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

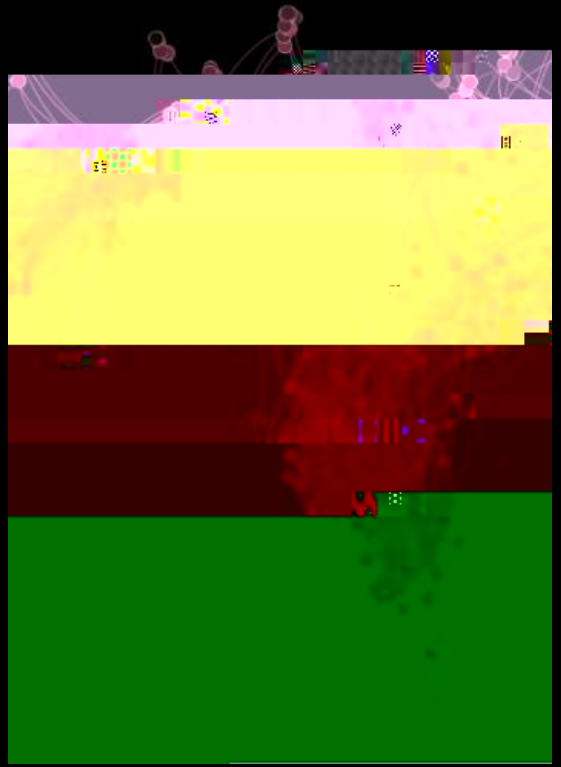
History

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

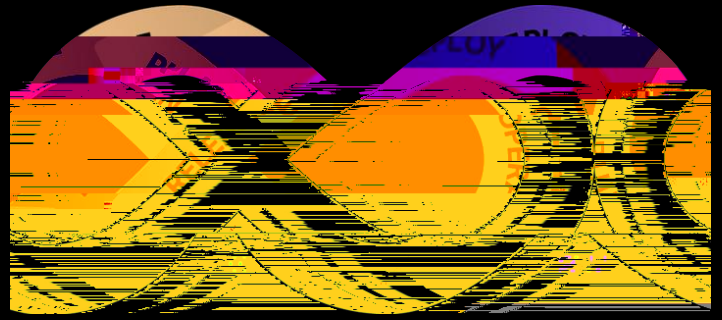


The Software in current generation ECMs is structured into around 400 modules

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

CI/CD System

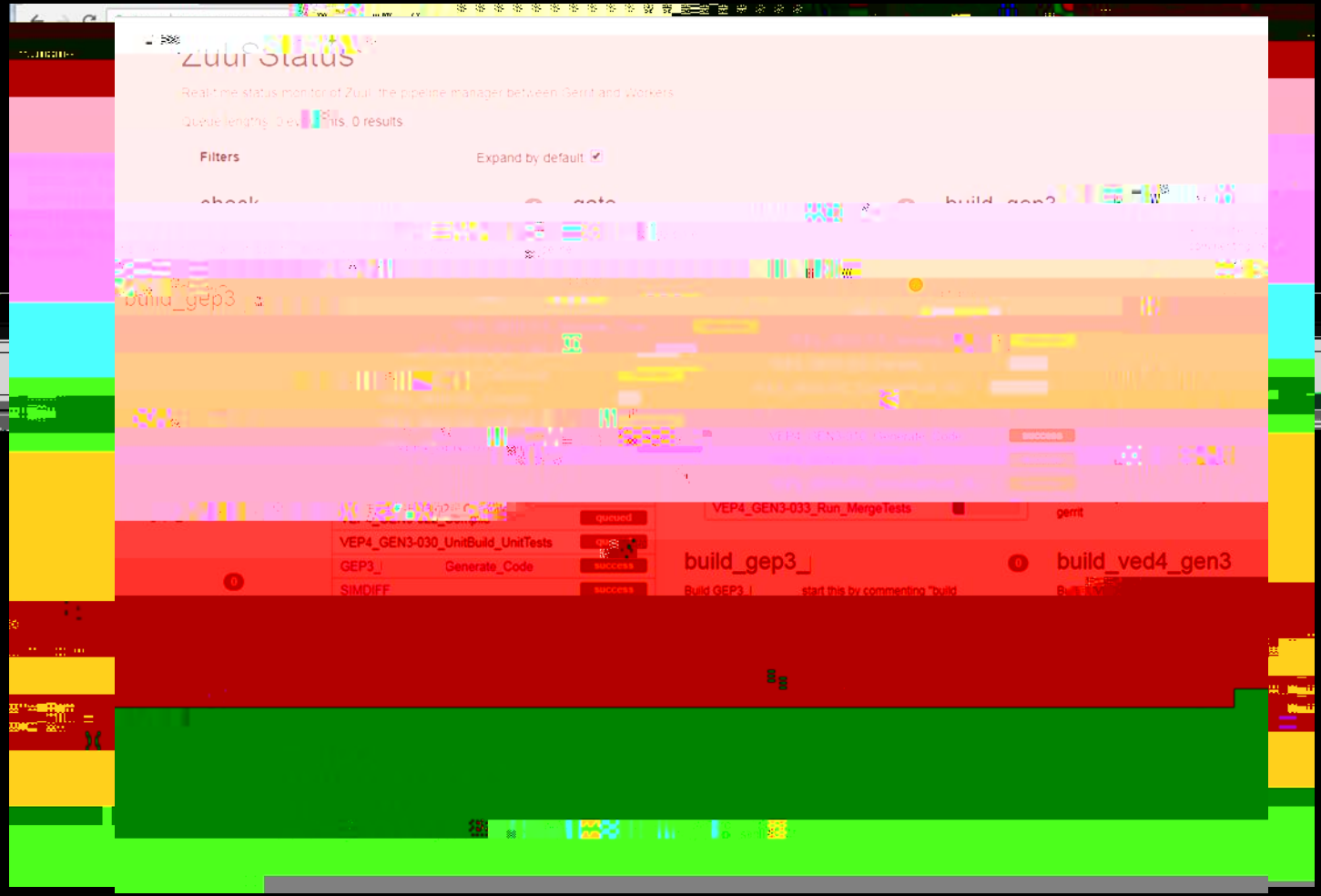
Ensuring the integrity is not dependent on a single individual making the right call. It is ensured by the system.
