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m-RIHAST

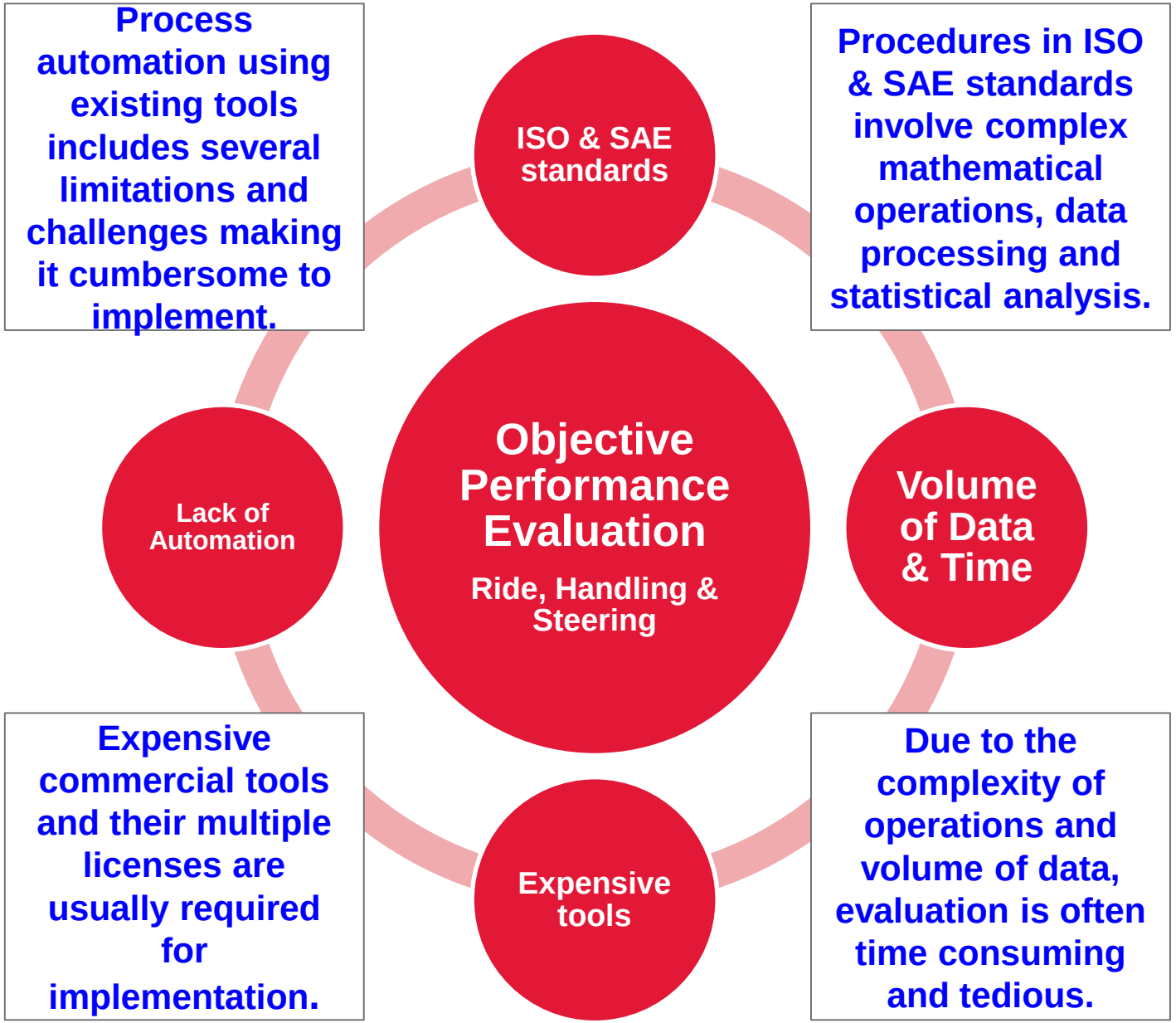
a performance evaluation tool for

RIde, **HA**ndling & **ST**eering

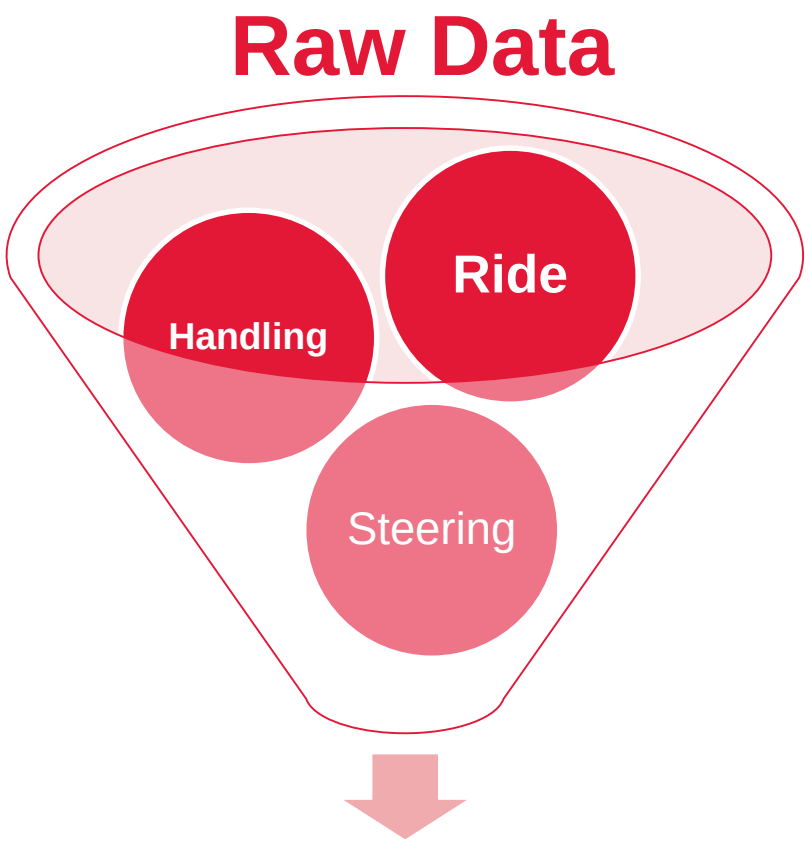
-Developed by:

Mr. Shubham Kedia, Dr. Divyanshu Joshi, Dr. Muthiah Saravanan
(Advanced Technology, Mahindra Research Valley, Chennai)

Problem Statement



Objectives



- Quantification
- Visualization
- Comparison
- GUI interface
- Stand Alone Application
- Assist vehicle Dynamics Testing & Evaluation

Scope

Ride and Vibration Domain

ISO 2631-1
- Weighted RMS
- VDV
- MSDV
- MTVV

ISO 2631-5
- Dose Value
- Static Equivalent Compressive Stress

ISO 10326
- Seat Effective Amplitude Transmissibility
- Damping Test

Handling Domain

ISO 4138
- Understeer Gradient
- Mathematical Operations with Lat. Acc. And Steering Angle

ISO 7401
- Response Delays
- Time Lags
- Overshoots
- Gains in Frequency and Time Domain

