

PROPULSION CI

In the beginning

Started 2002

10 model developers

SourceSafe/Vault

Used as a network storage

Manual starting bat files for
code gen and building

History

Prior to the current engine generation, most tests done in car
During the development of the current engine generation,
automatic unit and system tests were introduced.

Aftertreatment SW solely developed in Sil platform.

One senior SW developer said: *now I know it will work*

Software in the engine control Module



The Software in current generation ECMS is structured into around 400 modules

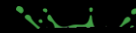
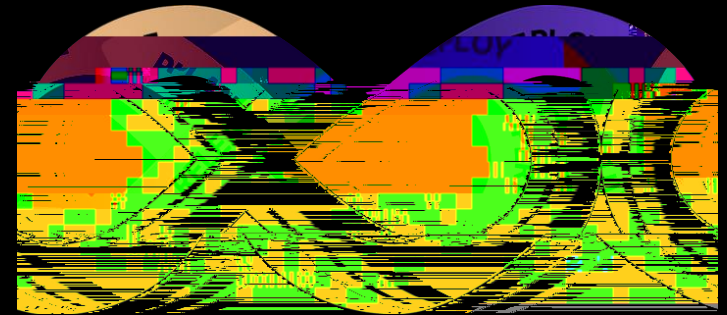
A small part of the application code is still made by the HW suppliers

CI/CD System

Ensuring the integrity is not dependent on a single individual making the right call. It is ensured by the system.

Fast Feedback, small changes often, automatic testing

Transparency, Follow your commit
CI/CD system as code, using Python plugin
Jenkins job builder and YAML files as pipeline configuration

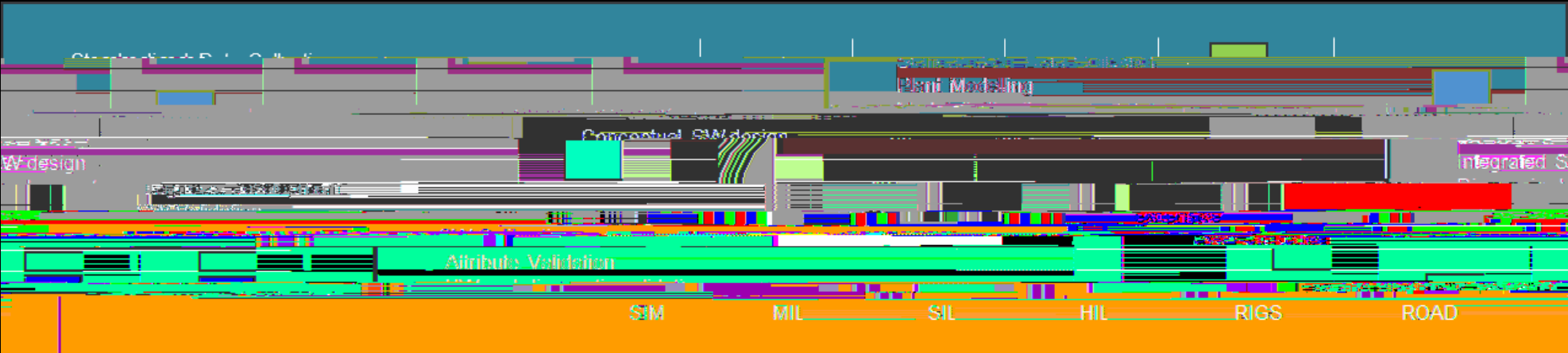
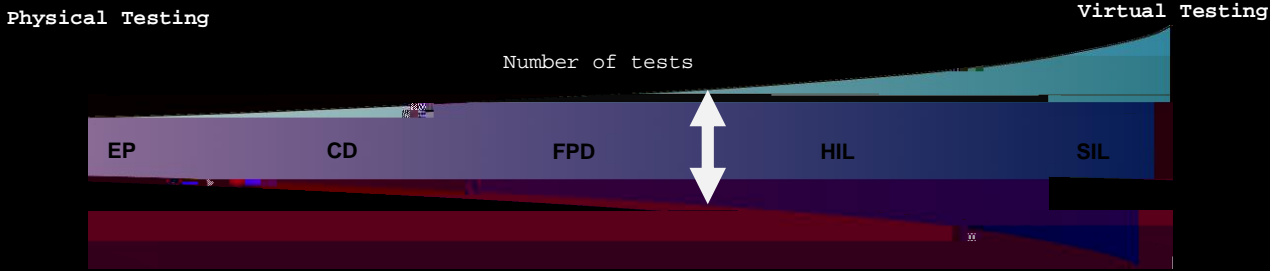


