

Development of Flaw Diagnosis/ Dimensioning/ Prognostics Algorithms for improvement of In-Country Aerospace Non-Destructive Testing (NDT) Capabilities

Project Outcome

The project was commenced on April 1, 2013 and completed after 36 months on March 31, 2016 under the team of Dr. Tariq Miraj Rasool at PNEC NUST Karachi. All 12 milestones were completed and submitted to the Fund.

The major purpose of the project was improvement in aerospace NDT infrastructure in Pakistan. During the conduct of the project, capacity was built in the field of aerospace NDT through improved understanding of NDT signals acquired while scanning aircraft structures. Actual NDT data was acquired from NDT facilities of Pakistan International Airlines (PIA). Modern Signal processing algorithms would be developed to diagnose the damage (cracks, flaws, voids etc.).

The historical NDT data of selected structure was also acquired to generate a database. The historical databases generated were used to validate the developed prognostic algorithms. The prognostic algorithms offered the remaining useful life of the aircraft structures which facilitated management to plan repair/replacement action well in time. The project also proved to be a precursor for NDT related projects in academia to improve industry capabilities.

The objectives achieved are listed as follows:

- Developed NDT signal processing algorithms for flaw diagnosis (detection and profiling). Data fusion would also be incorporated in the algorithms. This job was done for the first time in Pakistan on NDT data acquired while scanning aero planes of PIA fleet and also generated of historical NDT database of PIA inventory.
- Developed prognostics algorithms and validation of algorithms on historical NDT database acquired while scanning PIA fleet for prediction of remaining useful/safe life of aero planes without undergoing repair/ replacement.
- Presented two conference papers in second year and two journal paper in third year of the project. (Only one Journal was proposed).
- Diagnostics as well as prognostics algorithms were included in three MS thesis (proposed two initially).
- Developed NDT signal processing algorithms for flaw diagnosis (detection and profiling). Data fusion was incorporated in the algorithms.
- Developed PC based software comprising of flaw diagnostics algorithms for detection and profiling of damage. Actual NDT signals were injected in the software. Flaw detection and profiling report is the output of the software.
- Also generated a historical database of NDT data that was used in studies to analyze historical trend of degradation is to be captured.
- Developed prognostic algorithms for prediction of remaining useful life of the aircraft structure and components. The algorithms were validated on the historical database.
- Software comprising of prognostic algorithms were provided to industry. Any database of historical NDT data and fatigue models can be input to the software.
- Analysis of Aerospace NDT signal comprehension and processing.

- Flaw detection and profiling algorithm development.

The software was finally handed over to PIA for diagnosis and prognosis on NDT data acquired from critical aerospace structures. The software can be used by any aircraft maintenance/management agencies.