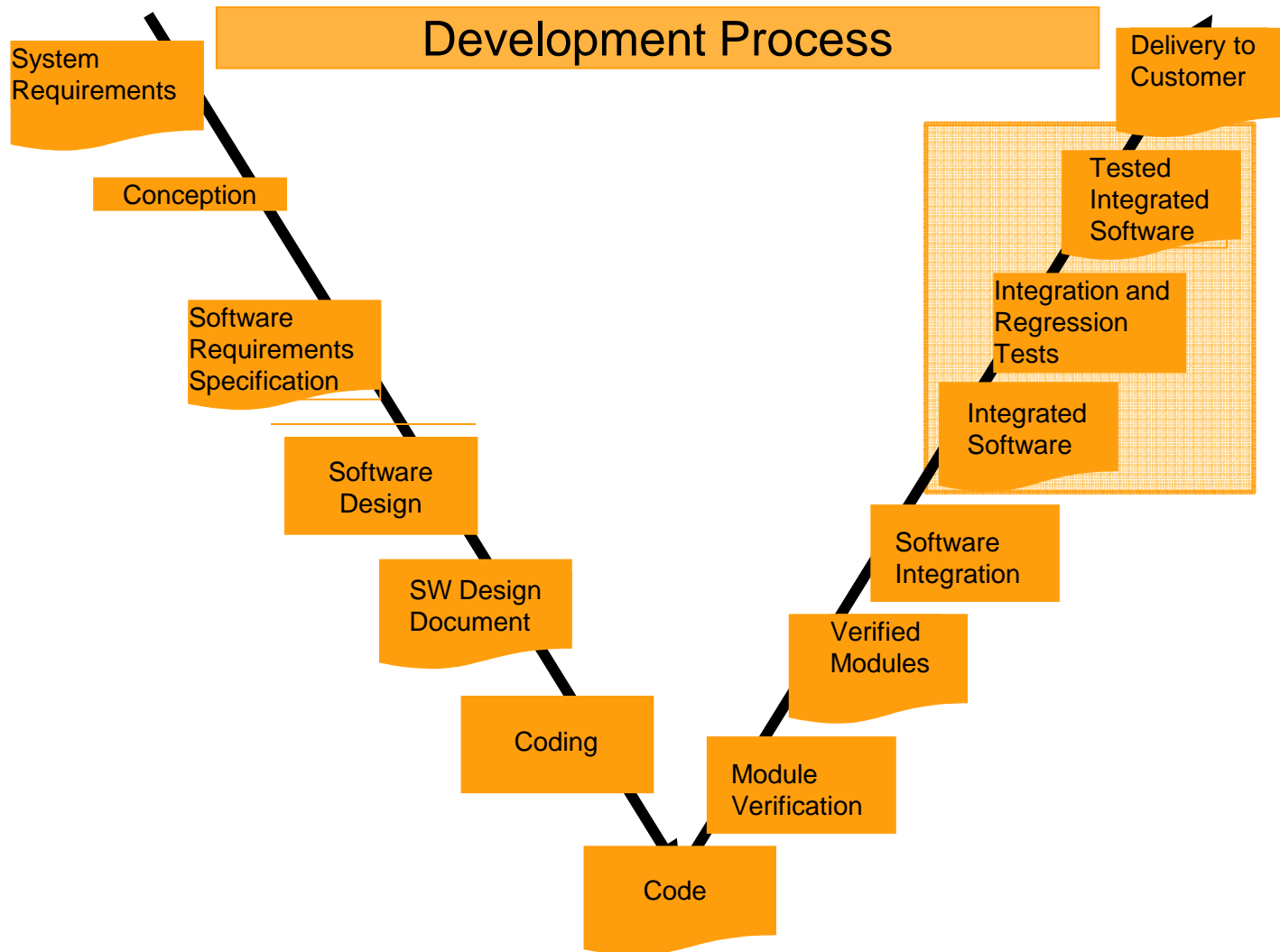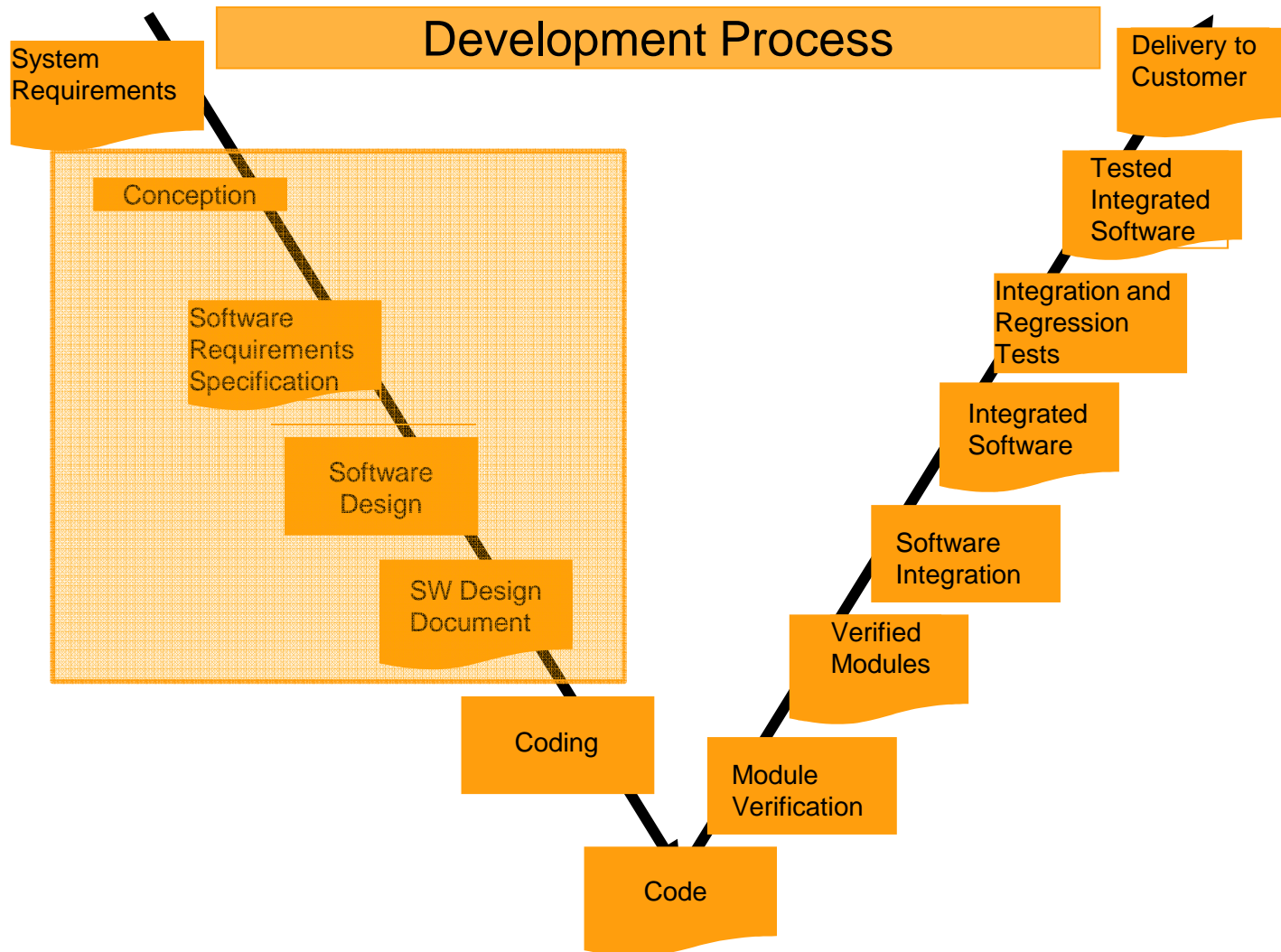# Functional testing via statistical and behavioral signatures for Engine Management Systems Using Matlab/Simulink