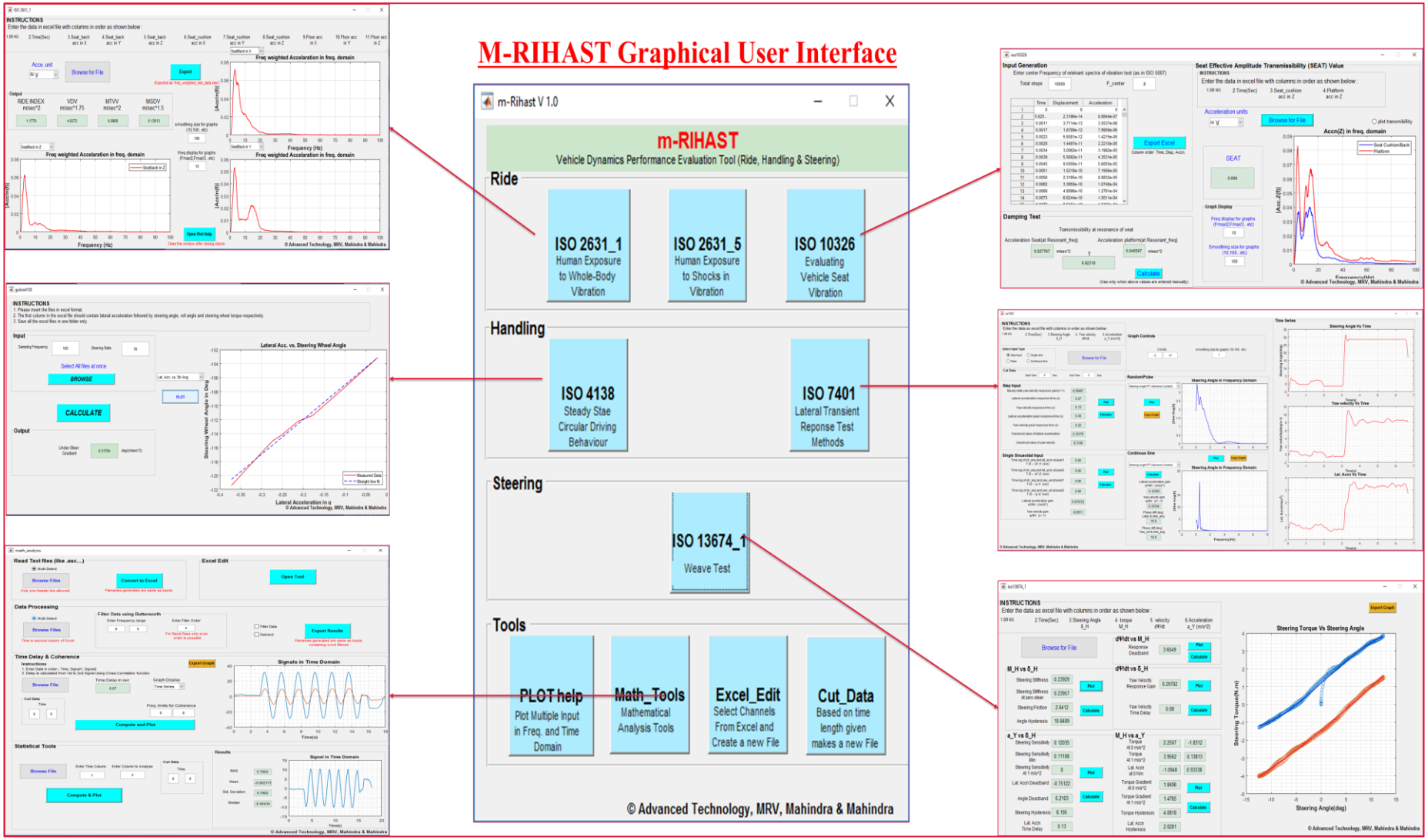
Steering Domain

ISO 13674-1
- Steering Stiffness
- Steering Friction
- Angle Hysteresis
- Steering Sensitivity
- Dead-Bands
- Delays
- Gain
- Torque Hysteresis

Mathematical Operations

- Filtering
- Detrending
- Time Delay using Cross-Correlation
- Coherence
- Statistical Parameters
- Data Processing
- Plot Helps in Time and Frequency Domains

Results


M-RIHAST Graphical User Interface
m-Rihast V 1.0
m-RIHAST
Vehicle Dynamics Performance Evaluation Tool (Ride, Handling & Steering)
Ride
ISO 2631_1
Human Exposure to Whole-Body Vibration
ISO 2631_5
Human Exposure to Shocks in Vibration
ISO 10326
Evaluating Vehicle Seat Vibration
Handling
ISO 4138
Steady Stae Circular Driving Behaviour
ISO 7401
Lateral Transient Reponse Test Methods
Steering
ISO 13674_1
Weave Test
Tools
PLOT help
Plot Multiple Input in Freq. and Time Domain
Math_Tools
Mathematical Analysis Tools
Excel_Edit
Select Channels From Excel and Create a new File
Cut_Data