Fast Feedback, small changes often, automatic testing
Transparency, Follow your commit
CI/CD system as code, using Python plugin Jenkins job builder and YAML files as pipeline configuration



QTronic
SIMULATION FOR ENGINEERING

openstack.

CI/CD System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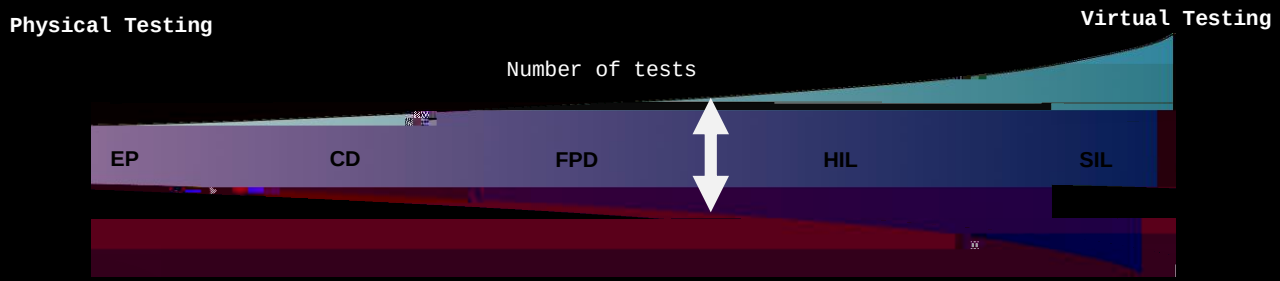
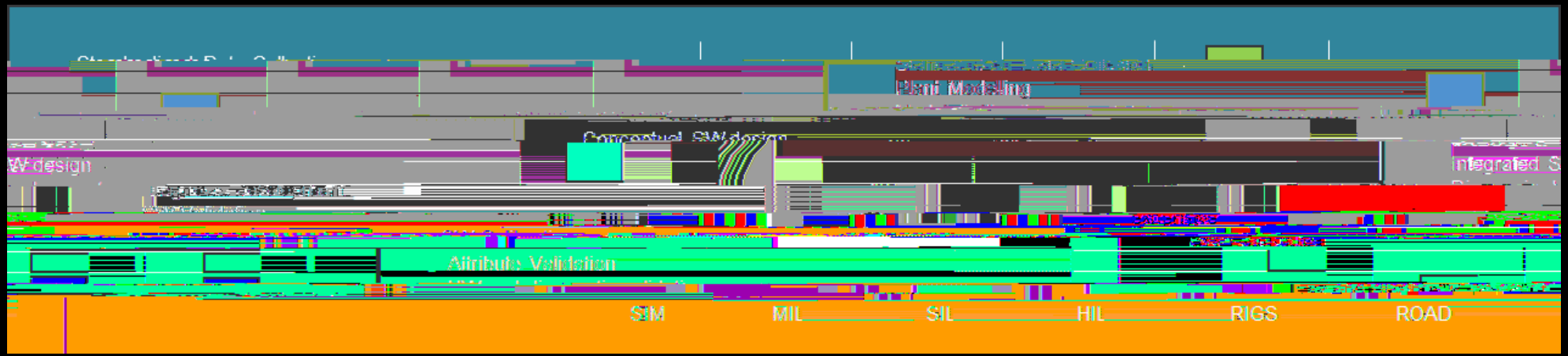
SIL, the core of the CI system