Christo Prakash and Vijith Natarajan
Engine Powertain Control
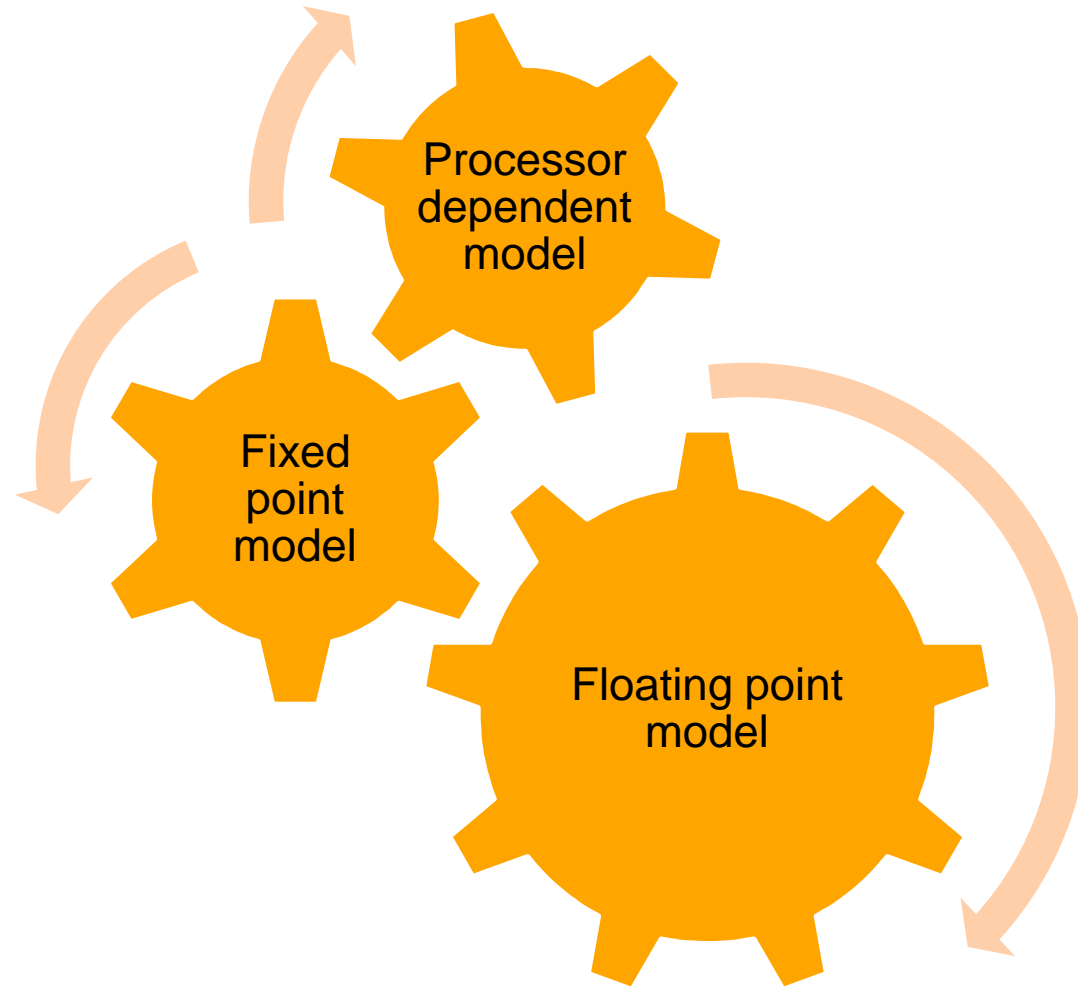
www.continental-corporation.com
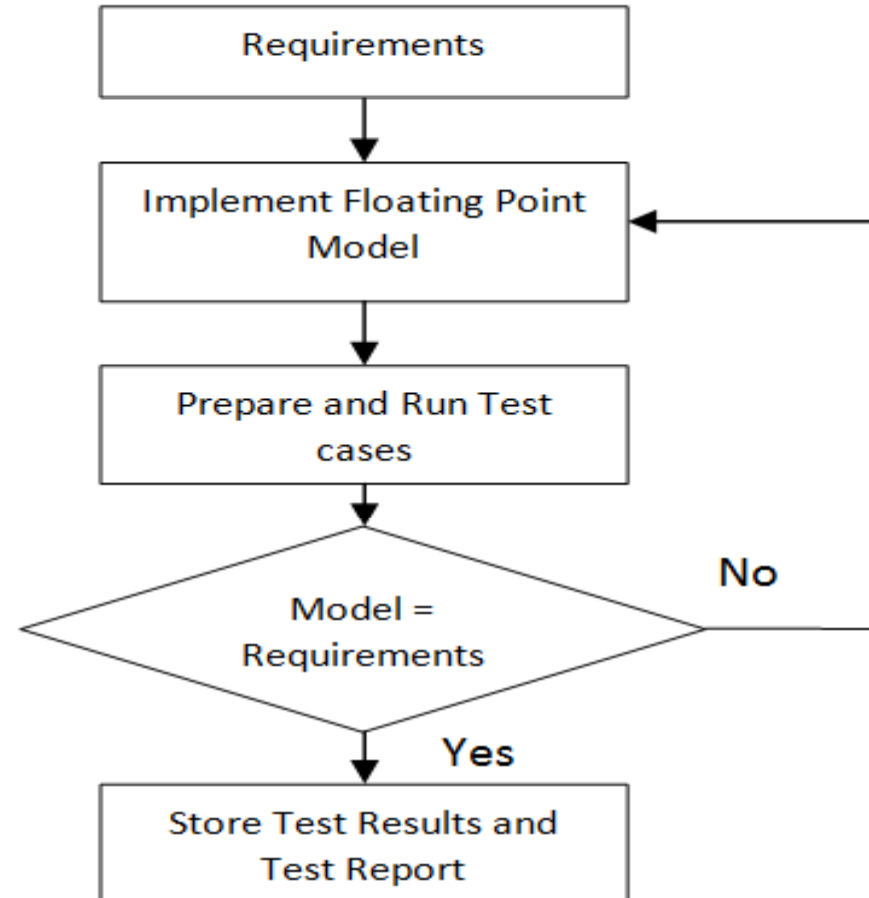
Powertrain Division