Based on time length given makes a new File
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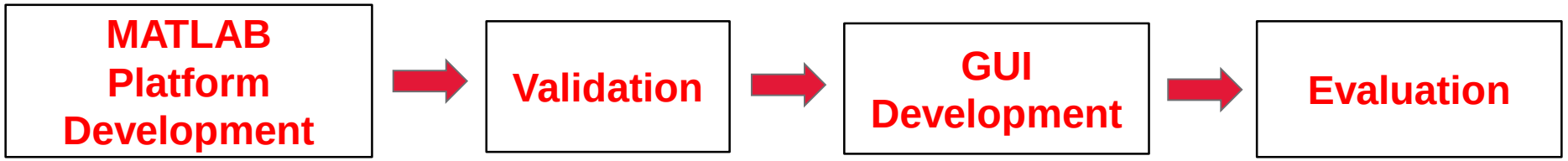
Methodology



MATLAB Platform

- Various logics and algorithms are developed to facilitate several mathematical computations
- Tools and functions available in MATLAB are used
- Mathematical operations and custom filters which are not available are manually programmed.

Validation

- Mathematical functions and algorithms developed for various operations involved in implementation of standards and the help tools are validated against available routines

GUI

- The GUI development is performed using MATLAB guide feature
- m-RIHAST is compiled as a standalone application using MATLAB compiler

Evaluation

- mRIHAST is evaluated by different internal teams
- Next version is under development

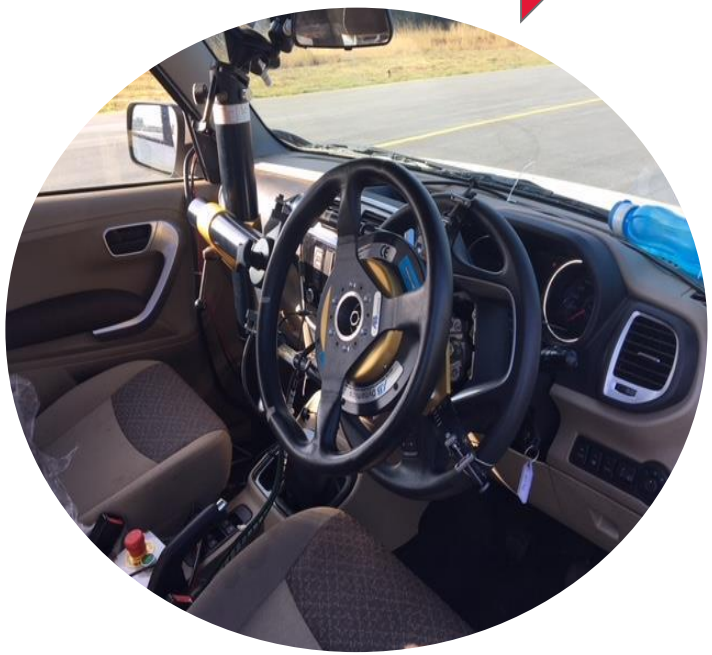
Tools Used:

- MATLAB (basic)
- MATLAB Controls System
- MATLAB Compiler Toolbox
- MATLAB Statistics Toolbox.