CI/CD System

7

The screenshot displays the Zuul Status dashboard, a real-time status monitor for Zuul, the pipeline manager between Gerrit and Workers. The dashboard shows a search bar with the text "Zuul Jenkins Dev" and "0 results". Below this, there are filters and a table of pipeline jobs. The jobs are organized into a grid, with each job having a status indicator (e.g., "queued", "in progress", "failed") and a "refresh" button. The jobs listed include "build_gcp3", "build_gcp3_1", "build_gcp3_2", "build_gcp3_3", "build_gcp3_4", "build_gcp3_5", "build_gcp3_6", "build_gcp3_7", "build_gcp3_8", "build_gcp3_9", "build_gcp3_10", "build_gcp3_11", "build_gcp3_12", "build_gcp3_13", "build_gcp3_14", "build_gcp3_15", "build_gcp3_16", "build_gcp3_17", "build_gcp3_18", "build_gcp3_19", "build_gcp3_20", "build_gcp3_21", "build_gcp3_22", "build_gcp3_23", "build_gcp3_24", "build_gcp3_25", "build_gcp3_26", "build_gcp3_27", "build_gcp3_28", "build_gcp3_29", "build_gcp3_30", "build_gcp3_31", "build_gcp3_32", "build_gcp3_33", "build_gcp3_34", "build_gcp3_35", "build_gcp3_36", "build_gcp3_37", "build_gcp3_38", "build_gcp3_39", "build_gcp3_40", "build_gcp3_41", "build_gcp3_42", "build_gcp3_43", "build_gcp3_44", "build_gcp3_45", "build_gcp3_46", "build_gcp3_47", "build_gcp3_48", "build_gcp3_49", "build_gcp3_50", "build_gcp3_51", "build_gcp3_52", "build_gcp3_53", "build_gcp3_54", "build_gcp3_55", "build_gcp3_56", "build_gcp3_57", "build_gcp3_58", "build_gcp3_59", "build_gcp3_60", "build_gcp3_61", "build_gcp3_62", "build_gcp3_63", "build_gcp3_64", "build_gcp3_65", "build_gcp3_66", "build_gcp3_67", "build_gcp3_68", "build_gcp3_69", "build_gcp3_70", "build_gcp3_71", "build_gcp3_72", "build_gcp3_73", "build_gcp3_74", "build_gcp3_75", "build_gcp3_76", "build_gcp3_77", "build_gcp3_78", "build_gcp3_79", "build_gcp3_80", "build_gcp3_81", "build_gcp3_82", "build_gcp3_83", "build_gcp3_84", "build_gcp3_85", "build_gcp3_86", "build_gcp3_87", "build_gcp3_88", "build_gcp3_89", "build_gcp3_90", "build_gcp3_91", "build_gcp3_92", "build_gcp3_93", "build_gcp3_94", "build_gcp3_95", "build_gcp3_96", "build_gcp3_97", "build_gcp3_98", "build_gcp3_99", "build_gcp3_100".

SIL, the core of the CI system



Why explorative

Background

Foufas asked senior calibration engineer:

JF: -what are the biggest problems with the air charge control system?

ANSWER: -Oscillations of the actuators during normal quite steady state conditions...

45360 km driven 9 days and 6 hours of continuous driving all in **5 days and 8 hours** of simulation time