Why explorative

Background

Foufas asked seniour calibration engineer:

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

ANSWER: –Oscilations 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

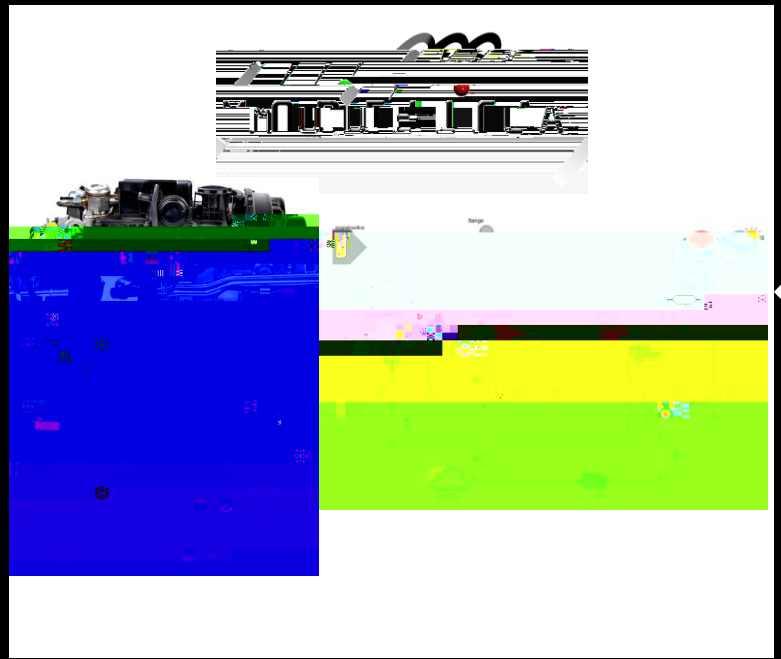