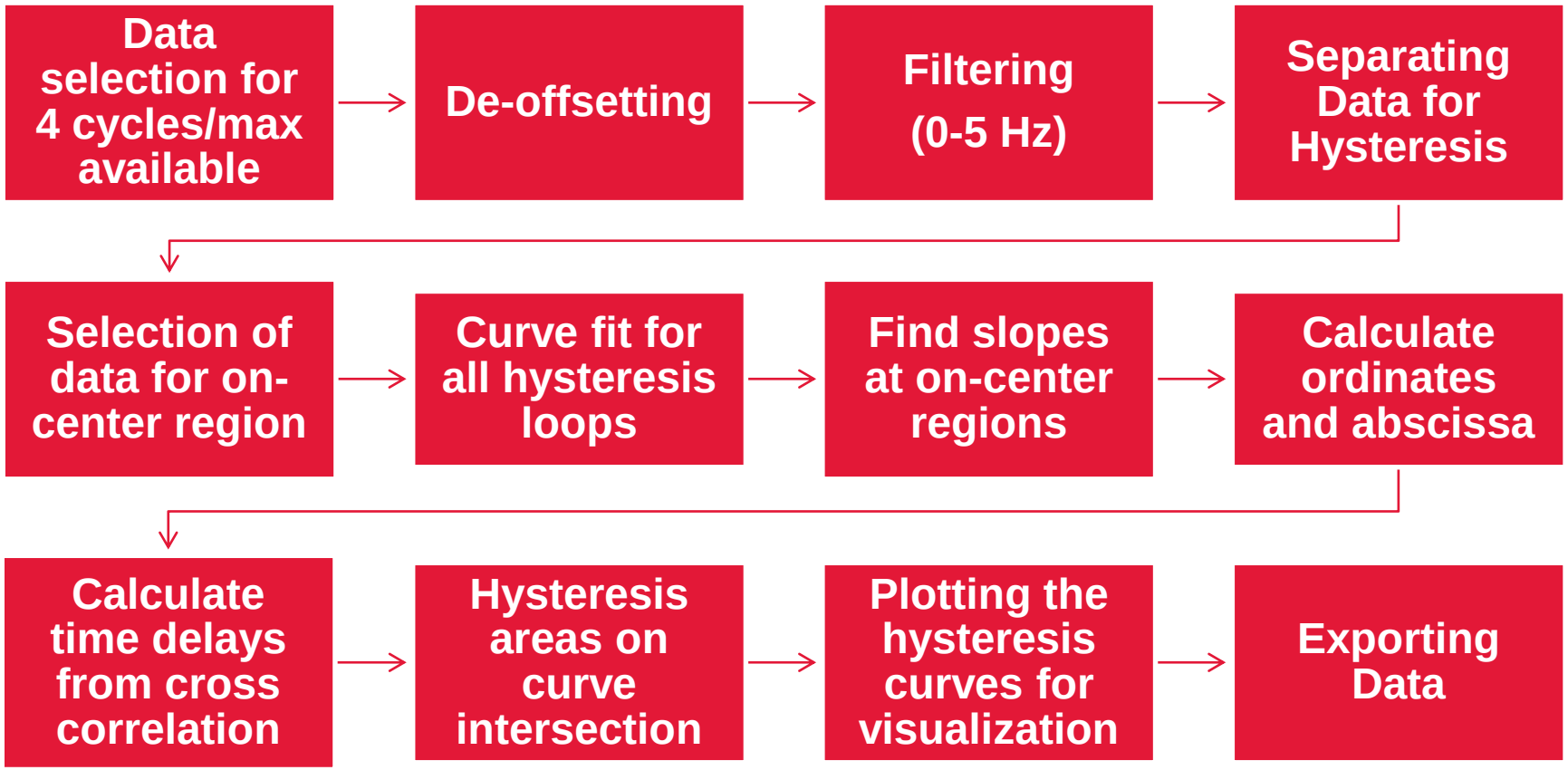
Sample overview

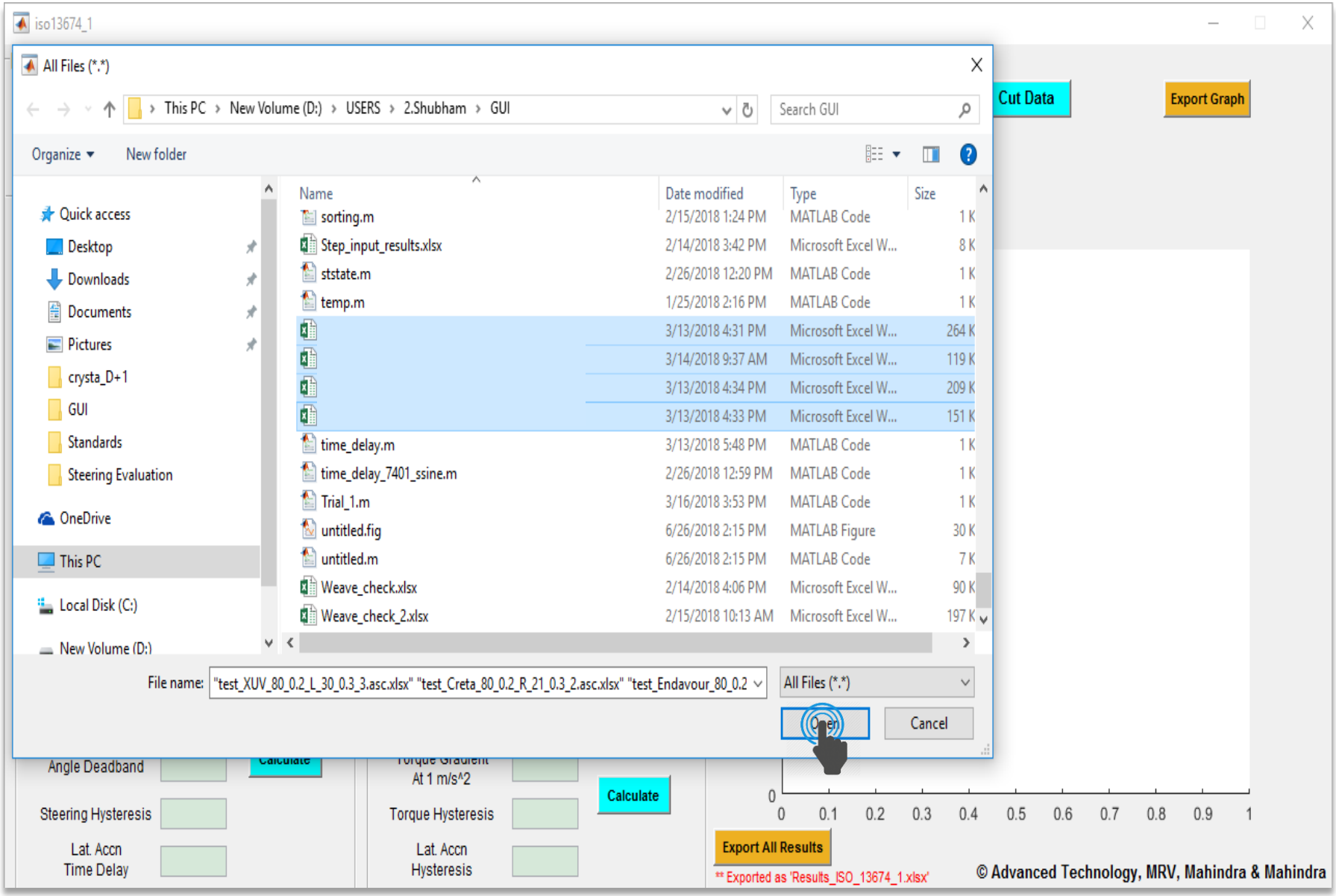
ISO 13674-1 : Implementation

(Weave test: method for the quantification of on-centre handling)



Operations involved (ISO 13674-1)




iso13674_1
All Files (*.*)
This PC › New Volume (D:) › USERS › 2.Shubham › GUI
Search GUI
Organize
New folder
Quick access
Desktop
Downloads
Documents
Pictures
crysta_D+1
GUI
Standards
Steering Evaluation
OneDrive
This PC
Local Disk (C:)
New Volume (D:)
Name
Date modified
Type
Size
sorting.m 2/15/2018 1:24 PM MATLAB Code 1 K
Step_input_results.xlsx 2/14/2018 3:42 PM Microsoft Excel W... 8 K
ststate.m 2/26/2018 12:20 PM MATLAB Code 1 K
temp.m 1/25/2018 2:16 PM MATLAB Code 1 K
3/13/2018 4:31 PM Microsoft Excel W... 264 K
3/14/2018 9:37 AM Microsoft Excel W... 119 K
3/13/2018 4:34 PM Microsoft Excel W... 209 K
3/13/2018 4:33 PM Microsoft Excel W... 151 K
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time_delay_7401_ssine.m 2/26/2018 12:59 PM MATLAB Code 1 K
Trial_1.m 3/16/2018 3:53 PM MATLAB Code 1 K
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untitled.m 6/26/2018 2:15 PM MATLAB Code 7 K
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Weave_check_2.xlsx 2/15/2018 10:13 AM Microsoft Excel W... 197 K
File name: "test_XUV_80_0.2_L_30_0.3_3.asc.xlsx" "test_Creta_80_0.2_R_21_0.3_2.asc.xlsx" "test_Endavour_80_0.2
All Files (*.*)
Open
Cancel
Cut Data
Export Graph
Angle Deadband
Calculate
Steering Hysteresis
Lat. Accn Time Delay
Torque Gradient At 1 m/s^2
Calculate
Torque Hysteresis
Lat. Accn Hysteresis
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Export All Results
** Exported as 'Results_ISO_13674_1.xlsx'
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iso13674_1

