Contents

1 Objective

To make a prediction for turbofan engine compressor stall fault using the ARIMA-LRM method depends on the LRM coefficients calculated from linear regression model, which uses the calculated ARIMA coefficients [arima(p, 0, q)] from each individual engine in the 'Training Dataset' collectively.

Currently, there a dataset for 28 engines used as the 'Training Dataset', which is identical to what used for the thesis (see Reference [1]);

Ideally a dataset contains 49 engines should satisfy the requirement of $R^2 = 0.85 and R^2_{adj} = 0.70$ if intended to apply $arima(12, 0, 4)$ for timeseries modeling (see Reference [1]).

Original formula to calculate VG values, which is a function of values from T2C, NG and IGV sensors, is from reference [2].

2 Notes for LRM Coefficients Calculation

It is intend to use two models from original 'Training Dataset'. One is taking all the data points from original rted data files, from starting of take-off to completion of landing; Another is taking 180 seconds cut from the end of landing.

The model from 180 seconds cut, regardless how long the flight is, has better performance from LRM modeling. This phenomenon can be explained by that the landing data may contains some confounding noise data points which contributed negatively to the final LRM model.

3 Summary

The LRM Coefficients Calculation results are displayed as below.

	NumberOfFlights	ARIMA	t1	t2	R^2	R^2_adj	Sigma^2	Model_p-value
1	1	arima(12,0,4)	0	0	0.8656	0.6700	0.240	0.0082
2	1	arima(12,0,4)	0	180	0.9204	0.8046	0.185	0.0007

Table 1: Experimental Calculation Result - For 1-Flight Data

	number_of_flights	arima	t1	t2	Coef_Intercept	Coef.AR1	Coef.AR2	Coef.AR3
1	1	arima(12,0,4)	0	0	0.239781	5.348240	5.967010	9.754880
2	1	arima(12,0,4)	0	180	-0.079226	0.212007	3.032970	6.450570

Table 2: Coefficients Calculation -1 - For 1-Flight Data

	t1	t2	Coef.AR4	Coef.AR5	Coef.AR6	Coef.AR7	Coef.AR8	Coef.AR9
1	0	0	-2.720870	4.616110	5.575340	-0.447217	2.162800	2.470690
2	0	180	-4.322480	3.478090	3.526910	-2.885070	-3.389630	3.696300

Table 3: Coefficients Calculation -1 - For 1-Flight Data

	t1	t2	Coef.AR10	Coef.AR11	Coef.AR12	Coef.MA1	Coef.MA2	Coef.MA3	Coef.MA4
1	0	0	13.484100	0.791643	11.930600	5.830950	-2.099990	4.201440	-5.785270
2	0	180	7.007040	-0.610742	12.380800	4.741580	-1.657630	7.185780	-6.394100

