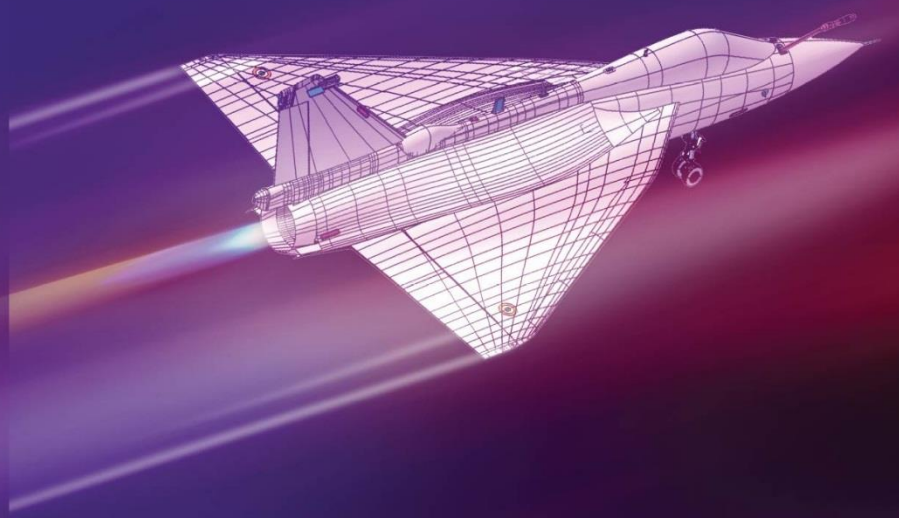
Development of Avionics Flight Test Data Analysis Tool using MATLAB



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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

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.**

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

Flight Test Data.

Data is recorded on multiple recording devices:

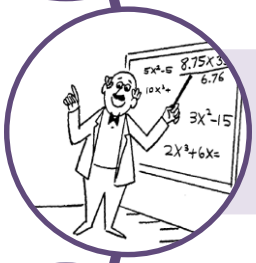
- On-board FTI Recorder & FTI Ground Station (instrumented aircrafts).
- Black Box (Standard equipment on all aircraft)

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.

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.

PowerPoint

Excel

AUTO EXPORT

Automate export to PowerPoint, Excel

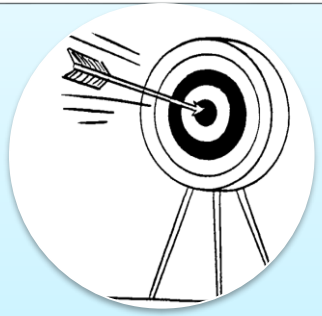
Using MATLAB for Data Analysis

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.

PowerPoint

Excel

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');
- 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

Saving Time & Effort.

From 3 hours per flight . . .

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

Eliminate manual ‘copy-paste-scale’ actions

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

. . . to 15 mins !

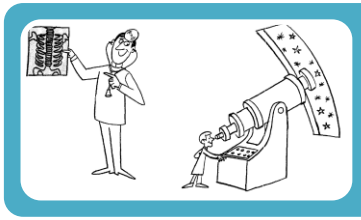
- Using this tool has reduced the preparation time of the analysis and presentation to approx. 15 min.

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.

Scalability & Adaptability.