INSTRUCTIONS

Enter the data as excel file with columns in order as shown below :

1.SR NO. | 2.Time(Sec) | 3.Steering Angle δ_H (deg) | 4. Torque M_H (N.m) | 5.Yaw Velocity dΨ/dt (deg/sec) | 6.Acceleration a_Y (m/s^2)

Tool for Channel Reassignment — Channel Reassignment

Multi-Select On

Browse for File

test_Creta_80_0.2_R_21_0.3_2.asc.
test_Endavour_80_0.2_R_20_0.3_4.
test_TUV1_80_0.2_L_29_0.3_2.asc.
test_XUV_80_0.2_L_30_0.3_3.asc.x

M_H vs δ_H

Steering Stiffness	0.19392
Steering Stiffness At Zero Steer	0.19528
Steering Friction	2.8116
Angle Hysteresis	14.3422

Plot / Calculate

dΨ/dt vs M_H

Response Deadband	3.8608

Plot / Calculate

dΨ/dt vs δ_H

Yaw Velocity Response Gain	0.20134
Yaw Velocity Time Delay	0.01

Plot / Calculate

a_Y vs δ_H

Steering Sensitivity	0.081948
Steering Sensitivity Min	0.077158
Steering Sensitivity At 1 m/s^2	0.079904
Lat. Accn Deadband	0.58927
Angle Deadband	7.3061
Steering Hysteresis	7.2168
Lat. Accn Time Delay	0.01

Plot / Calculate

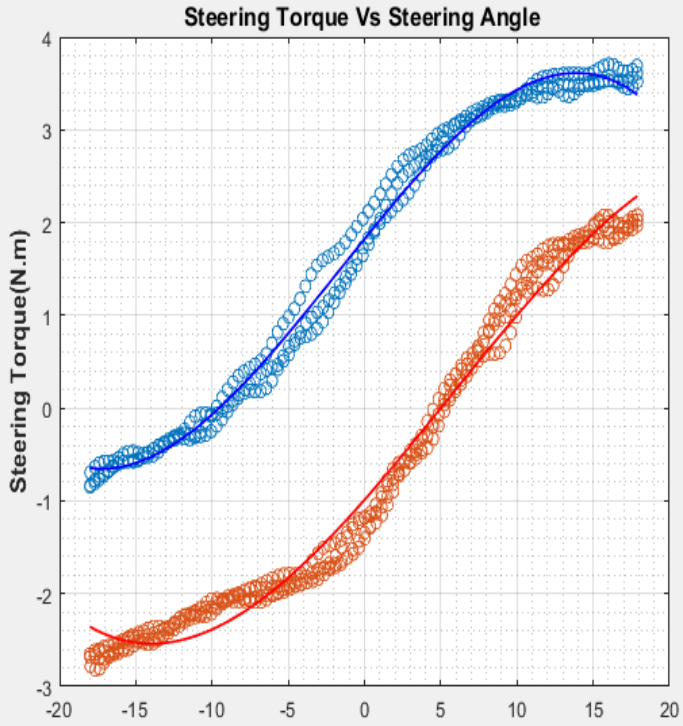
M_H vs a_Y

Torque At 0 m/s^2	2.5403	-1.5695
Torque At 1 m/s^2	3.5676	0.72935
Lat. Accn at 0 Nm	-1.1208	0.71821
Torque Gradient At 0 m/s^2	2.013	
Torque Gradient At 1 m/s^2	-0.3501	
Torque Hysteresis	4.1098	
Lat. Accn Hysteresis	1.839	