Conventional Test Procedure

Development Process

- System Requirements
- Conception
- Software Requirements Specification
- Software Design
- SW Design Document
- Coding
- Code
- Module Verification
- Verified Modules
- Software Integration
- Integrated Software
- Integration and Regression Tests
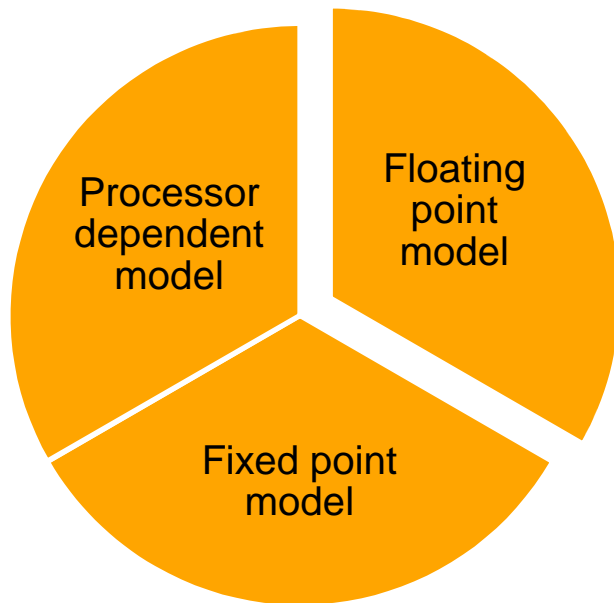- Tested Integrated Software
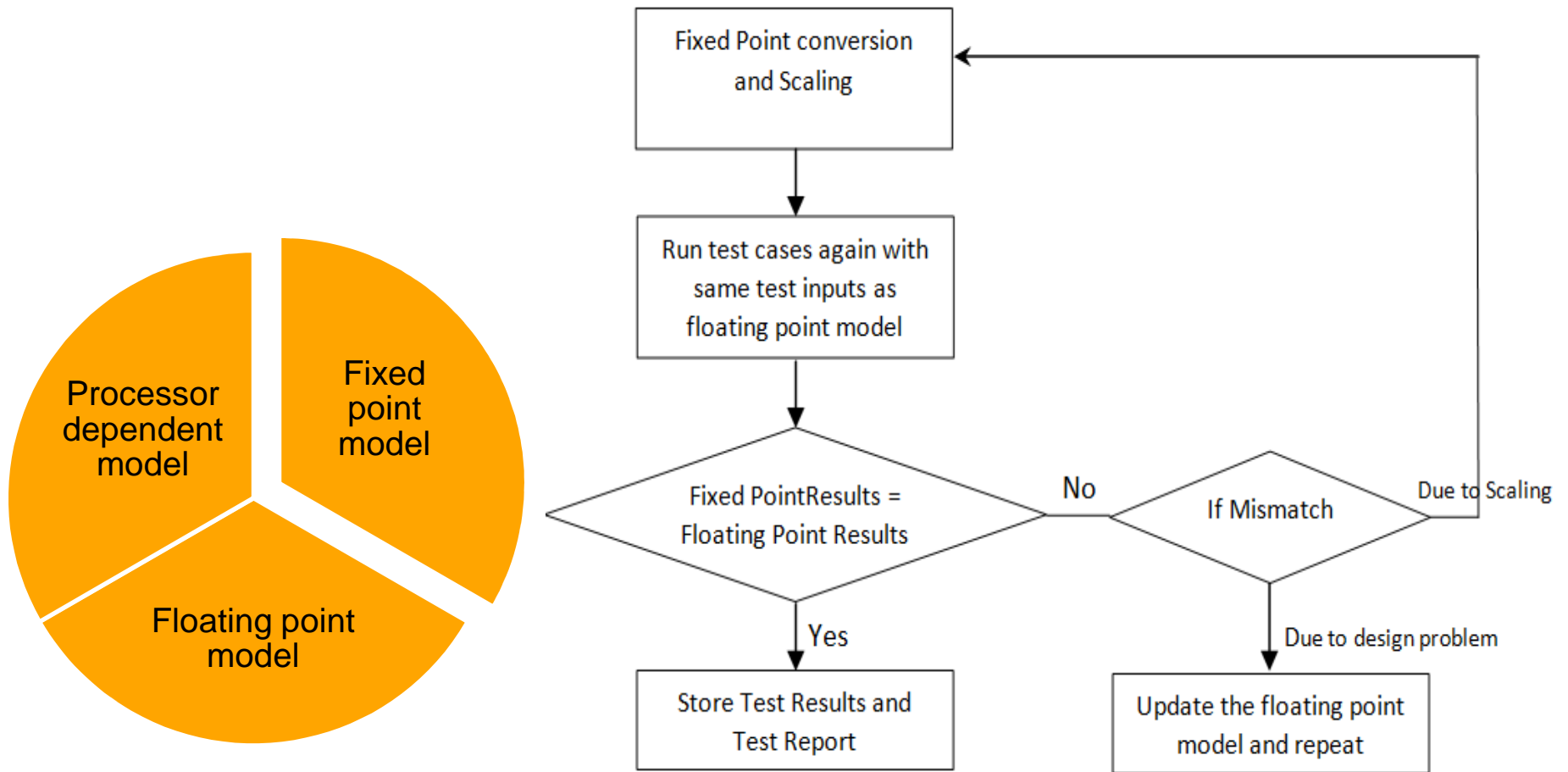- Delivery to Customer
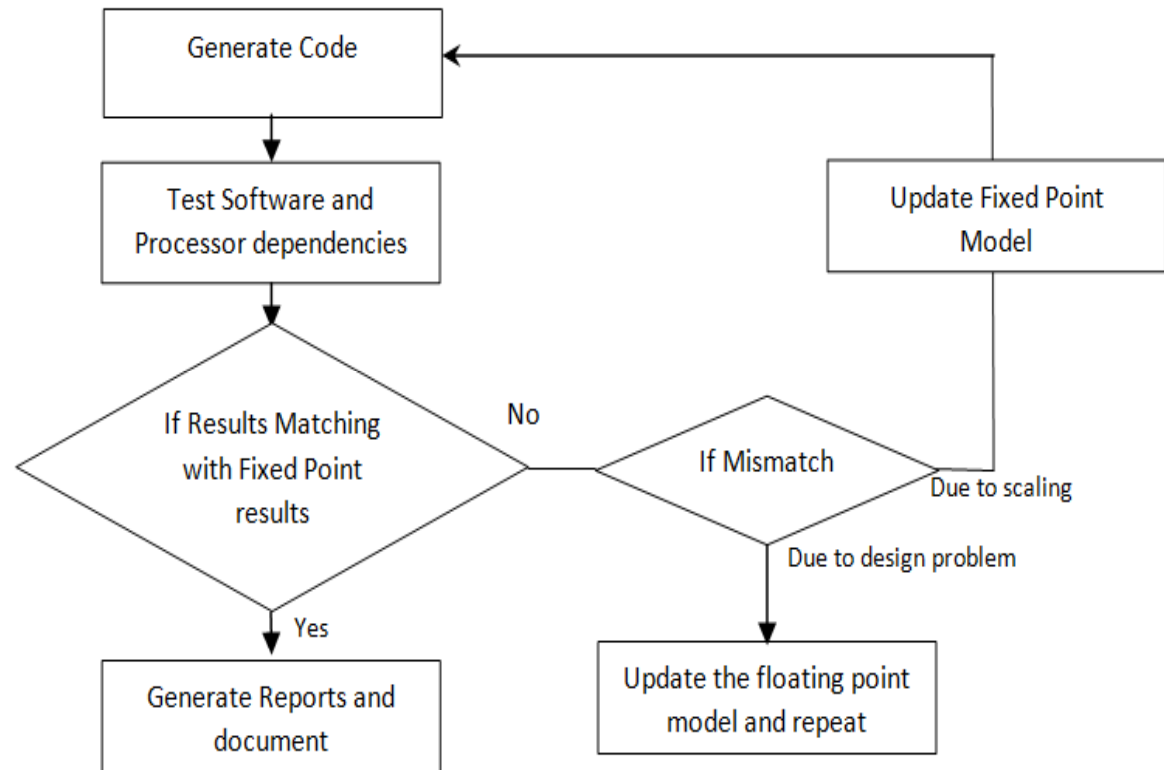
Modified Test Procedure
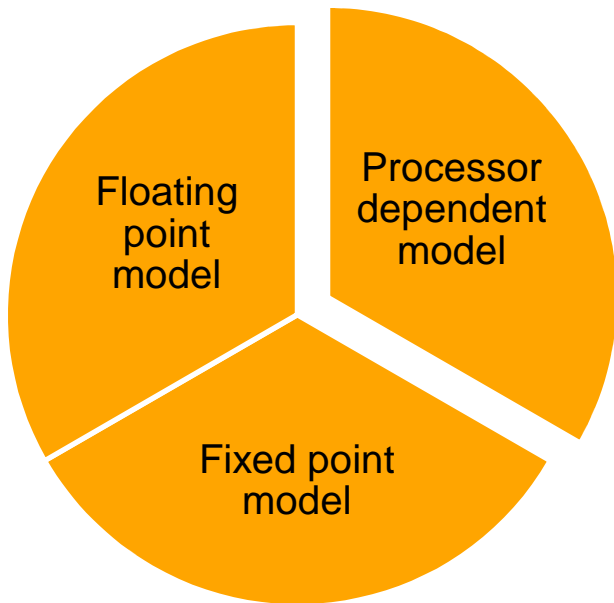
Model based design work flow