Table 4: Coefficients Calculation -1 - For 1-Flight Data

4 Visualization of Fits from Training Dataset

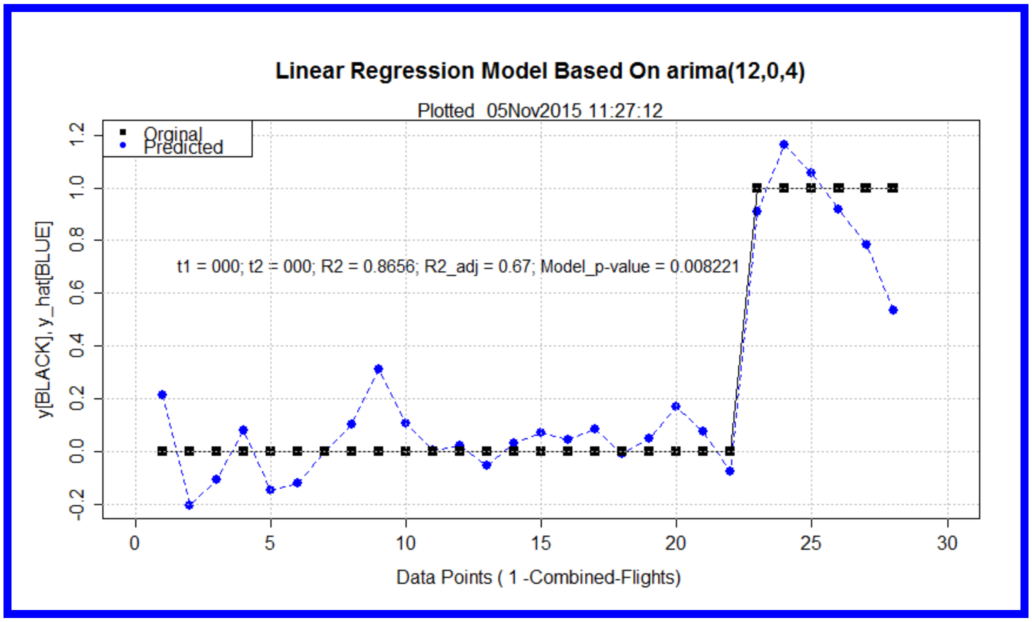

Figure 1: $data$=1-Combined-Filights; $arima(12, 0, 4)$; t_1=000; t_2=000

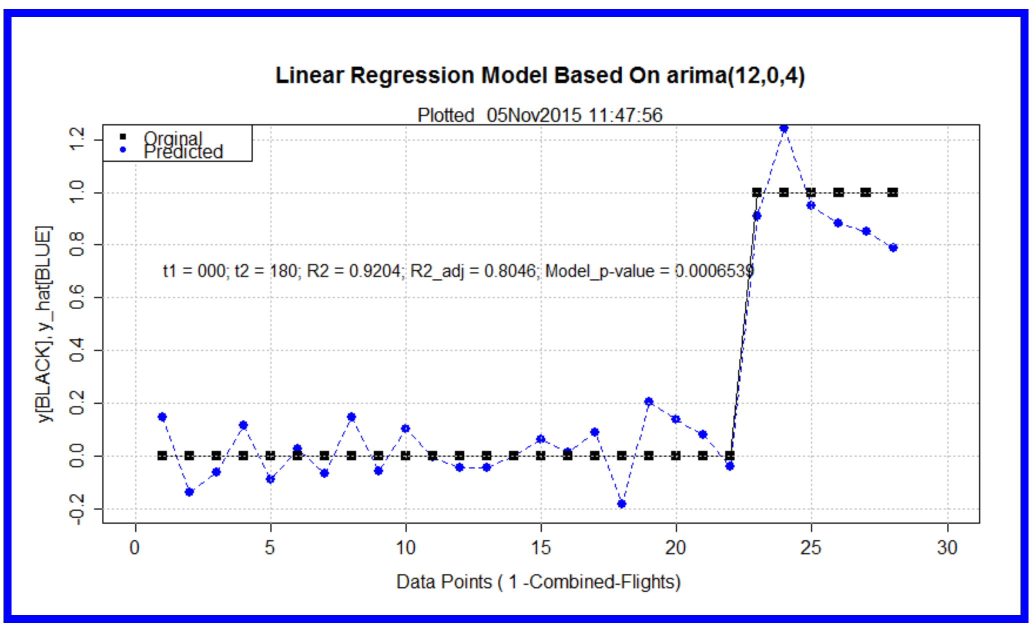

Figure 2: $data$=1-Combined-Filights; $arima(12, 0, 4)$; t_1=000; t_2=180

List of Figures

List of Tables

References

[1] Shuxiang Albert Li and G Trevor Jones. *A Method to Predict Compressor Stall in TF34-100 Turbofan Engine Utilizing Real-Time Performance Data*. Air Force Institute of Technology, 2015.

[2] Field Engineering Unit/H564 Northrop Electronics Division. *Field Engineering A-10 TEMS Software Handbook, A-10 Turbine Engine Monitor System, for Version 54.1 and 56.1 software, section 3.1.4 VG Schedule*. 2010.