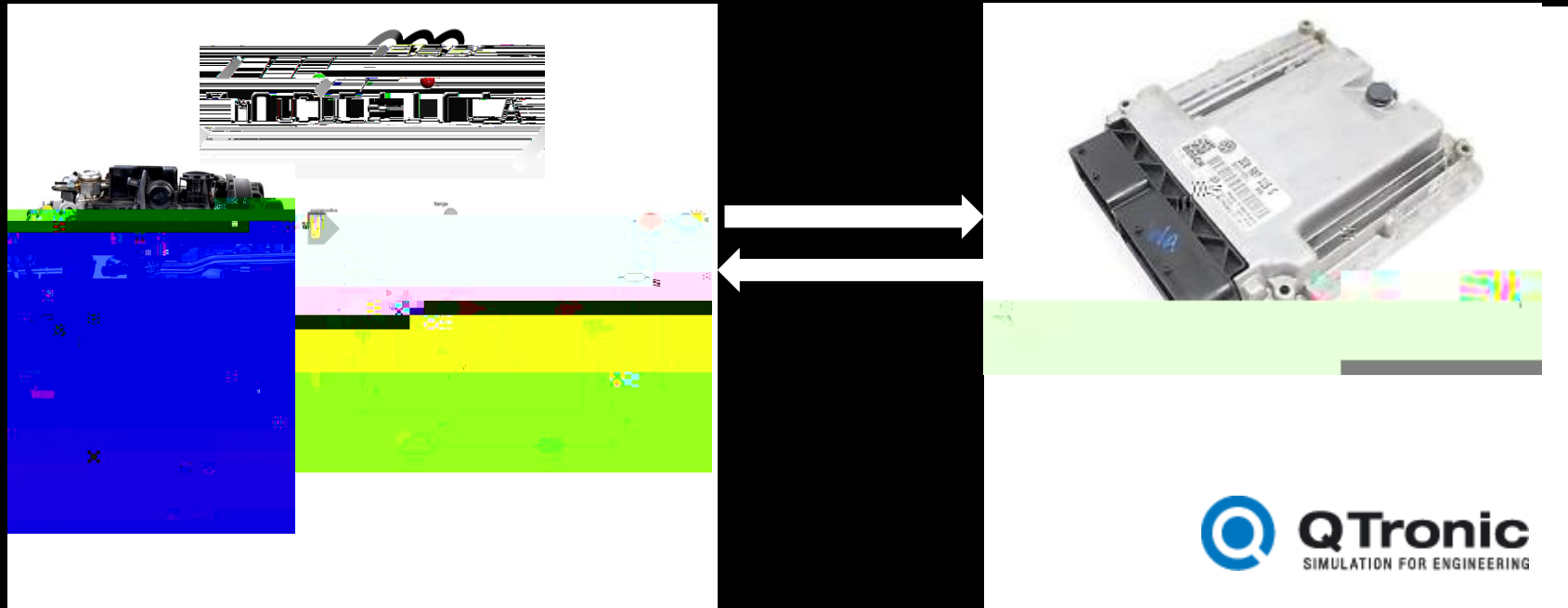
Current max is 30000kh each 24h

Maximize state coverage of Engine speed, Engine torque, Car speed, code coverage and choosen problem areas

