Development of Avionics Flight Test Data Analysis Tool using MATLAB

A. S. Chandane.
Senior Manager (Design)
Aircraft Research & Design Centre

www.hal-india.com
Overview of MATLAB based tool developed for analysis of Avionics Systems Flight Test Data.

- Background & Context of the Problem
- Problem Statement
- Approach used to solve the problem
- Description of the tool & results achieved
- MATLAB features used
- GUI Screen-Shots
- Questions & Interactions
Background

About ARDC, HAL, Bangalore.

- One of the nine R&D Centers of Hindustan Aeronautics Limited.
- ISO 9001 2000, AS9100B certified Company
- Design, Develop, Prototype and Test Fixed Wing Aircraft from Concept to Certification.
Background & Context

Avionics Systems in Aircraft.

Radio Navigation Instruments -
  - VHF Omni Range
  - Instrument Landing System
  - Distance Measuring Equipment
  - GPS Receiver
  - Radio Altimeter . . .

Sensor Systems -
  - Air Data Computer
  - Angle of Attack
  - Inertial Sensors
  - Fuel Sensors . . .

Mission & Weapon Systems
Data is recorded on multiple recording devices:

- On-board FTI Recorder & FTI Ground Station (instrumented aircrafts).
- Black Box (Standard equipment on all aircraft)

Analysis is directed towards performance analysis of avionics systems/ LRUs.

Test data is analysed by the designer and presented to Flight Operations group before the next flight of the aircraft.
Analyses of Flight Test Data.

Generating graphs/plots of raw & processed data.

Analysis & interpretations derived from test data.

Preparing a professional presentation.
Problem Statement

Optimizing the Data Analysis process

FASTER
Reduce the time taken to perform detailed analysis.

ACCURATE
Eliminate errors in manual analysis.

ALGORITHMIC
Detect specific ‘phenomena’ from data.

AUTO EXPORT
Automate export to PowerPoint, Excel
Using MATLAB for Data Analysis

**FASTER**
Reduce the time taken to perform detailed analysis.
Make a GUI based application front-end – GUIDE.
Script/Code the generation of plots – plot, plotyy ...

**ACCURATE**
Eliminate errors in manual analysis.
Script/Code – data selection, reading of data labels & columns, checking data integrity etc.
Using MATLAB for Data Analysis

**ALGORITHMIC**

Detect specific ‘phenomena’ from data.
Script/ Code/ Model: Computations, Formulae, Algorithms used for the data analyses.

**AUTO EXPORT**

Automate export to MS PowerPoint and MS Excel.
Easy preparation of a professional presentation containing plots with logo, date & time stamp, tables...
Typical MATLAB functions used

- guide, uigetfile,
- disp('<a href="matlab:test_file;""""Click here</a>');
- tic, toc
- for loop, if else, switch case
- ceil,
- xlsread, xlswrite
- figure, axes, plot, [AX,H1,H2] = plotyy(...)
- xticklabel_rotate,
- xlim, ylim, zlim
- datacursormode, UpdateFcn
- handles, get, set
- find, findpeaks, mean,
- annotation, imagesc,
- saveppt2
Results Achieved

Saving Time & Effort.

- Using MS Excel templates for plots and Turbo C routines for algorithmic calculations – taking up to 3 hours of designers time

From 3 hours per flight . . .

- Eliminate manual ‘copy-paste-scale’ actions of each plot to create a presentation. A single command exports all relevant plots to MS PowerPoint file.

Eliminate manual ‘copy-paste-scale’ actions

. . . to 15 mins !

- Using this tool has reduced the preparation time of the analysis and presentation to approx. 15 min.
Ease of Use.

User of the tool DOES NOT require prior knowledge of MATLAB programming: User-friendly and simple GUI.

Tool automatically creates co-incident grids for multiple axes plots, links common axes, provides time labels, Titles & Legends, fonts etc.

Tool caters for dynamic scaling of limits & axes, assignment of colours, threshold limits etc.

Tool allows adding custom data cursors & comments, interactive Zoom & Pan of the plots as required.
Results Achieved

Scalability & Adaptability.

The tool is designed to cater for multiple platforms with varied instrumentation schemes.

The program can be adapted & scaled for use on any platform

- Easy inclusion of additional data analyses.
- Addition of different sensors data.
- Intelligent filtering & algorithmic interpretation.
- Rapid generation of plots/graphs of other systems data.

It is also used to analyse Black Box data.
Data File Screen Shot

Multiple MS Excel files.
20000 Rows x 130 Columns each
Screen Shots
Screen Shots

GPS 3D Track Map Overlay

Lat: 12.375°
Lon: 78.232°
IAOA: 4.9561°
Hdg: 235.75°
Alt: 3893m
3059
7554
10:50:33

Lat: 12.473°
Lon: 78.213°
IAOA: 4.7333°
Hdg: 148.67°
Alt: 2724m
2643
7138
10:48:49

Aircraft Research & Design Center
THANK YOU!