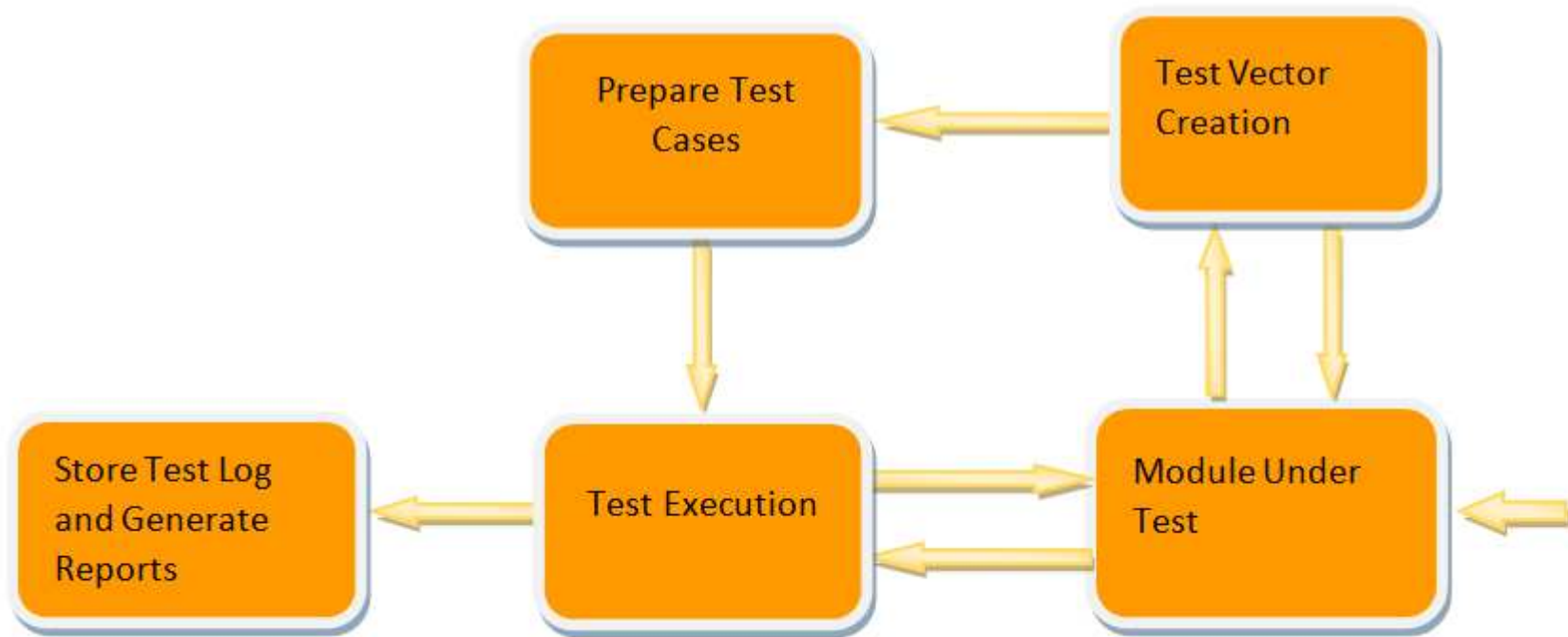# Model based design work flow

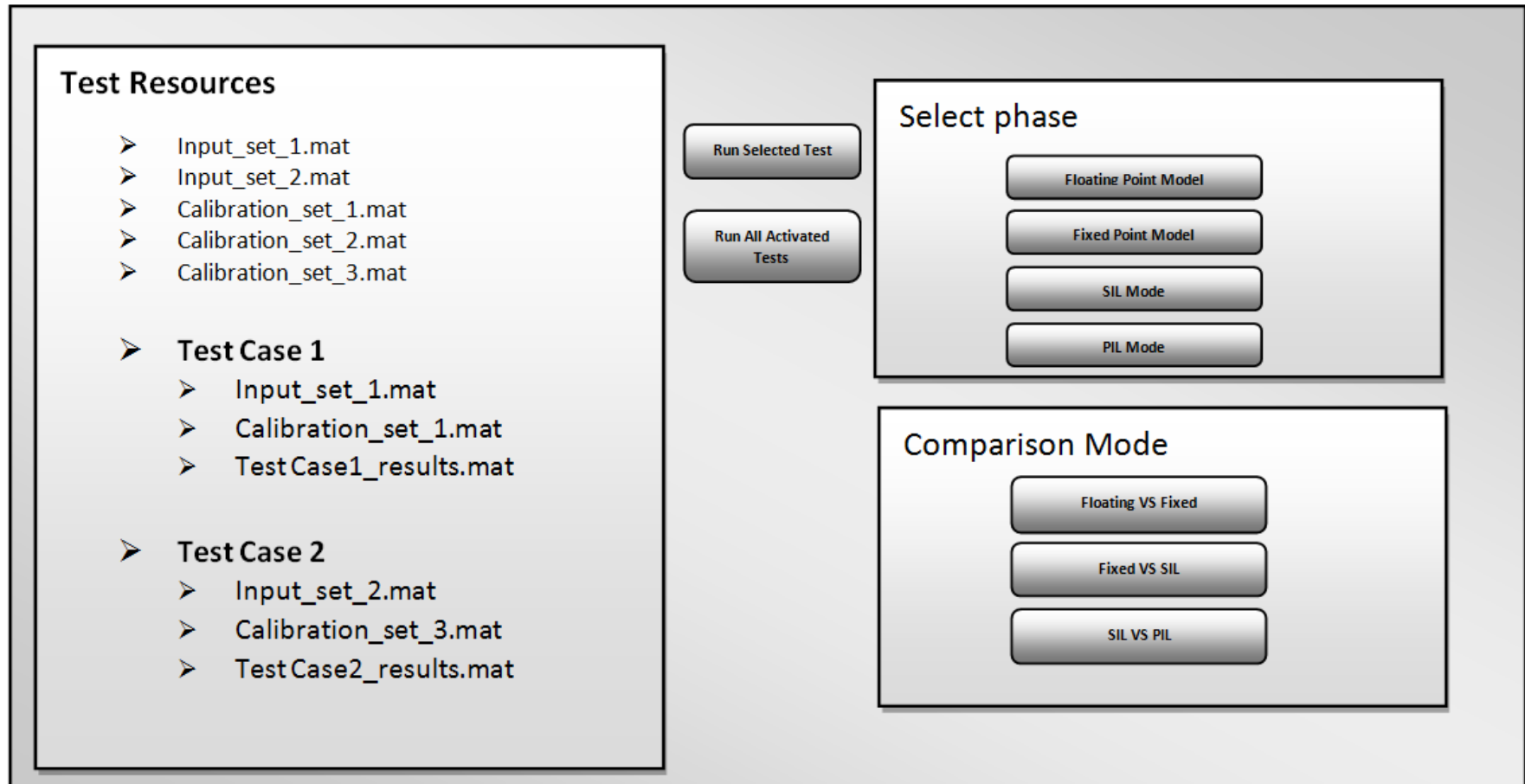# Model based design work flow

Model based design work flow

