ME504 Project

Predictive Maintenance using LSTM

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What is Predictive Maintenance

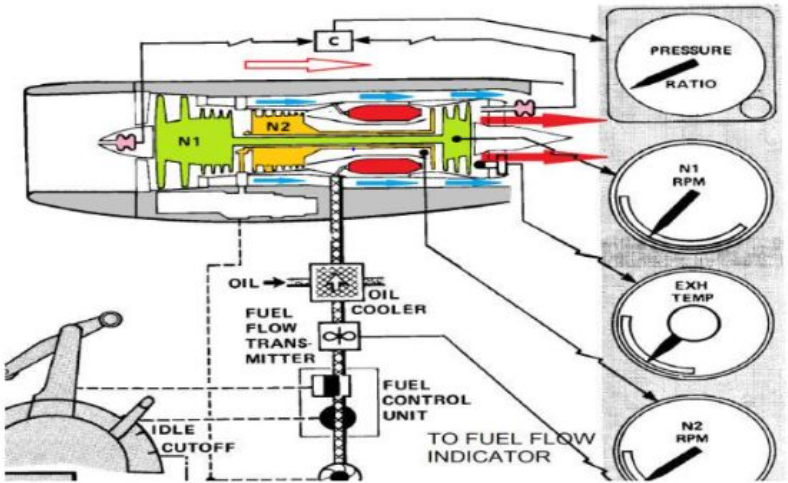
Predictive maintenance focuses on the techniques used to predict when an in-service machine will fail, so that maintenance can be planned in advance.

The Problem

Airlines are interested in predicting engine failures in advance to enhance operations and reduce flight delays.Observing engine's health through sensors is assumed to facilitate this type of maintenance by predicting Time to Failure(TFT) of in-service equipment. How can we predict the TFT using sensor reading?

Solution Approach

By exploring aircraft engine's sensor values over time, LSTM can learn the relationship between sensor values and changes in sensor values to the historical failures in order to predict the failure in future.



Data

id	cycle	setting1	setting2	setting3	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19	s20	s21
1	1	-0.0007	-0.0004	100	518.67	641.82	1589.7	1400.6	14.62	21.61	554.36	2388.06	9046.19	1.3	47.47	521.66	2388.02	8138.62	8.4195	0.03	392	2388	100	39.06	23.419
1	2	0.0019	-0.0003	100	518.67	642.15	1591.82	1403.14	14.62	21.61	553.75	2388.04	9044.07	1.3	47.49	522.28	2388.07	8131.49	8.4318	0.03	392	2388	100	39	23.4236
1	3	-0.0043	0.0003	100	518.67	642.35	1587.99	1404.2	14.62	21.61	554.26	2388.08	9052.94	1.3	47.27	522.42	2388.03	8133.23	8.4178	0.03	390	2388	100	38.95	23.3442
100	198	0.0004	0	100	518.67	643.42	1602.46	1428.18	14.62	21.61	550.94	2388.24	9065.9	1.3	48.09	520.01	2388.24	8141.05	8.5646	0.03	398	2388	100	38.44	22.9333
100	199	-0.0011	0.0003	100	518.67	643.23	1605.26	1426.53	14.62	21.61	550.68	2388.25	9073.72	1.3	48.39	519.67	2388.23	8139.29	8.5389	0.03	395	2388	100	38.29	23.064
100	200	-0.0032	-0.0005	100	518.67	643.85	1600.38	1432.14	14.62	21.61	550.79	2388.26	9061.48	1.3	48.2	519.3	2388.26	8137.33	8.5036	0.03	396	2388	100	38.37	23.0522

id-Engine Id

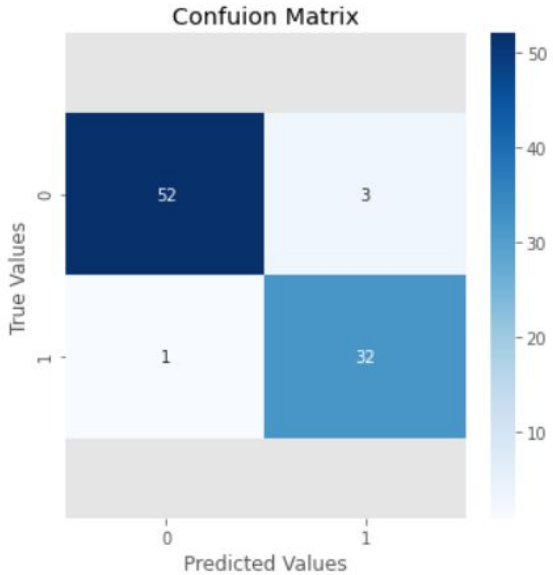
Setting1 to setting3 : engine operational setting