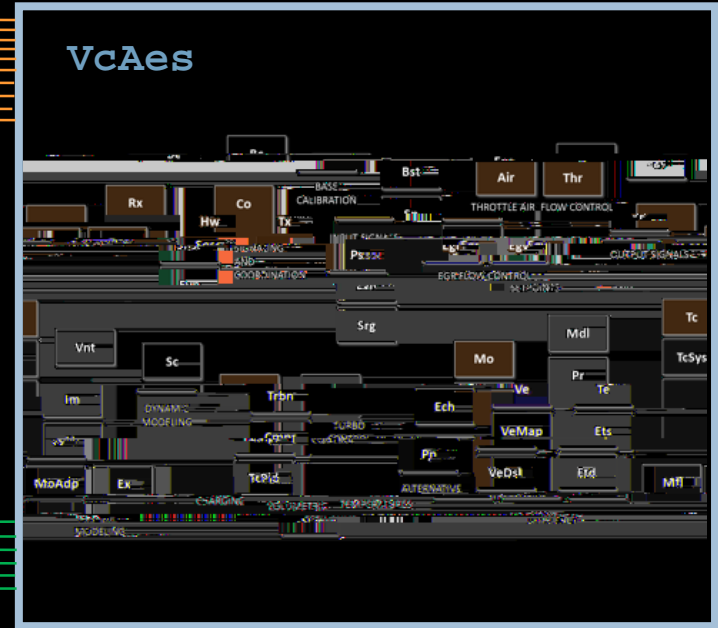
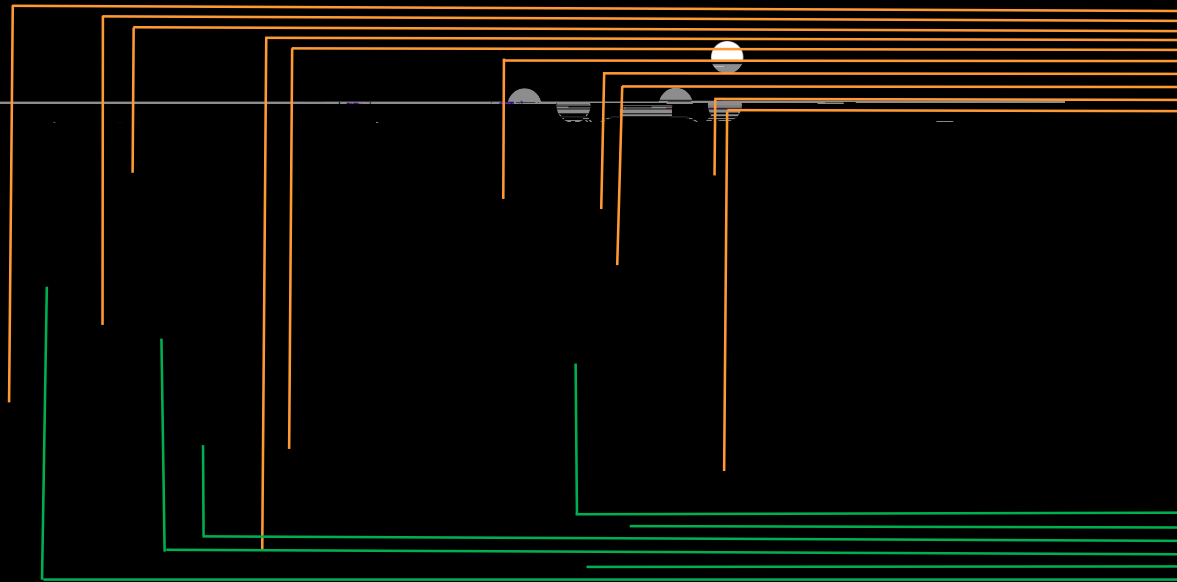
Active intelligent search for system flaws and errors, ie breach of requirements. There will be more nodes in these problematic