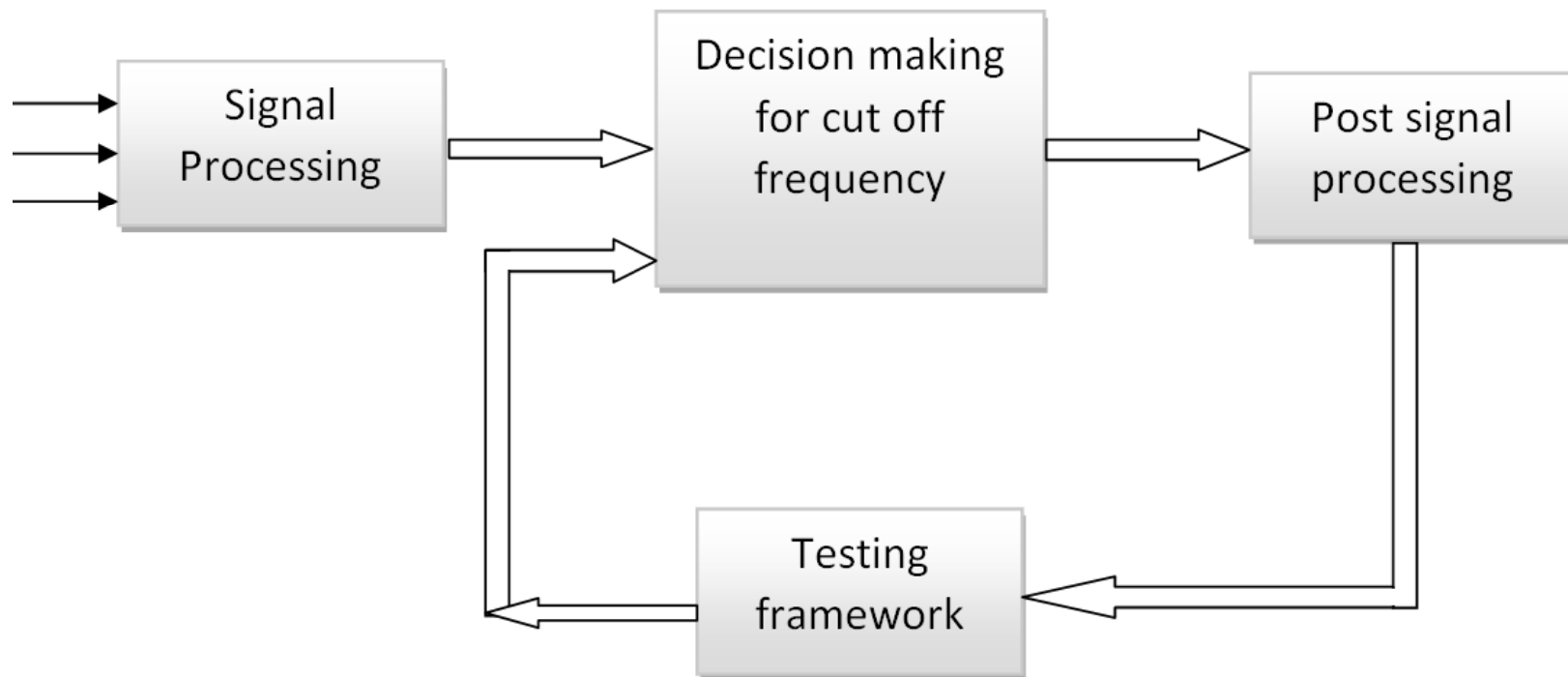# Model based testing work flow

Model based testing framework

➢ **Test Manager**– Centralized environment for creating and