Vibration fault detection of fuel pumps using Recurrence Quantification Analysis

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Introduction

- Looking for critical parts of systems
- Reliability increasing of aircraft systems
- Airplane parts under continuous monitoring
Current status

Tools for reliability increasing

1. Temperature and combustion processes
2. Aerodynamics and pressure
3. Fuel systems
4. FADEC system
5. Vibrations & Vibrodiagnostics
Current status

Continuous monitoring of Vibrations

- Faults indications:
  - Foreign object debris (FOD)
  - Engine wear
  - Icing
  - Unbalance

Vibrodiagnostics

- Method of diagnostic:
  - Fast fourier transform (FFT)
  - Modal analysis
  - Power spectral density function (PSD)
  - Applied on periodic mechanism
Recurrence quantification analysis

Tool of non-linear data analysis

- Based on:
  - Chaos theory attractor
  - Behaviour prediction of system
  - Butterfly effect

- Provide data of large group of parameters

- Complements the methods of traditional vibro-tools
Recurrence quantification analysis

**From vibration signal, through phase space to RQA graphs**

(Single point of "Q" of \(n\)-dimensional phase space represents the entire state of some physical system, including instantaneous motions of all its parts.)
Experimental verification

- Choosing the object for data providing.
  - Fuel pumps
  - Small jet turbine
  - Pitting experimental stage
  - Bearing faults
  - Additional measurements
Results of the research

Achieved:
- Analysis of current status in field of vibrodiagnostic
- Collect the data from different experiments

Expected:
- Create the complex of parameters standards of RQA related to known faults for early prediction of incoming faults (CONDITION BASED MAINTENANCE)
Thank you

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