Plot / Calculate

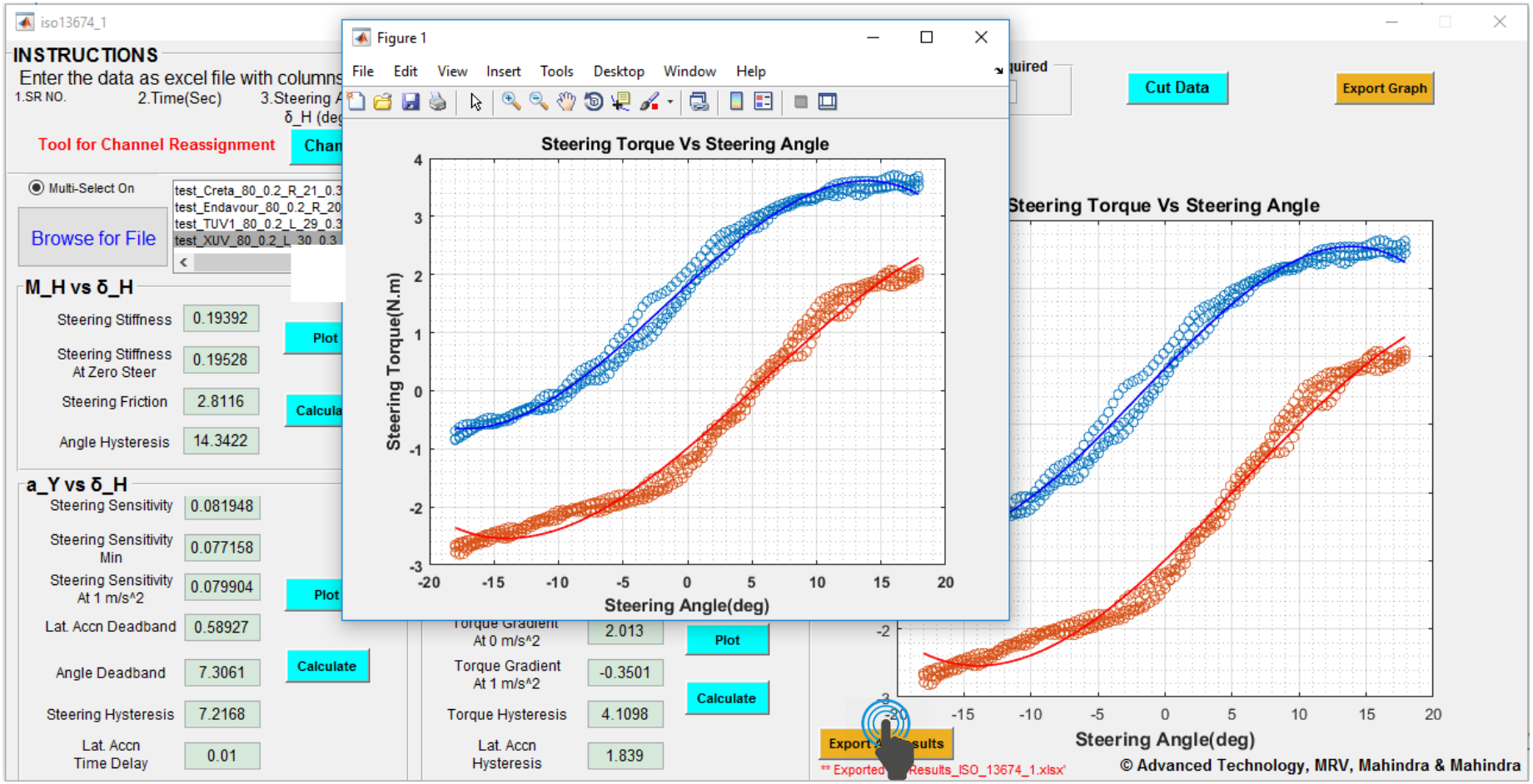
Total Peaks Required: 16

Cut Data — Export Graph



Export All Results

** Exported as 'Results_ISO_13674_1.xlsx'


iso13674_1
INSTRUCTIONS
Enter the data as excel file with columns
1.SR NO.
2.Time(Sec)
Tool for Channel Reassignment
Multi-Select On
Browse for File
test_Creta_80_0.2_R_21_0.3
test_Endavour_80_0.2_R_20
test_TUV1_80_0.2_L_29_0.3
test_XUV_80_0.2_L_30_0.3
M_H vs δ_H
Steering Stiffness
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Steering Sensitivity At 1 m/s^2
0.079904
Lat. Accn Deadband
0.58927
Angle Deadband
7.3061
Steering Hysteresis
7.2168
Lat. Accn Time Delay
0.01
Calculate
Figure 1
File Edit View Insert Tools Desktop Window Help
Steering Torque Vs Steering Angle
Steering Torque(N.m)
Steering Angle(deg)
Torque Gradient At 0 m/s^2
2.013
Torque Gradient At 1 m/s^2
-0.3501
Torque Hysteresis
4.1098
Lat. Accn Hysteresis
1.839
Cut Data
Export Graph
Steering Torque Vs Steering Angle
Steering Angle(deg)
** Exported Results_ISO_13674_1.xlsx'
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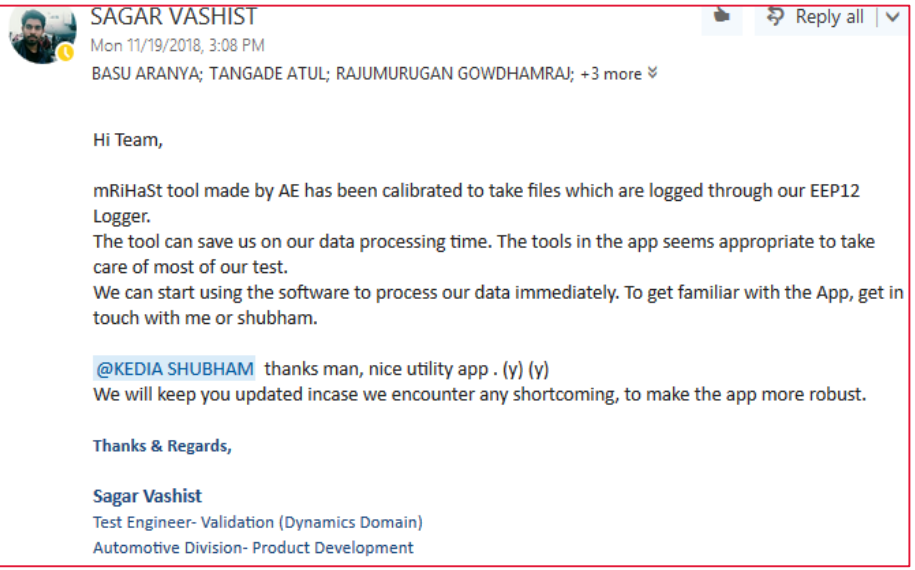
User Comments



