Applications of AI for Target Identification with Microwave Imaging System

Project Presentation for CSN-300 (Spring Semester 2020-2021)

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Introduction

- In recent years, there has been continuous development in machine learning technology and this has also lead to a new standard in Target recognition with respect to Synthetic Aperture Radar (SAR) images.
- We analysed SAR photographs of Roorkee obtained from two separate sources: Sentinel-1 and ALOS PALSAR. Railway line tracks and urban structures surrounded by foliage were identified as targets. In this method, we used a variety of machine learning techniques.
- This project has limitless applications, for example, on the oceans, where ships can be identified and tracked by their wakes. In addition, regular leakage from oil storage facilities is commonly observed. This could reveal more about the oil companies.

Introduction

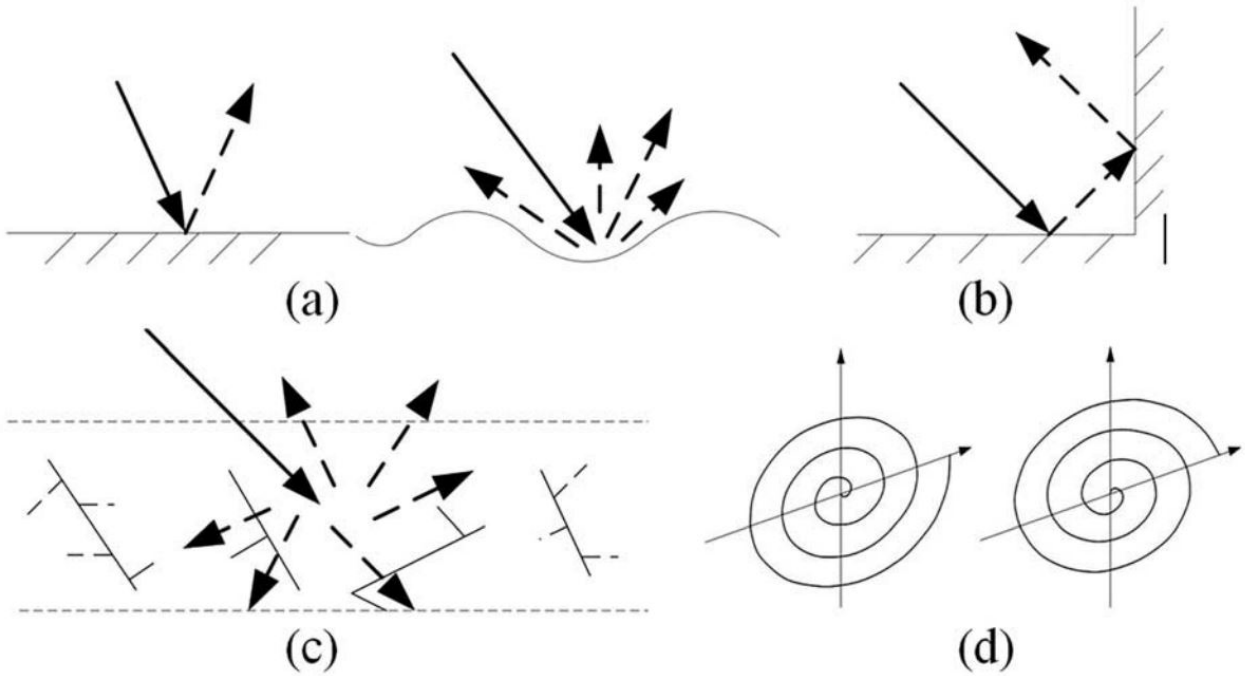

Fig. 1. Elementary scattering mechanisms. (a) Surface scattering. (b) Double-bounce scattering. (c) Volume scattering. (d) Helix scattering.

Literature Review

1.First Paper [**?**]

- Proposed method was a system for SAR ATR by matching the ASCs.
- Apporach was to classy ASC's inot binary region which uses a point of differentiation rather than just matching the ASC point features to the target region.
- The spatial locations, relative amplitudes, and lengths of various binary regions of an discrete ASC are determined by zones and shapes of those regions.
- The proposed approach outperforms state-of-the-art approaches; the methods are effective for recognising errands that are often the desired object under SOC, and it has a PCC of 98 %
- Under different setup variations, significant depression point difference, noise contamination, and partial occlusion, the proposed approaches work better.