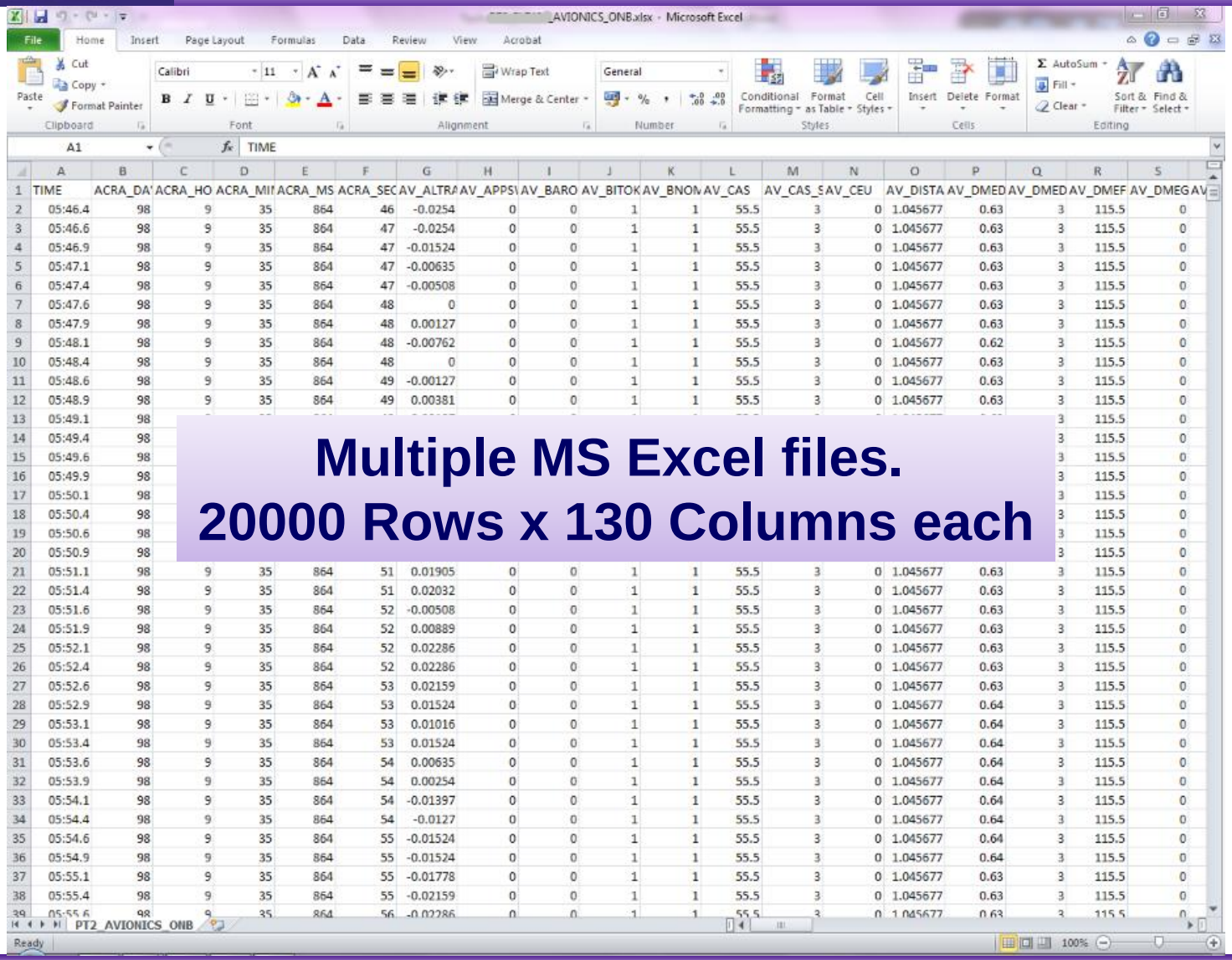
The tool is designed to cater for multiple platforms with varied instrumentation schemes.