managing Test vectors and Test cases
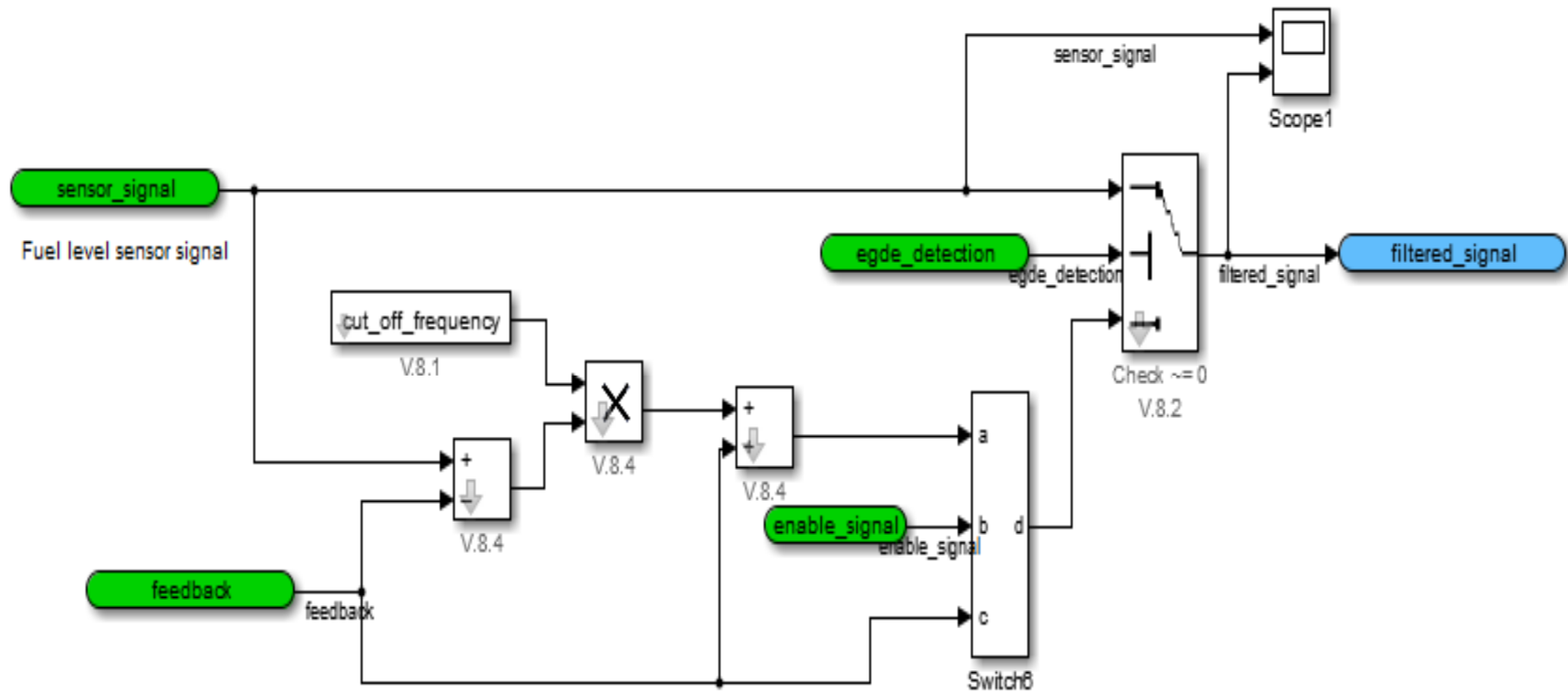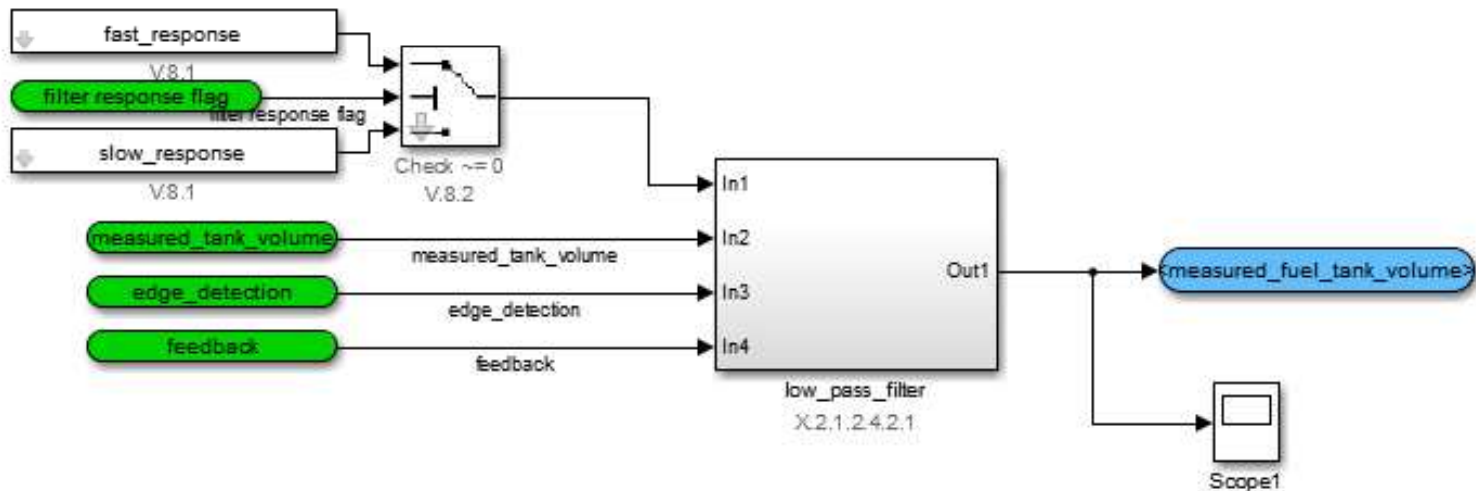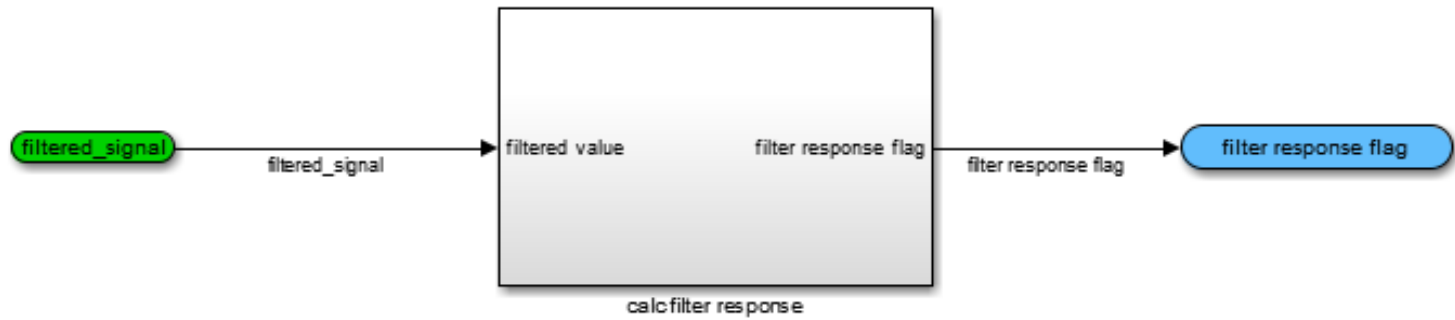
Example