Literature Review

2.Second Paper [**?**]

- They were able to develop a lightweight Convolution Neural Network which is based on optical attention and depth-wise distinct convolution of SAR pictures goal classification.
- A modern WDM loss function is used to unravel the data asymmetry between knowledge sets.
- In the end, they tested their models using a pair of datasets: : MSTAR and OpenSARShip.
- Networks are vulnerable to noise to some extent, and there is still the opportunity to improve in this area.
- If there is a difference in the size of the input images, the identification results would be affected, so the pictures must all be the same size.
- New Machine learning algorithm required which will improve the Recognition and will be reducing the dependency on training data.

Problem Statement

- Given Sentinel-1 and PALSAR Synthetic Aperture Radar Images of Roorkee(247667).
- Your Goal is to classify Railway Tracks and Urban areas among tall Vegetated(i.e. IITR Main Building or Civil Hospital).
- Since SAR data set contains data in various TH-RX polarisation variations the image provided will be a .tiff image file from which data must be extracted.
- Finally , create a Machine Learning Model that will recognises train tracks and urban areas is built using the data collection.

Problem Statement

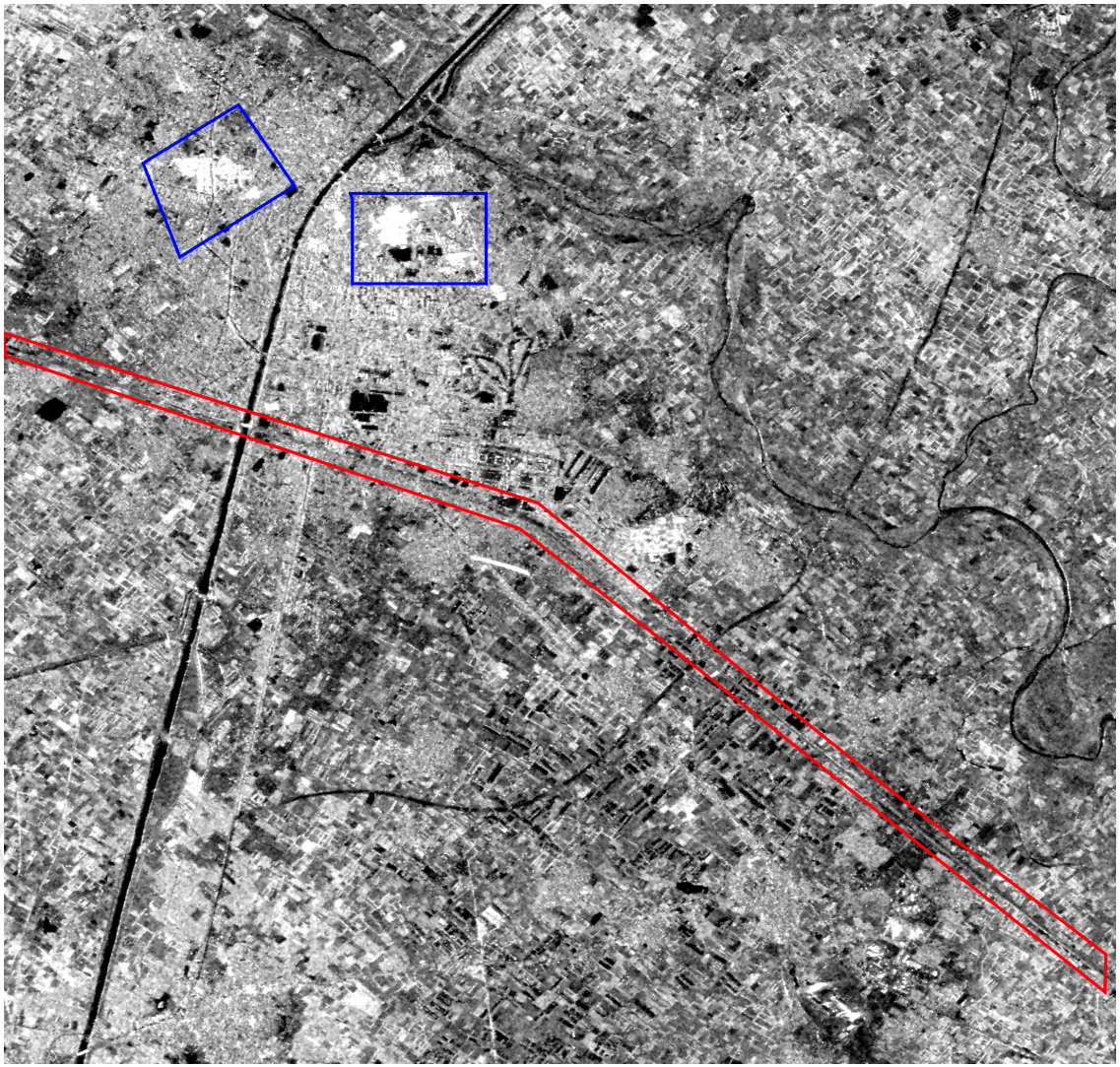

Figure: Classified Image

Methodology

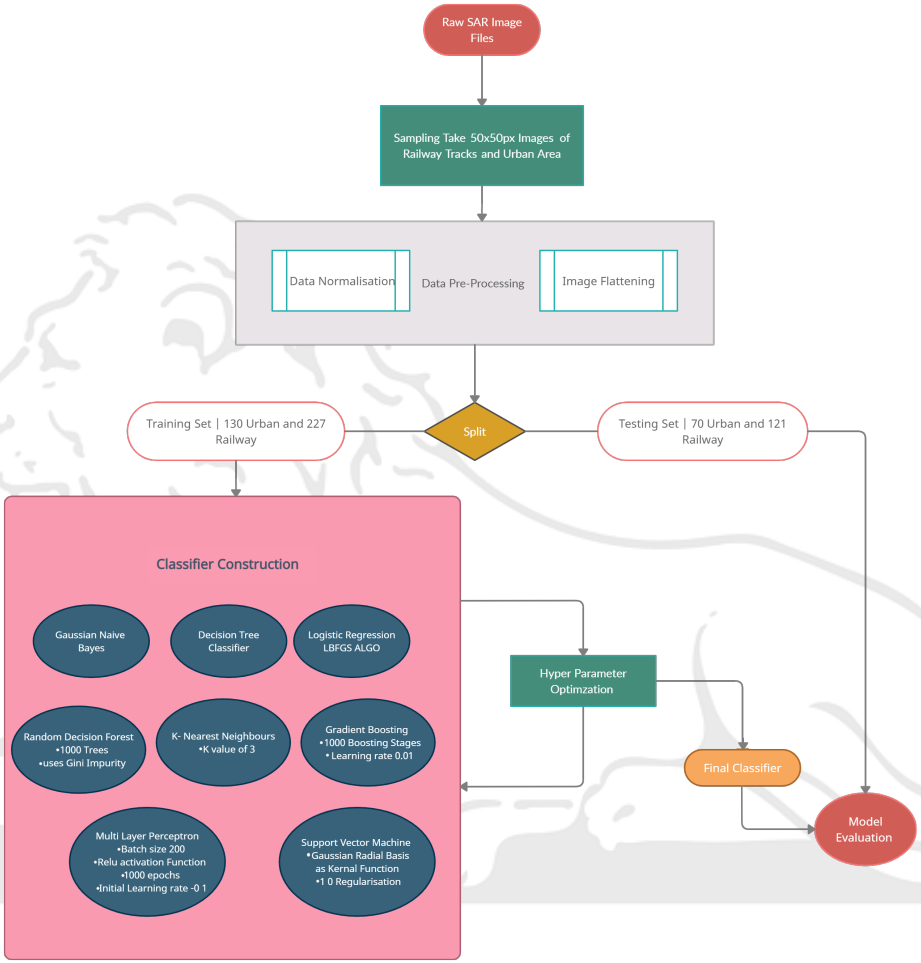

Figure: Methodology Flowchart

Methodology

- We broke down the initial big images into tiny 50x50 pixel images.
- and then selected those that contained an object from our target groups.
- These images were created, and we manually labelled and sorted them into separate classes, resulting in labelled data for these two classes.