Explorative tests

Test setup

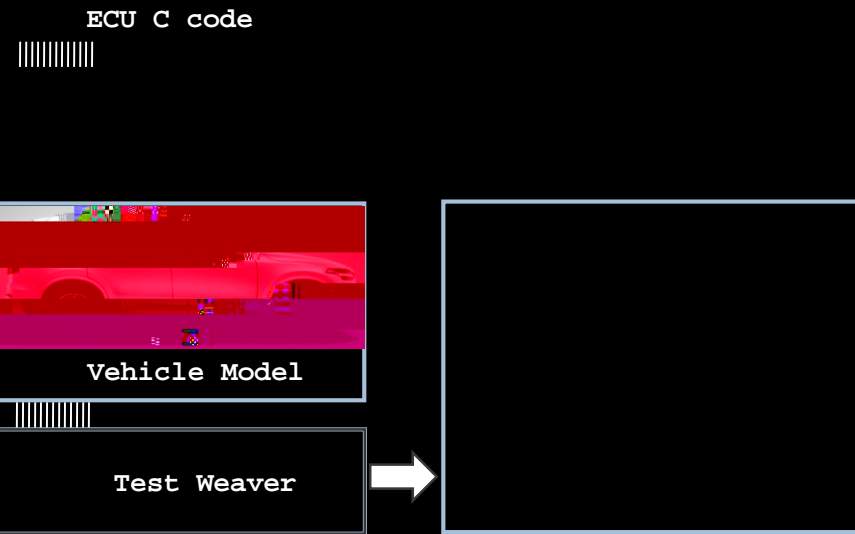


Explorative tests



Explorative tests

Test setup



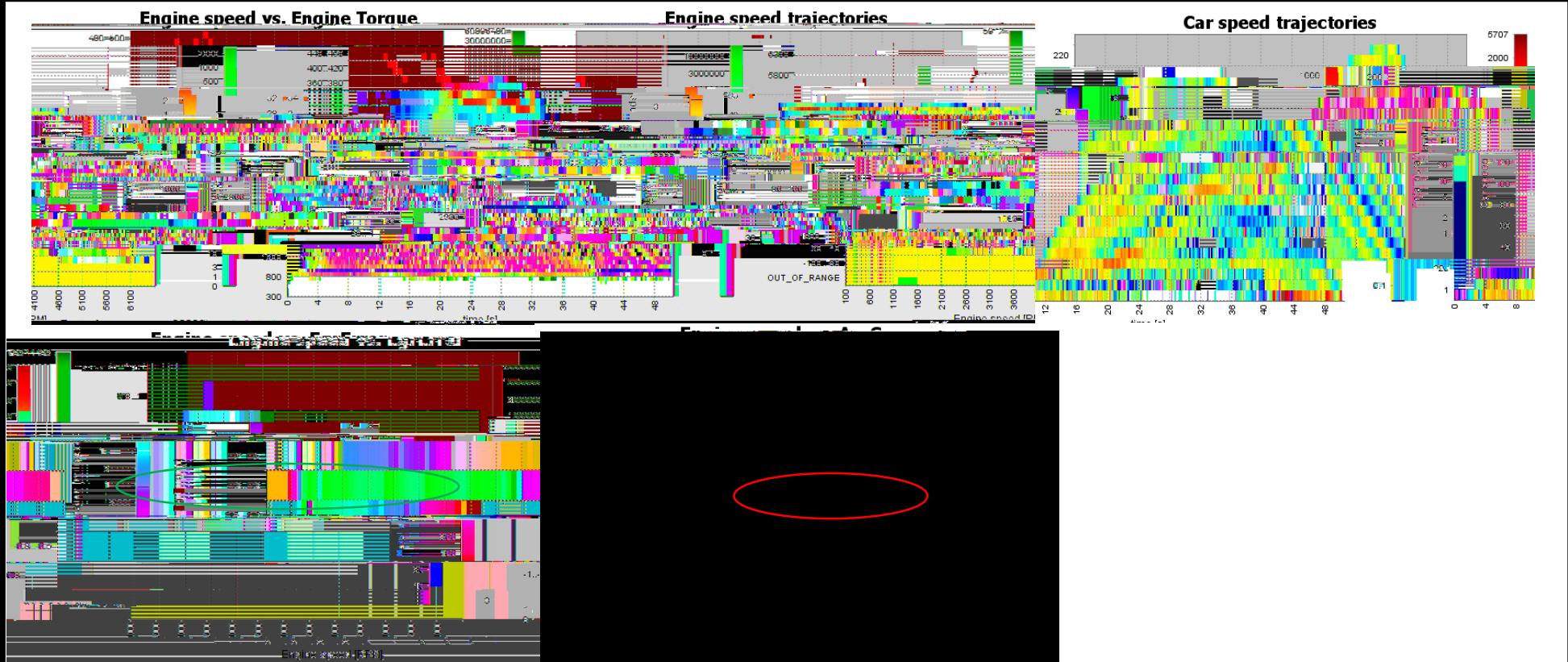
Test configuration

Oscillations are detected with a state of the art ECM algorithm

1 minute cycles, focusing on Engine Speed, Torque exploration

and Oscillations of the Intake Air Mass
gl G[A)9(i)9(r)]TJETQxQEMC /Span <MCID 24/Lang (svSE)>27n8/Lang