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



TIME	ACRA_DA	ACRA_HO	ACRA_MI	ACRA_MS	ACRA_SEC	AV_ALTRA	AV_APPS	AV_BARO	AV_BITOK	AV_BNOM	AV_CAS	AV_CAS_S	AV_CEU	AV_DISTA	AV_DMED	AV_DMED	AV_DMEF	AV_DMEG	AV
05:46.4	98	9	35	864	46	-0.0254	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:46.6	98	9	35	864	47	-0.0254	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:46.9	98	9	35	864	47	-0.01524	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:47.1	98	9	35	864	47	-0.00635	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:47.4	98	9	35	864	47	-0.00508	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:47.6	98	9	35	864	48	0	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:47.9	98	9	35	864	48	0.00127	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:48.1	98	9	35	864	48	-0.00762	0	0	1	1	55.5	3	0	1.045677	0.62	3	115.5	0	
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05:48.9	98	9	35	864	49	0.00381	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:49.1	98															3	115.5	0	
05:49.4	98															3	115.5	0	
05:49.6	98															3	115.5	0	
05:49.9	98															3	115.5	0	
05:50.1	98															3	115.5	0	
05:50.4	98															3	115.5	0	
05:50.6	98															3	115.5	0	
05:50.9	98															3	115.5	0	
05:51.1	98	9	35	864	51	0.01905	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
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05:53.1	98	9	35	864	53	0.01016	0	0	1	1	55.5	3	0	1.045677	0.64	3	115.5	0	
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05:53.6	98	9	35	864	54	0.00635	0	0	1	1	55.5	3	0	1.045677	0.64	3	115.5	0	
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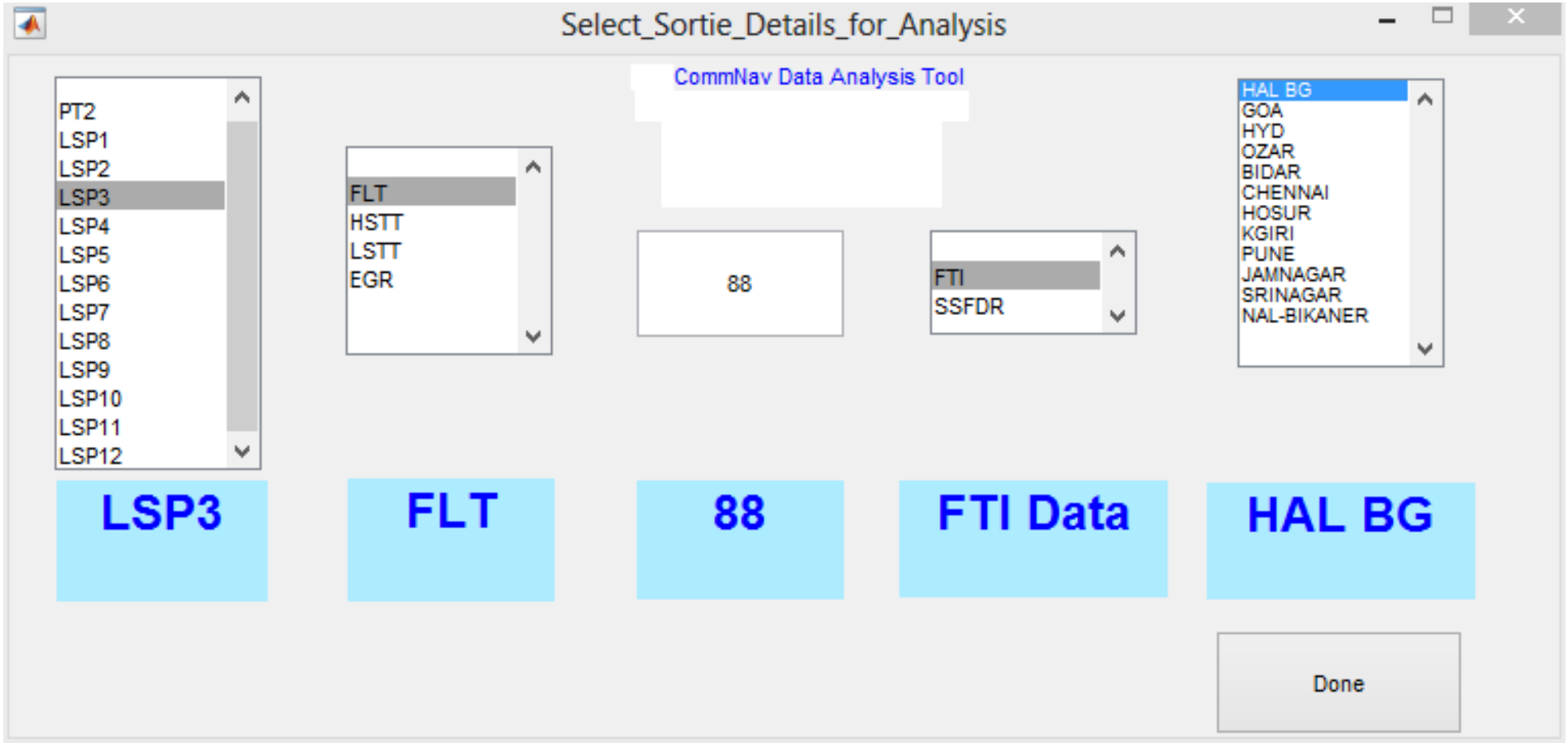
05:54.4	98	9	35	864	54	-0.0127	0	0	1	1	55.5	3	0	1.045677	0.64	3	115.5	0	
05:54.6	98	9	35	864	55	-0.01524	0	0	1	1	55.5	3	0	1.045677	0.64	3	115.5	0	
05:54.9	98	9	35	864	55	-0.01524	0	0	1	1	55.5	3	0	1.045677	0.64	3	115.5	0	
05:55.1	98	9	35	864	55	-0.01778	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:55.4	98	9	35	864	55	-0.02159	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	
05:55.6	98	9	35	864	56	-0.02286	0	0	1	1	55.5	3	0	1.045677	0.63	3	115.5	0	