Current max is 30000kh each 24h

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



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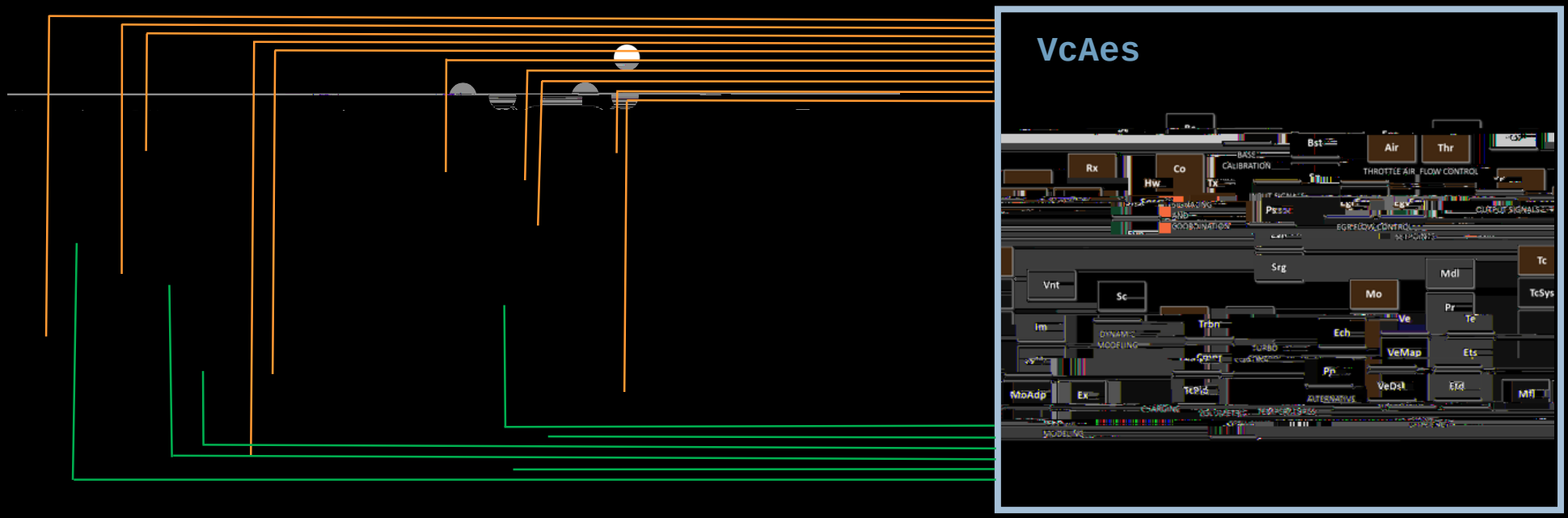
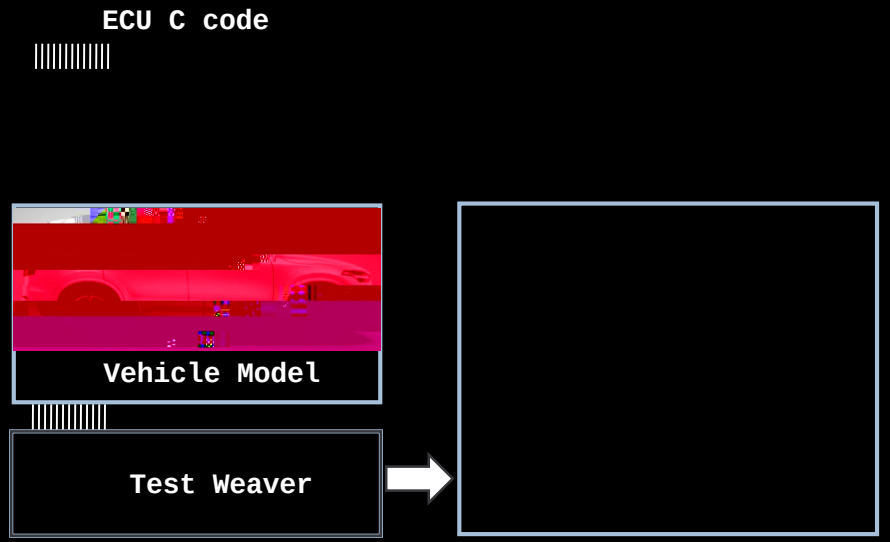
SIMULATION FOR ENGINEERING