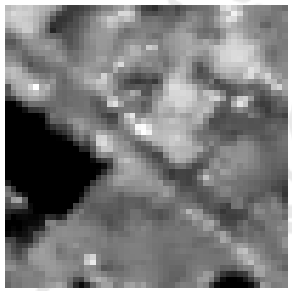

Figure: SAR image of Railway track

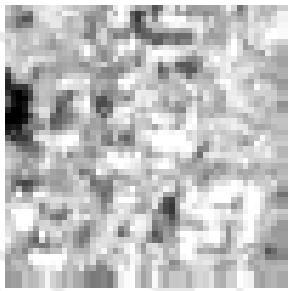

Figure: SAR image of urban building.

Simulation Results

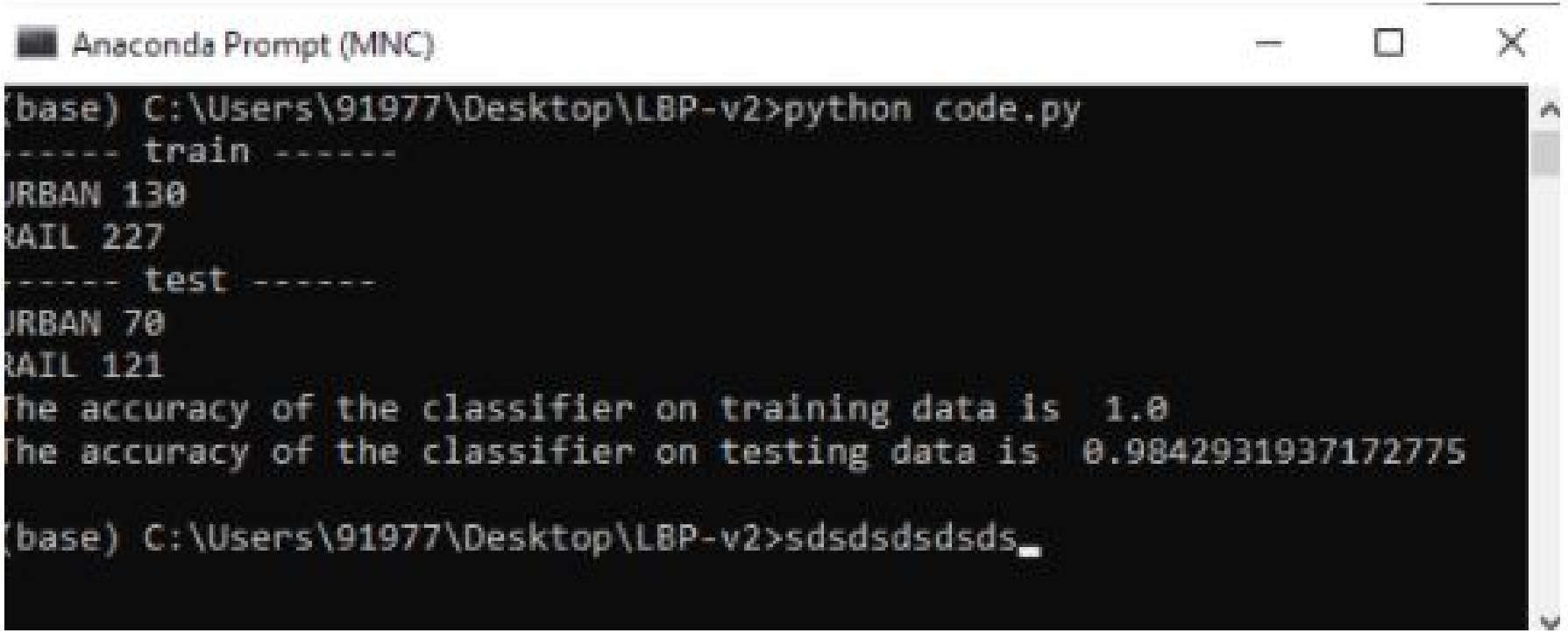

Figure: Terminal Snippet

Simulation Results

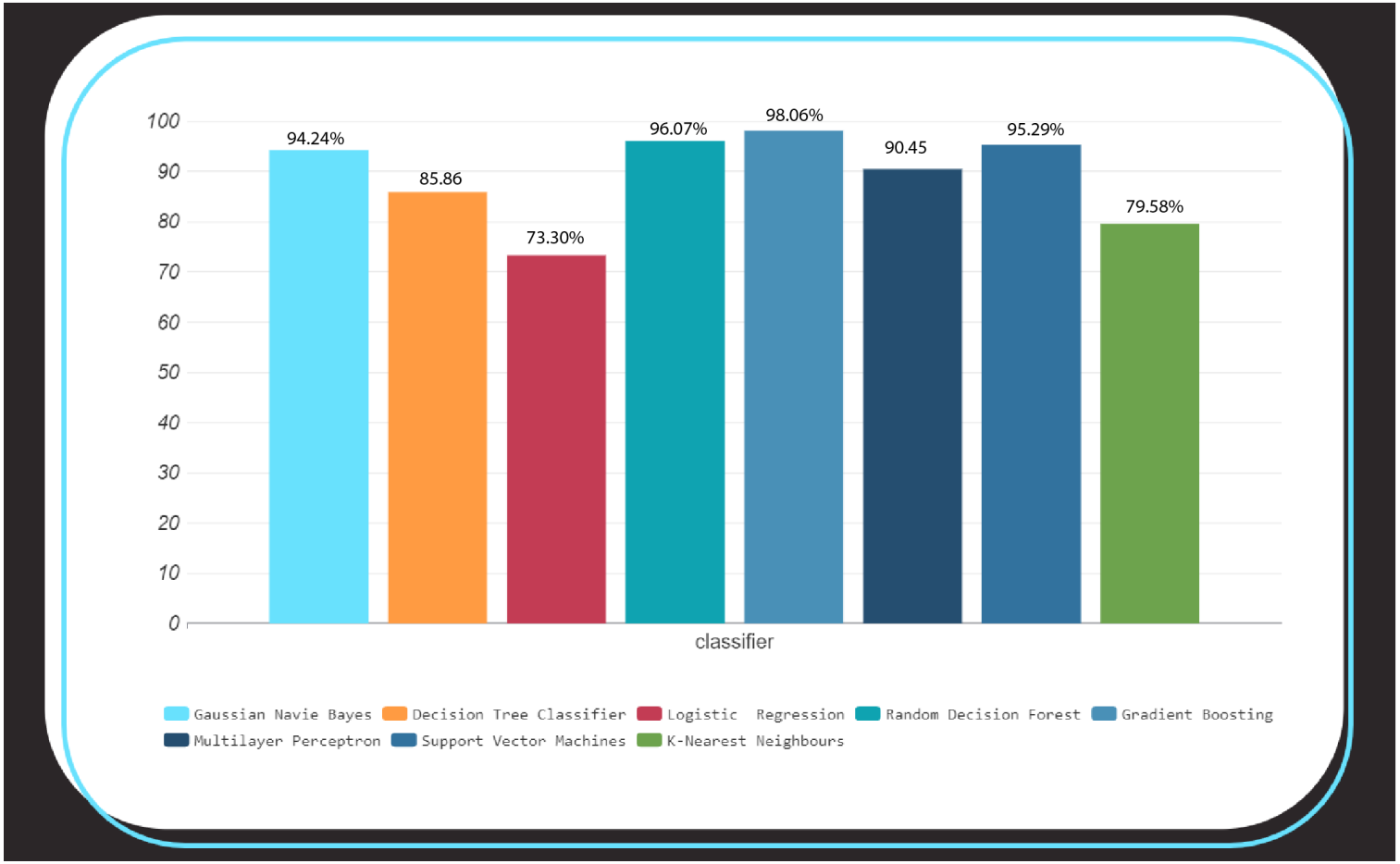

Figure: Graphical Representation of different Models and Accuracy

Conclusions

- We learned a lot about SAR images and different machine learning models through this extensive and enlightening project
- Our best accuracy was 98.06 % using the Gradient Boosting model, with good accuracy achieved also using Support Vector Machines and Random Decision Forest Classifiers.
- We believe that by increasing our data-set, our accuracy could increase further. We might try using more models and techniques in our future research into this topic.

References

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Thank you!