MATLAB & Simulink in validating future technologies with Real time test data in Automotive Engineering

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## Agenda

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Introduction

- Increasing software applications in Automotive industries.
  - The usage of software in automotive industry is inevitable and its share keeps on growing beyond 80%.
  - The percentage will rise more than 90% within the next decade.
- Applications in automotive – Safety critical
- Effective testing of the applications from software development phase itself.

- Software development in Simulink
- MATLAB & Simulink are provided with lot of features for software verification and validation.
Application validation

General application validation can be with any of the following test inputs,

- Manual test cases based on requirement
- Auto generated test cases
- Real time vehicle input data.
New Application

OEMs focus on adding new features to the vehicle in order
• To satisfy the more strict safety requirements
• To provide better driving experiences to customer
• To compete in Market

Initial phase of any new application would be to simulate it on software level. This simulation should prove
• Application functionality
• That it will work in real time environment

The challenge would be to prove that the new application will work in real time!
Challenges in validating new applications

Collecting test data for new applications in real time poses various challenges to us such as,

- Long vehicle run with specific safety critical drive conditions.
- Time consumption.

How do we test the new application with real time data with these challenges?
And How MATLAB & Simulink helps us to make it simple?
Alternate method of validation

- The alternative approach
  - Collect the real time test data for short distance drive in real time with specific conditions necessary
  - Create complete test cases with combinations of the collected real time test data
  - Validate the software (Simulink model) by simulation in MATLAB
Test scenario creation

- Extracting vehicle data
  - Set of CAN data from vehicle are taken and converted to .mat file for loading into the MATLAB workspace.
- Creating scenarios
  - Combinations of set of input data are formed in MATLAB with the help of a tool developed with m-script.
- Model validation
  - Validation by simulating the model with input combinations using the tool.
  - Result analysis with the plots generated out of simulation against inputs
Validation with huge data

- Simulation process needs more memory because of
  - Lengthy test cases created in .mat
  - More temporary memory allocation need for complex Simulink models
  - Large data storage for result analysis

- Allocated MATLAB heap memory for workspace is not sufficient to handle the simulation with huge test data.

- Validating with lesser input data will not provide the intended result and requires user to stay nearby for long time for successive simulations.
Accelerator mode of simulation and Simstate

- With “Normal” mode of simulation, all the internal states and variables are stored for every sample time – Leading to Out of Memory Error
Accelerator mode of simulation and Simstate

- Hence moving to Accelerator mode of simulation – which stores only the final output values
Accelerator mode of simulation and Simstate

- Need for the final state information & accelerated simulation
- With Simstate settings in Simulink, Final state of a smaller simulation can be saved and restored as the initial state for the next simulation.
Simulation approach

- This approach helps in clearing and saving of the workspace variables in-between the simulations, thereby effectively reusing the memory without causing memory error.
Tools support

- Software Validation taken closer to real time
Benefit

• MATLAB, Simulink helps us to validate our new applications with real time test data in easy way with less number of resources and effort
Thank you for your attention!

Any Questions?