Multiple MS Excel files.
20000 Rows x 130 Columns each


Select_Sortie_Details_for_Analysis
CommNav Data Analysis Tool
PT2
LSP1
LSP2
LSP3
LSP4
LSP5
LSP6
LSP7
LSP8
LSP9
LSP10
LSP11
LSP12
FLT
HSTT
LSTT
EGR
88
FTI
SSFDR
HAL BG
GOA
HYD
OZAR
BIDAR
CHENNAI
HOSUR
KGIRI
PUNE
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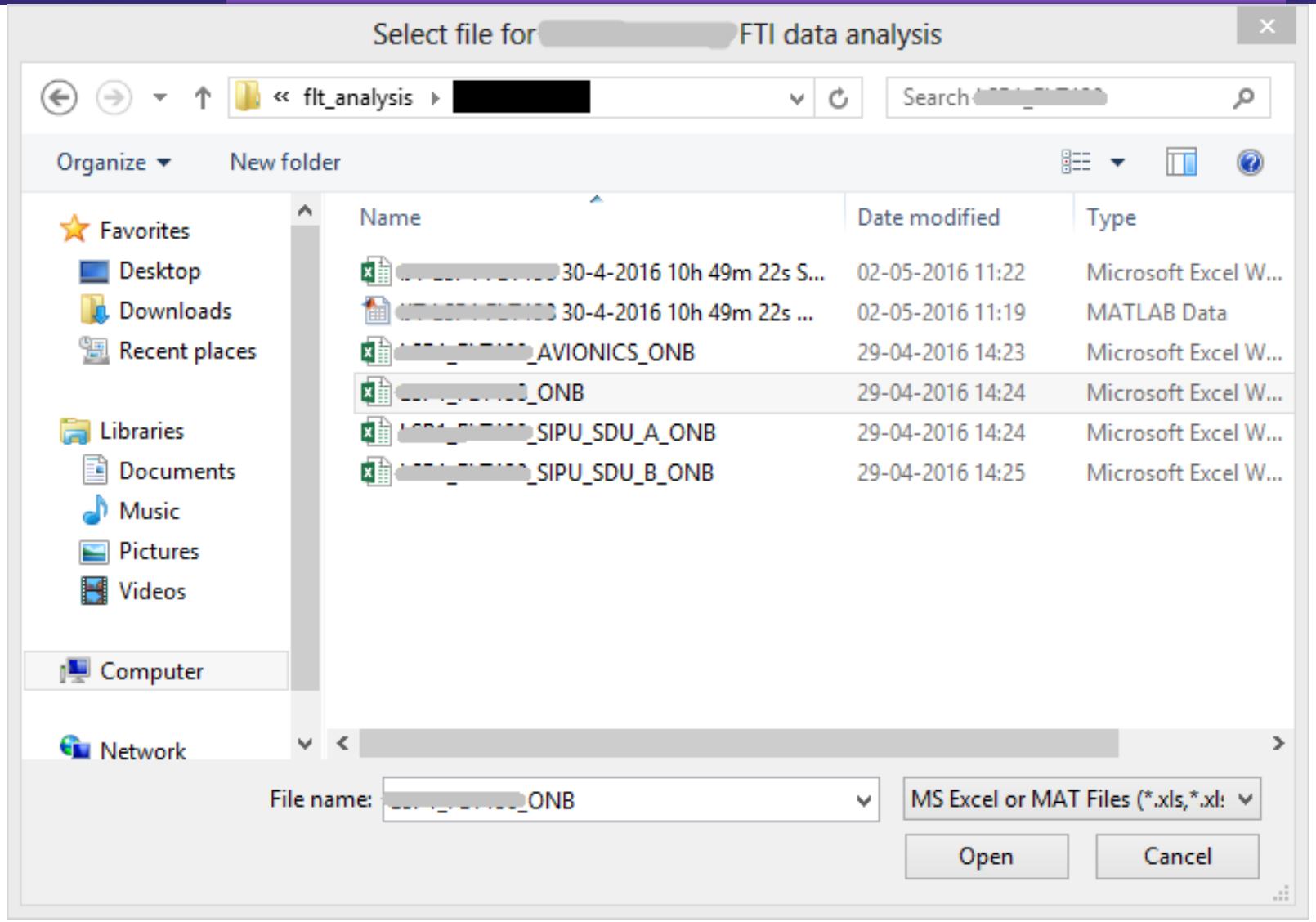
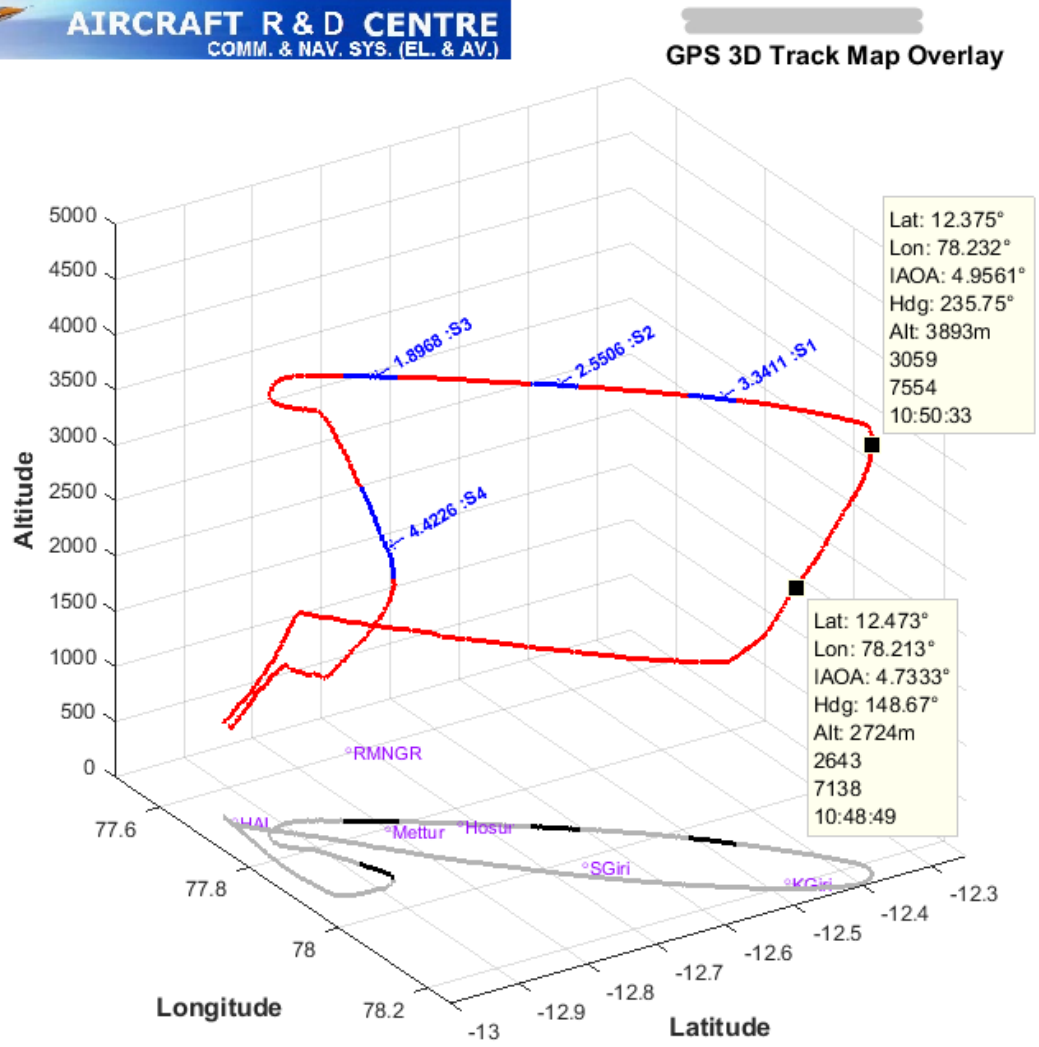
SRINAGAR
NAL-BIKANER
LSP3
FLT
88
FTI Data
HAL BG
Done

Screen Shots



Screen Shots

AIRCRAFT R & D CENTRE
COMM. & NAV. SYS. (EL. & AV.)



THANK YOU !