Temasek Defence Systems Institute

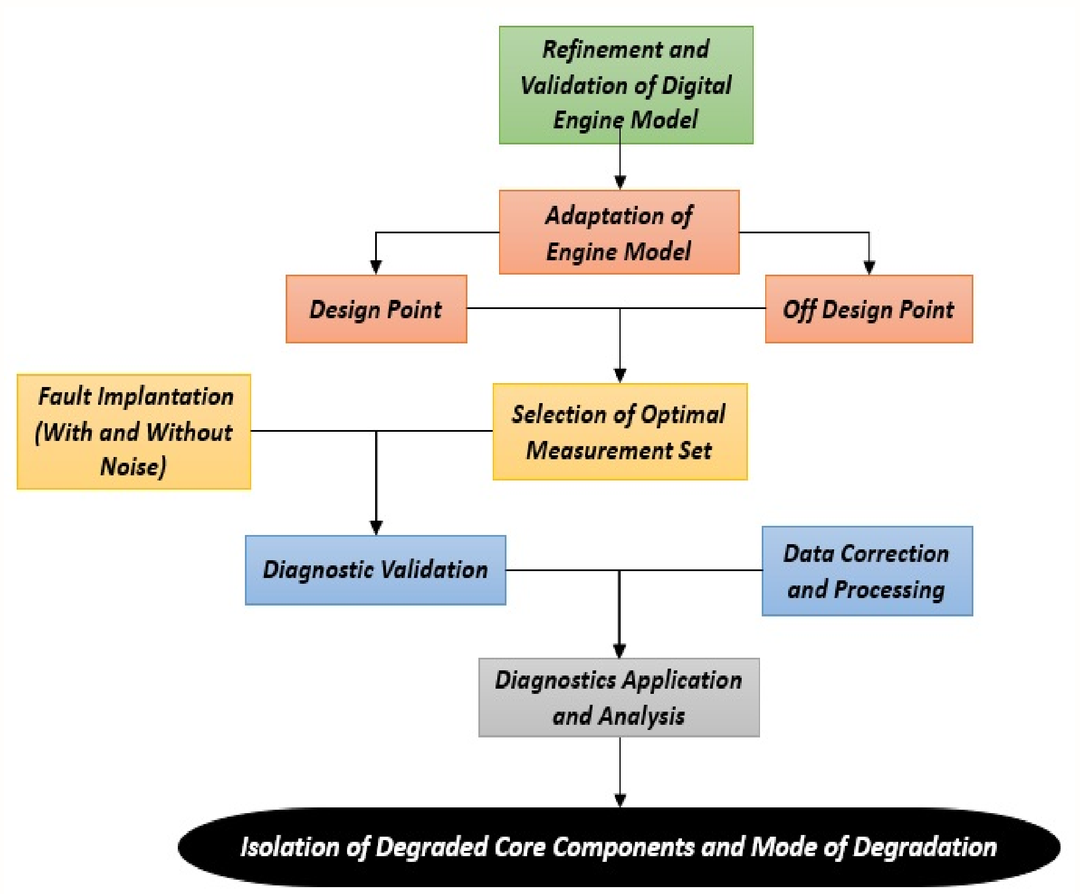
Performance & Diagnostics Analysis for A Civil Aero Gas Turbine Engine

Vinod Kumar s/o K. Puviarasan
Dr Yiguang Li

Aim:

- To investigate the degradation of the core gas path components of a civil aero turbofan engine using GPA

Methodology:



Results:

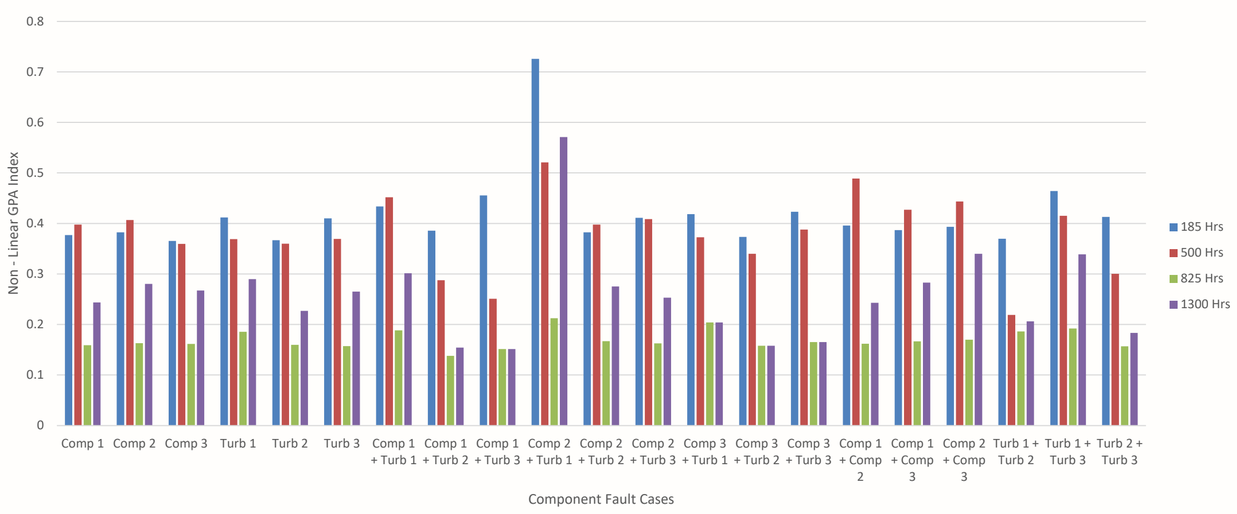
- DP & OD adaptation errors well within 1%
- Top 9 set selected as optimal diagnostic measurement set – 20 of 21 fault cases validated
- Comp2 definitely degraded based on 3 likely fault cases
- Comp2 Turb2 most likely 2 component degraded fault case (fouling) due to realistic health parameter predictions and trend overtime
- Maintenance action probably carried out between 185 and 500 hours leading to loss of GPA prediction accuracy overtime

