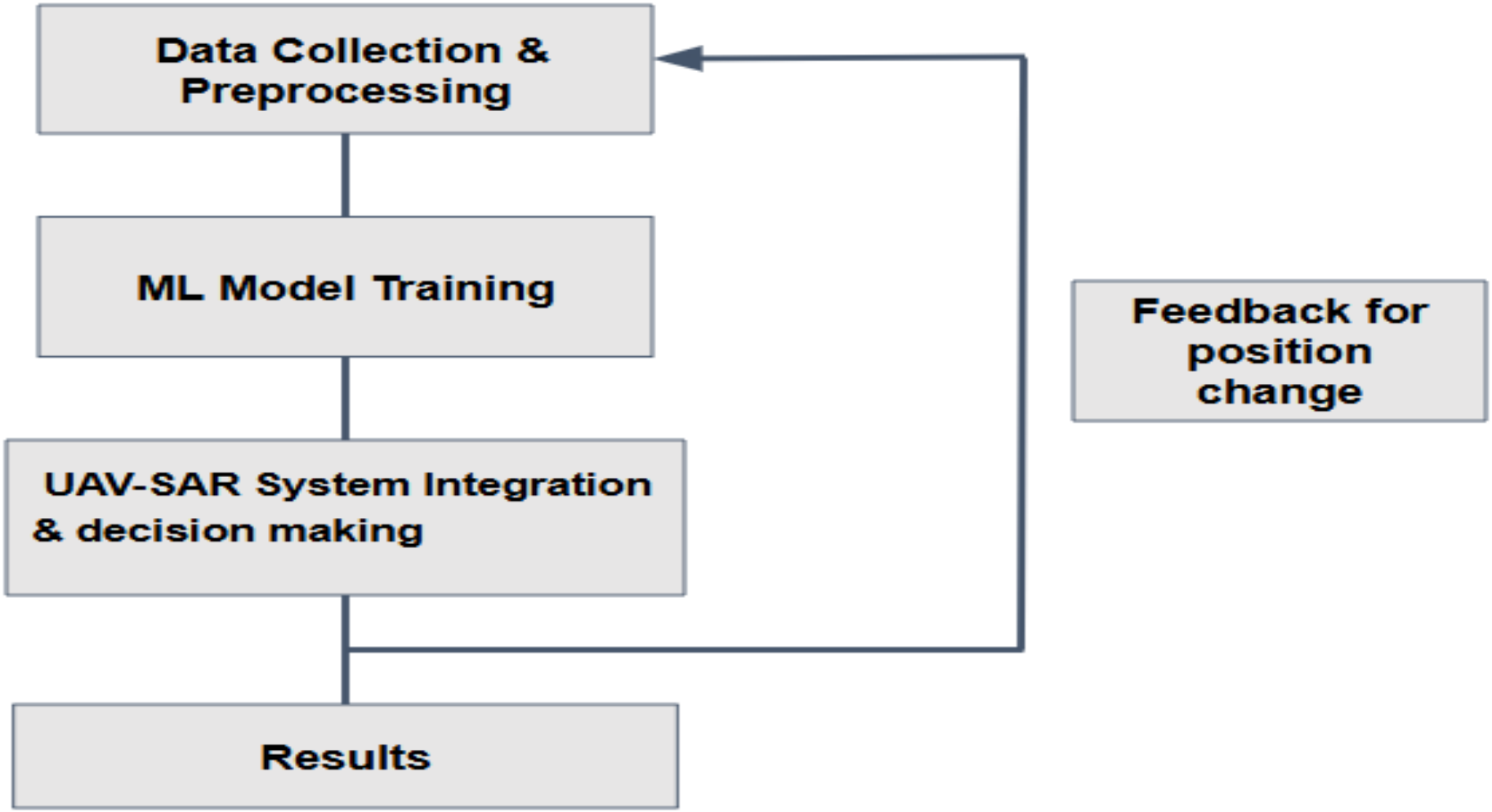
The project will develop and evaluate various machine learning models to enhance SAR data interpretation, focusing on improving detection accuracy and operational efficiency. A key objective is to demonstrate the **potential of machine learning in enabling UAVs to make autonomous decisions based on SAR imagery**, thus enhancing mission success in applications such as disaster response and security operations. The integration of machine learning into UAV-SAR systems presents a powerful framework for advancing their capabilities, making them more reliable, efficient, and effective in both military and civilian applications.

This project will ultimately contribute to the development of smarter, data-driven UAV-SAR systems, facilitating better situational awareness, faster response times, and enhanced mission outcomes.

Literature Review

Reference	Title / Approach	Methodology	Key Findings	Limitations
Williams et al., 2004	ASAPtSAPS Utility for Adaptive ATR Development and Assessment	ATR (Automatic Target Recognition) for SAR images	Improved accuracy in object classification	Limited dataset coverage for real-time UAV operations
Li et al., 2017	Deep Learning for SAR Image Target Recognition	Used CNNs to classify SAR targets	Achieved high accuracy in target identification	Computationally expensive for UAV deployment
Zhang et al., 2019	YOLO-based Object Detection for Aerial SAR Images	Applied YOLOv3 for real-time object detection	Fast and efficient object detection for UAV SAR	Limited performance in cluttered environments
Chen et al., 2021	SAR Target Classification with Hybrid CNN-RNN	Combined CNN and RNN for improved feature extraction	Increased robustness in SAR image classification	Requires large labeled datasets for training

Methodology



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Gantt Chart

PROCESS	Feb - Mar		Mar -Apr		Apr - May	
	Week 1 - 4		Week 1 - 4		Week 1 - 4	
Project Planning,Data Collection						
Ground Truth Labeling ,Data Preprocessing						
Model Selection and Design, Training and Validation						
Real-Time System Integration						
System Testing and Evaluation						
Deployment & Final Report and Documentation						

Online course

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Course outline

- About NPTEL
- How does an NPTEL online course work?
- Week 0: Assignment 0
- Week 1
- Week 2
- Week 3
- Week 4
- Week 5
- Text Transcripts
- Books
- Problem Solving Session - Jan 2025

Cloud Computing

ABOUT THE COURSE :
Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

INTENDED AUDIENCE : CSE,ECE,EE

PREREQUISITES : Basics of Computer Architecture and Organization, Networking

INDUSTRY SUPPORT : IT industries

Prof. Soumya Kanti Ghosh

IIT Kharagpur

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

Thank you