SAGAR VASHIST
Mon 11/19/2018, 3:08 PM
BASU ARANYA; TANGADE ATUL; RAJUMURUGAN GOWDHAMRAJ; +3 more

Reply all

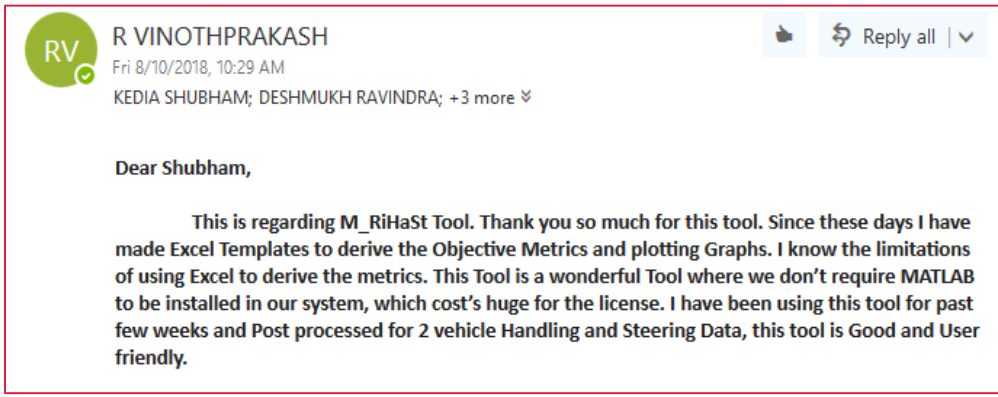
Hi Team,

mRiHaSt tool made by AE has been calibrated to take files which are logged through our EEP12 Logger.
The tool can save us on our data processing time. The tools in the app seems appropriate to take care of most of our test.
We can start using the software to process our data immediately. To get familiar with the App, get in touch with me or shubham.

@KEDIA SHUBHAM thanks man, nice utility app . (y) (y)
We will keep you updated incase we encounter any shortcoming, to make the app more robust.

Thanks & Regards,

Sagar Vashist
Test Engineer- Validation (Dynamics Domain)
Automotive Division- Product Development

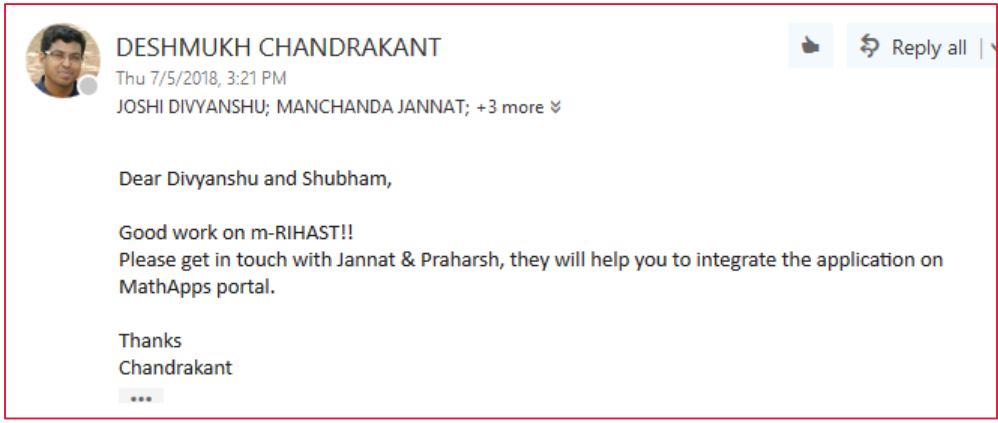


R VINOTHPRAKASH
Fri 8/10/2018, 10:29 AM
KEDIA SHUBHAM; DESHMUKH RAVINDRA; +3 more

Reply all

Dear Shubham,

This is regarding M_RiHaSt Tool. Thank you so much for this tool. Since these days I have made Excel Templates to derive the Objective Metrics and plotting Graphs. I know the limitations of using Excel to derive the metrics. This Tool is a wonderful Tool where we don't require MATLAB to be installed in our system, which cost's huge for the license. I have been using this tool for past few weeks and Post processed for 2 vehicle Handling and Steering Data, this tool is Good and User friendly.



DESHMUKH CHANDRAKANT
Thu 7/5/2018, 3:21 PM
JOSHI DIVYANSHU; MANCHANDA JANNAT; +3 more

Reply all

Dear Divyanshu and Shubham,

Good work on m-RIHAST!!
Please get in touch with Jannat & Praharsh, they will help you to integrate the application on MathApps portal.

Thanks
Chandrakant

Thank You

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