Explorative tests



Explorative tests

First try gave oscillating air mass in 20 cases

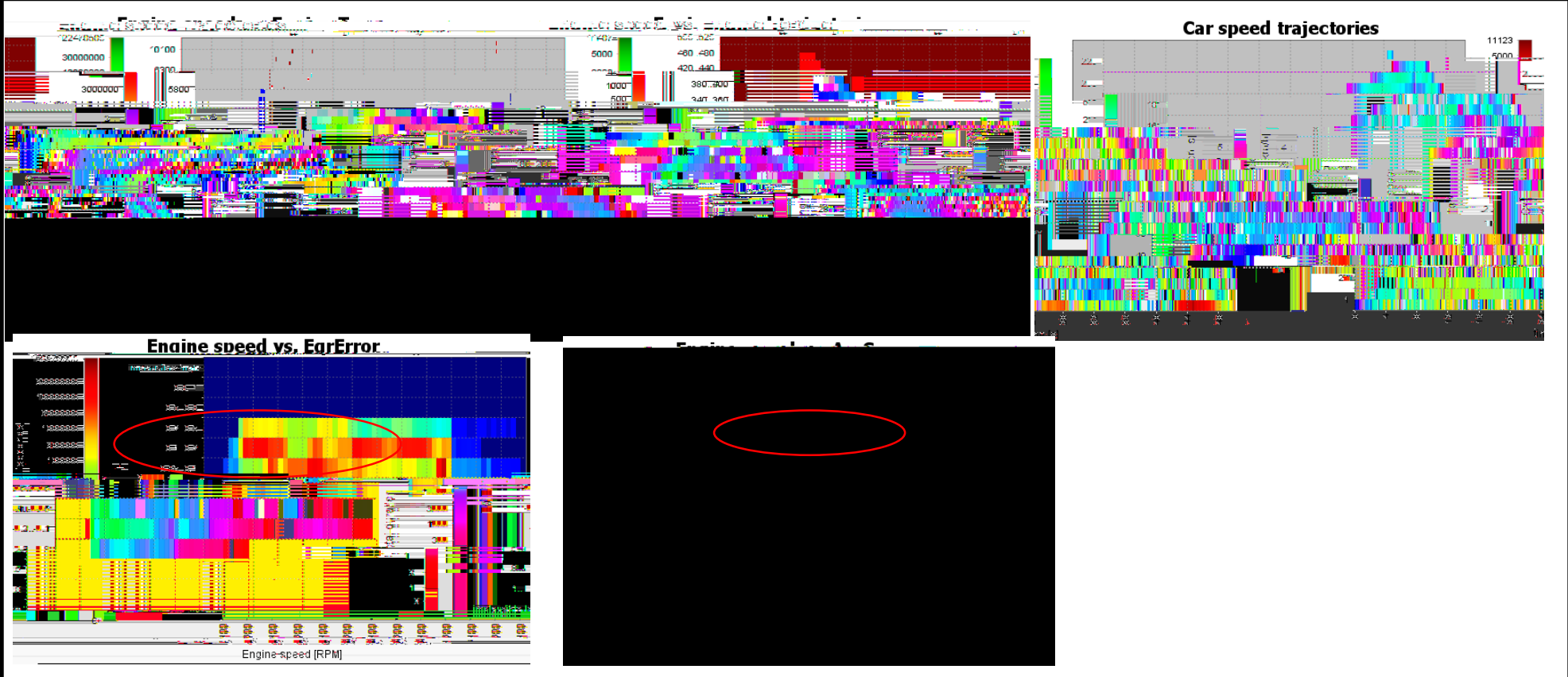
First case identified after 8 minutes

Alarm states



surge			
AgeSec	Mass	Temp	Pressure
2s	0.1..0.2	-60..-40	\$190..6
8s		-40..-20	\$9..20..6
4s		-20..-1	\$9..20..6

Explorative tests



Explorative tests

Third test

Lifting the Software from release 40 to release 55

Fixing two SW buggs on the way...