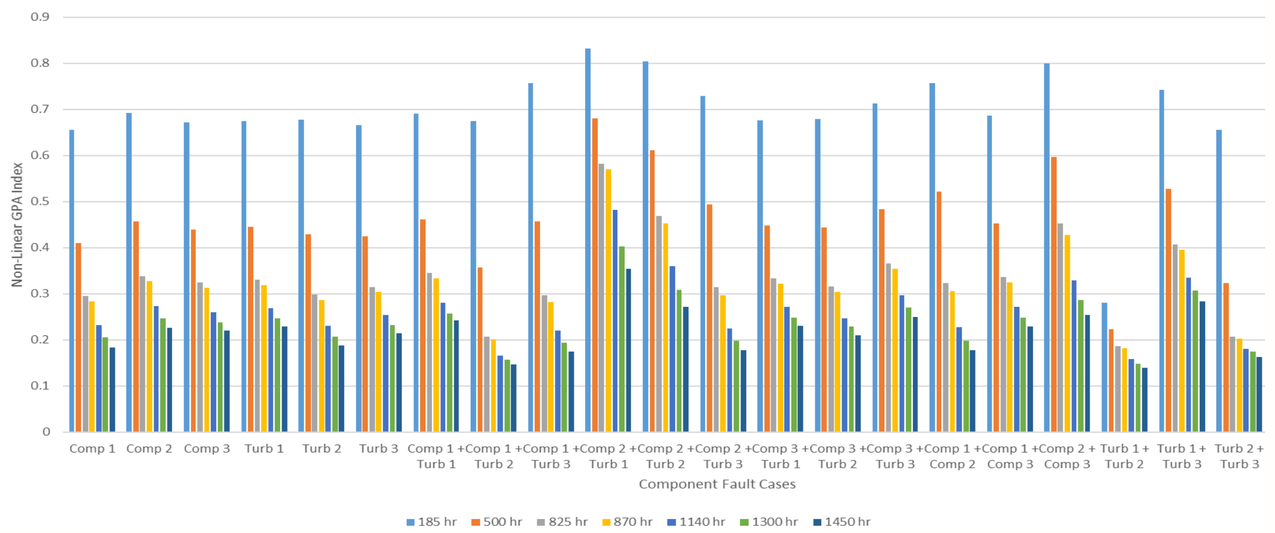
Research Benefits:

- Reducing gas turbine downtime and improving availability
- Reducing unnecessary maintenance costs in overhauling gas turbines at OEM predetermined intervals

Future Work:

- Integrate together with other techniques to deal better with noise and produce better degradation predictions
- Continue with prognostic analysis to determine remaining useful life



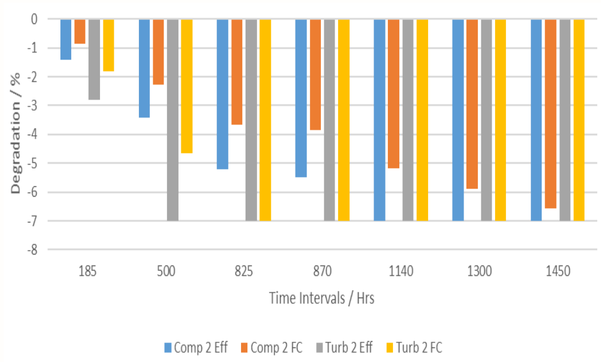


Initial Diagnostic Result with Raw Data

S/N	CFC	Non-Linear GPA Index	Calculated Fault
10	Comp 2, Turb 1	0.8320	Eff: 0.92% FC: -0.996%
			Eff: -1.587% FC: -0.688%
11	Comp 2, Turb 2	0.8039	Eff: -1.407% FC: -0.862%
			Eff: -2.786% FC: -1.818%
18	Comp 2, Comp 3	0.7997	Eff: 1.364% FC: -0.919%
			Eff: -1.917% FC: -0.779%

Likely CFCs and Predictions at 185 hour

Diagnostic Result with Postprocessed Data



Comp2 Turb2 Degradation Overtime

References

1. Urban, L. A. (1972) 'Gas-path Analysis Applied to Turbine Engine Condition Monitoring', in AIAA/SAE 8th Joint Propulsion Specialist Conference.
2. Jasmani, M. S., Li, Y.-G. and Ariffin, Z. (2011) 'Measurement Selections for Multicomponent Gas Path Diagnostics Using Analytical Approach and Measurement Subset Concept', Journal of Engineering for Gas Turbines and Power, 133(11), pp. 111701-111701–10.
3. Li, Y. G., Ghafir, M. F. A., Wang, L., Singh, R., Huang, K. and Feng, X. (2011) 'Nonlinear Multiple Points Gas Turbine Off-Design Performance Adaptation Using a Genetic Algorithm', Journal of Engineering for Gas Turbines and Power, 133(7), pp. 071701-071701-9.

NUS National University of Singapore