INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

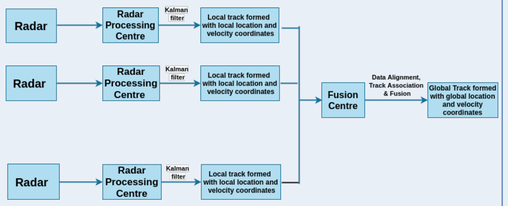
R&D SHOWCASE 2021
Technology, Social Impact

Improving Tracking Accuracy in Indian Air Force Surveillance through Ensemble based Machine Learning

Multi Sensor Fusion (MSF) in Radars

Radars fall into the spectrum of high-end defence sensors or systems on which the security and surveillance of the entire world depends.

Due to the differences in sampling rate of sensors, the communication delay between sensors and the overlapping regions of observations for the various sensors, there is asynchronity in sensors' observations resulting in errors in MSF System.

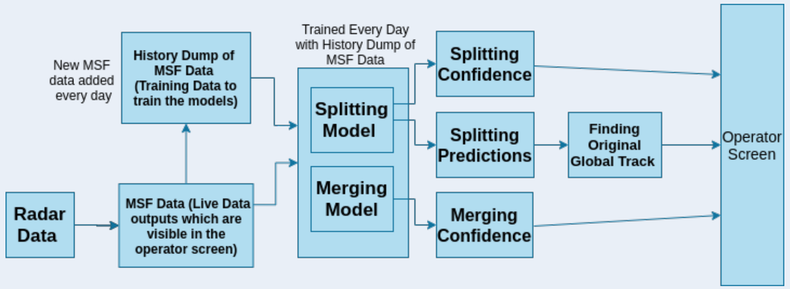


MSF System

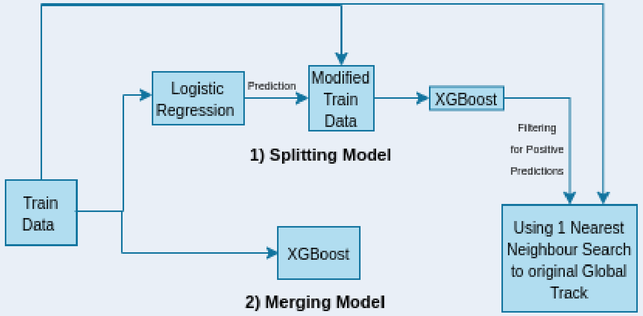
Errors in MSF

Consider a scenario in which there are say 2 air targets. However, there will be times where the actual number of air targets observed are 2+/2- for a certain period. We call these errors in observation **Splitting** and **Merging Error**. Splitting Error can lead to the system assuming that there is an enemy flight in the air even though there is not any. Merging Error can lead to the system assuming that there is no enemy flight in the air even though there may be one (or more).

Methodology



1)The preprocessed MSF data is collected on a daily basis and is stored as a history dump) to train (two separate) models that handle splitting and merging issues.
2) The proposed algorithm provides confidence and the original global track number for the data presented to the operator in real time.
3) We use stacking of logistic regression with xgboost for the splitting model, xgboost for the merging model and 1-Nearest Neighbour for Finding Original Global Track.



Results

Splitting Model Predictions

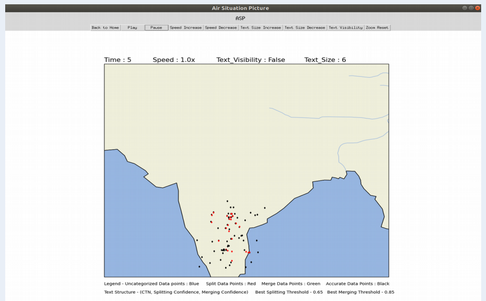
Algorithm	F1 Score	Recall
Logistic Regression	0.55	0.68
Gaussian Naive Bayes	0.49	0.69
Support Vector Machines	0.49	0.37
K Nearest Neighbours	0.38	0.38
Random Forest Classifier	0.86	0.81
XGBoost	0.89	0.84
Stacking Logistic Regression with XGBoost	0.94	0.94
Artificial Neural Networks	0.64	0.81

Merging Model Predictions

Algorithm	F1 Score	Recall
Logistic Regression	0.1	0.19
Gaussian Naive Bayes	0.04	1
Support Vector Machines	0.12	0.4
K Nearest Neighbours	0.11	0.11
Random Forest Classifier	0.45	0.35
XGBoost	0.91	0.89
Stacking Logistic Regression with XGBoost	0.88	0.85
Artificial Neural Networks	0.51	0.62

1) Out of our **3.3 million data points** in complete dataset, with around 20 percent having splitting error and 2 percent having merging error, we are able to predict 98 percent of the data points that have splitting error and 99 percent of the data points that have merging error if we categorize data points with high splitting confidence as split and high merging confidence as merged.
2) Initially data had an accuracy of 78% which using our splitting model predictions we can increase to around 91% and adding our merging model predictions to around 93%.
3) This boils down to a total **15 percent increase in tracking accuracy** with our AI model after MSF.
4) This work is published in ICONIP 2020 conference.

Real Time Implementation



1) The simulation made in tkinter library python shows flights with black points as real and red points which are split.
2) Using UDP sockets, we receive our data from MSF system, get splitting/merging confidence and original global track and send it again to MSF System in real time.

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