New temperature model VcTeExh

Update plant models

23h simulation time

New oscillation problems

Control instability

During Intake Air Throttle

Boost Control more stable

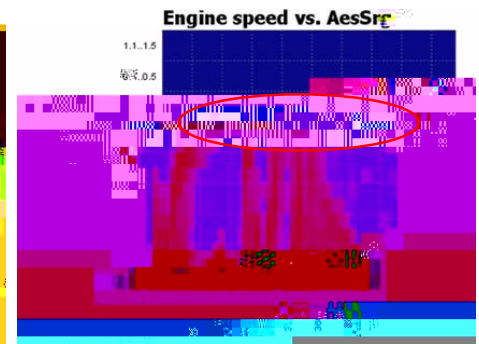
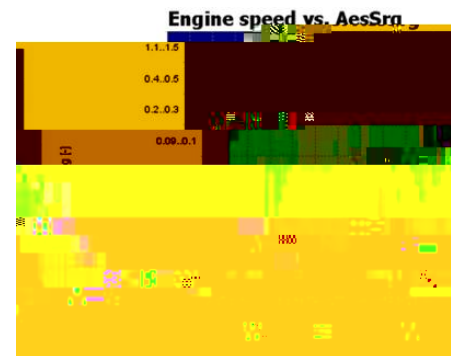
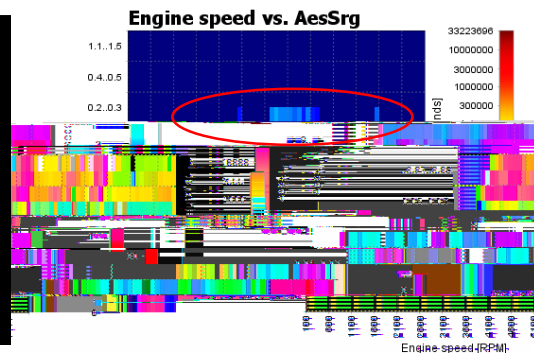
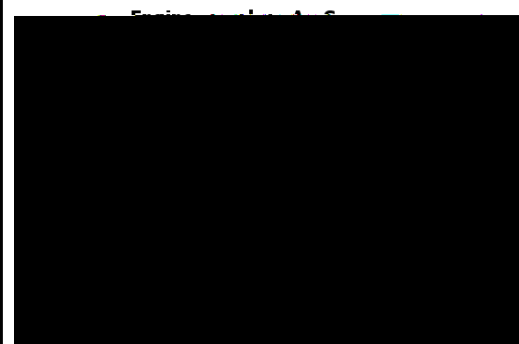
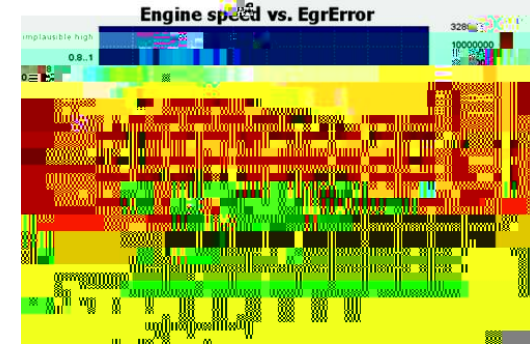
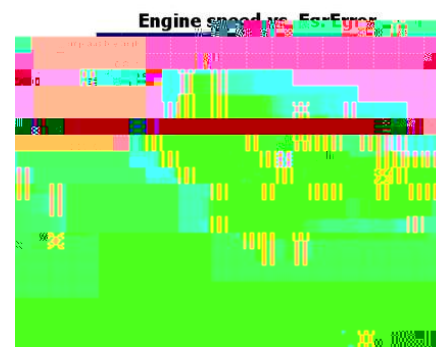
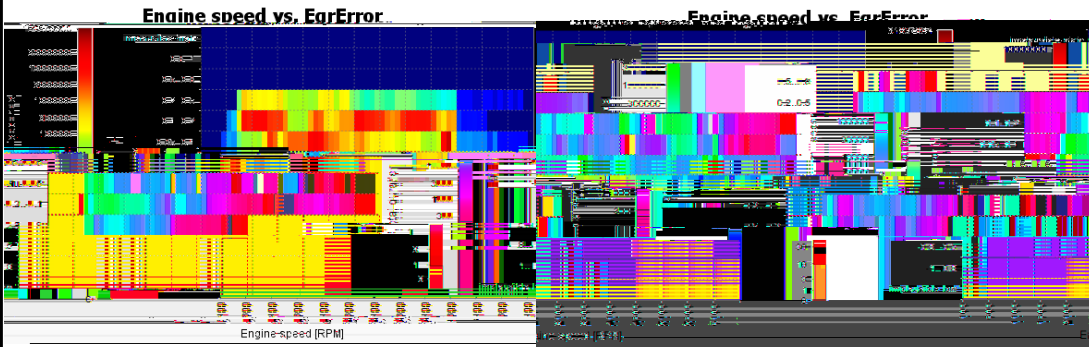
Explorative tests, timeline

Second test

Third test

Third test

Fifth test, New WCAC



Explorative tests, Conclusions