Identification of range of the cut off frequency for fuel tank level monitoring using model based testing

Matlab/Simulink model
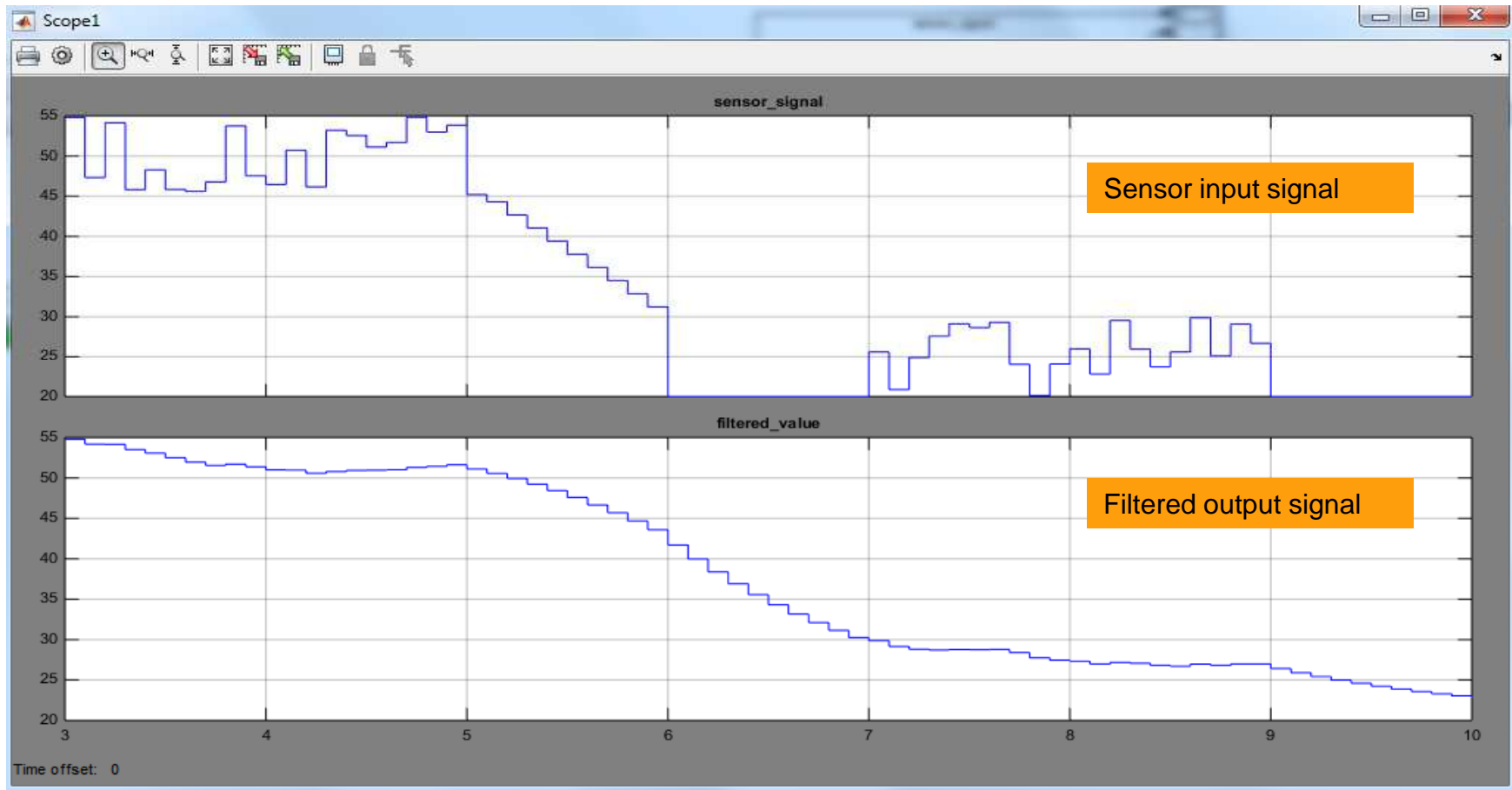
Matlab/Simulink model
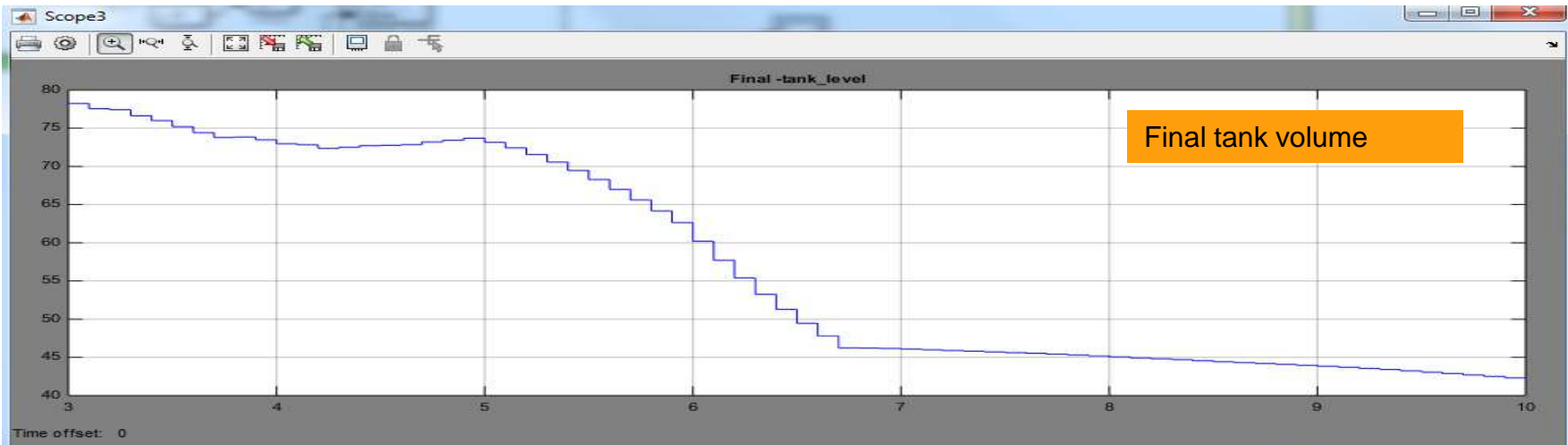
Simulation Results

Case 1: Cut off frequency 0.5

Simulation Results

Case 2: Cut off frequency 0.08

Simulation Results

Final Iterative simulation result

Filtered tank volume

Final tank volume
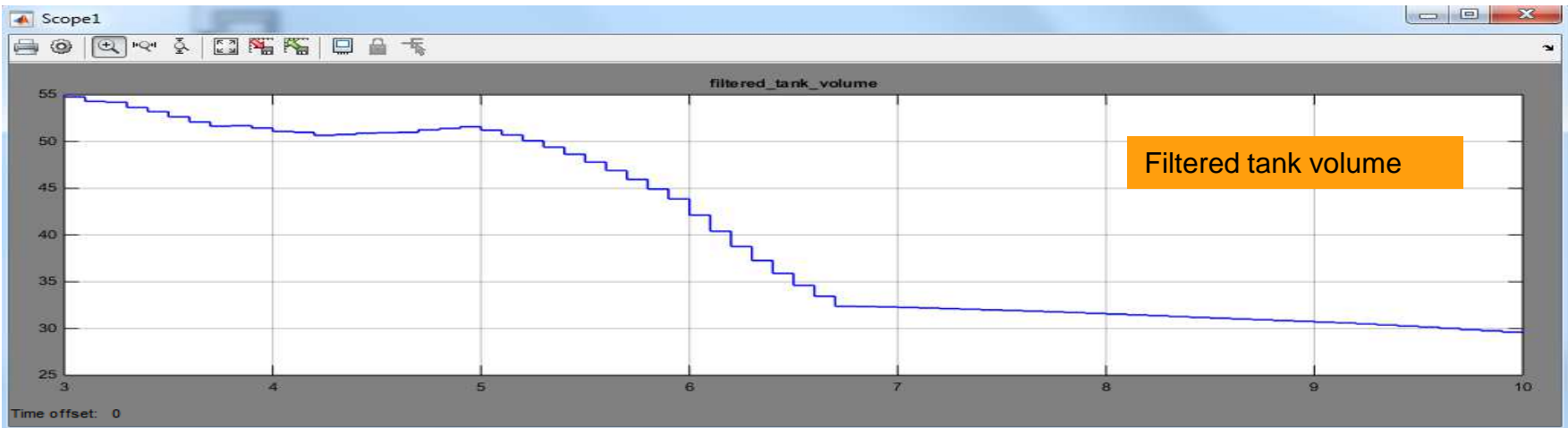
Simulation Results

Filter Coefficient	Signal strength	Performance
0.5	Noisy signal	☹
0.08	Filtered signal	☺

From the simulation results it is evident that our system is stable and defect free at the design stage itself

Hence a drastic reduction in the effort spend on HIL /vehicle testing and design rework at later stages.

Challenges faced

Centralized data base management for the environmental model.

Onetime effort to create the environmental model and training the software developer

Conclusion

The authors feel that with Model based testing the quality of software increases due to the simulation and test capability of MATLAB and the knowledge of the developer

From the case study and the test framework used it is concluded that better understanding of the vehicle real time behavior and any unforeseen behavior problems can be corrected.

The effective model based testing showed the improved accuracy of the calibration in order to fine tune the vehicle performance.

Thank you
for your attention!