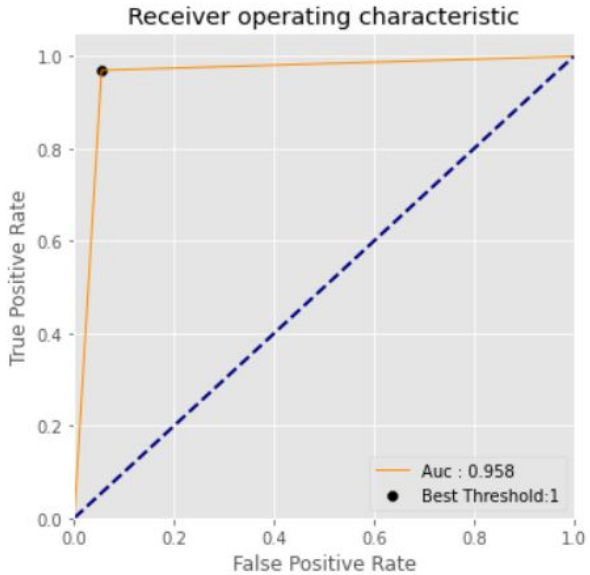
S1 to s21: sensor measurements in each cycle

Labels

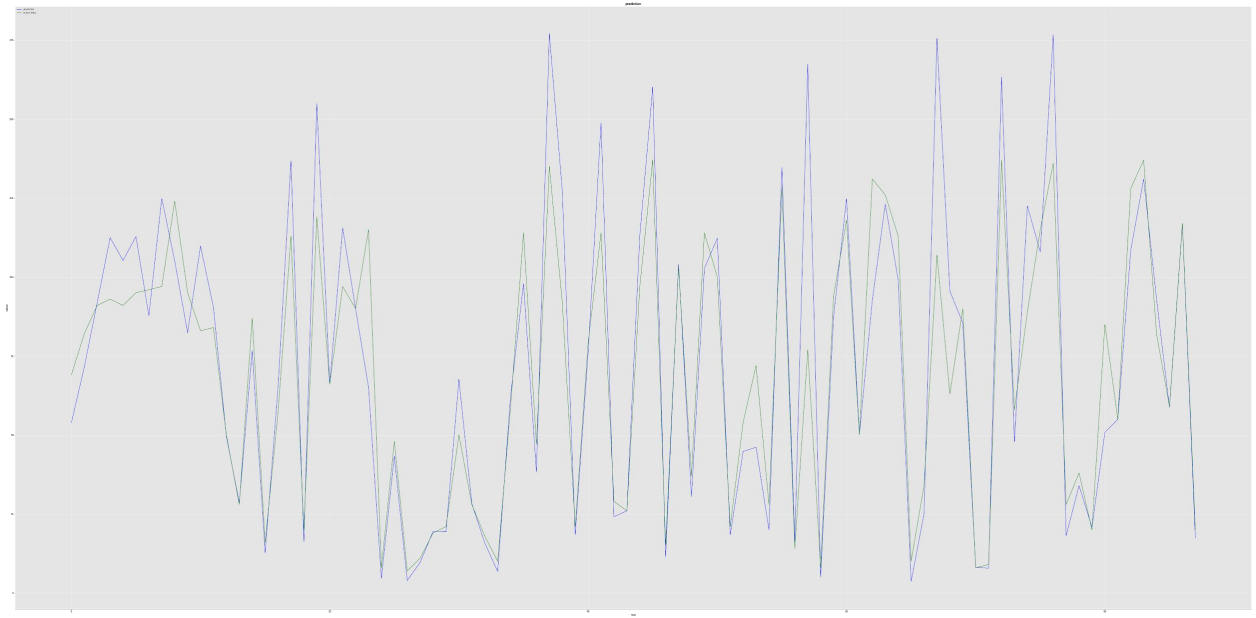
- **Regression**: Remaining Useful Life(RUL) is the number cycles between that cycle and last cycle of the engine in the training data.
- **Binary Classification**: Predict if an asset will fail within certain time frame(eg. cycles).
- **Multiclass Classification**: Predict if an asset will fail in different time windows. (eg., 0-15,16-30,30+).

Binary Classification Results





Regression Model Results



Future Improvement

- Perform mutli-class Classification.
- Try using other Machine Learning Algorithms.
- Perform Feature selection and dimensionality reduction techniques to enhance model performance metrics and speed.

Thank You!!!