Explorative tests



Explorative tests

Test setup

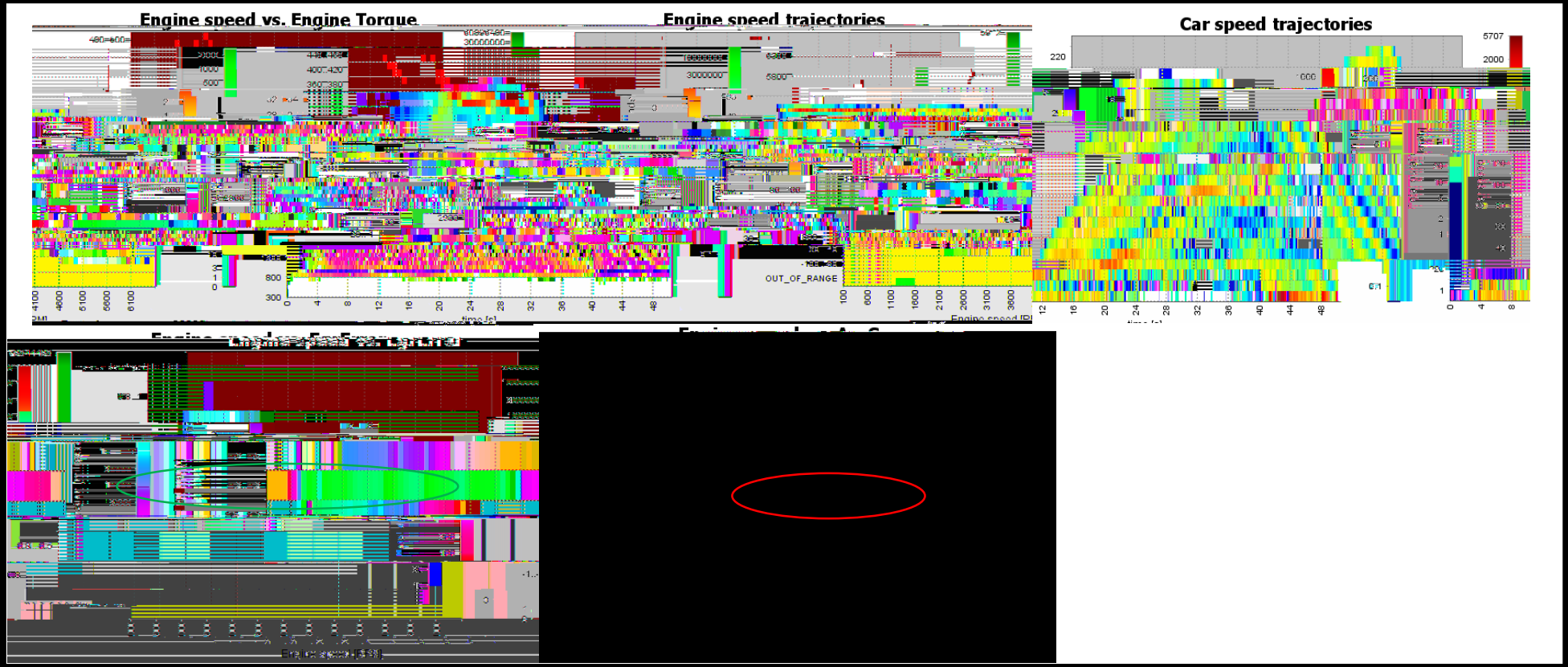


Test configuration

Oscilations are detected with a state of the art ECM algorithm

1 minute cycles, focusing on Engine Speed, Torque exploration
and Oscilations of the Intake Air Mas g1 G[A)9(i)9(r)]TJETQxQEMC /Span ≠MCID 24/Lang (svSE)>27n8/Lang

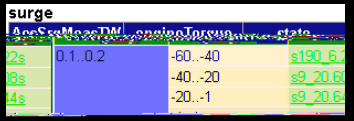
Explorative tests



Explorative tests

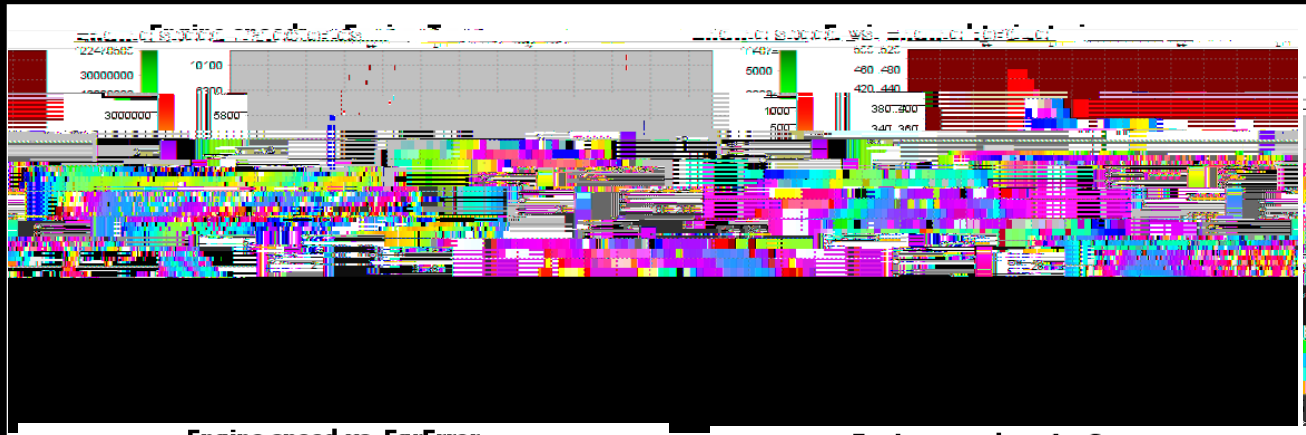
First try gave oscilating air mass in 20 cases

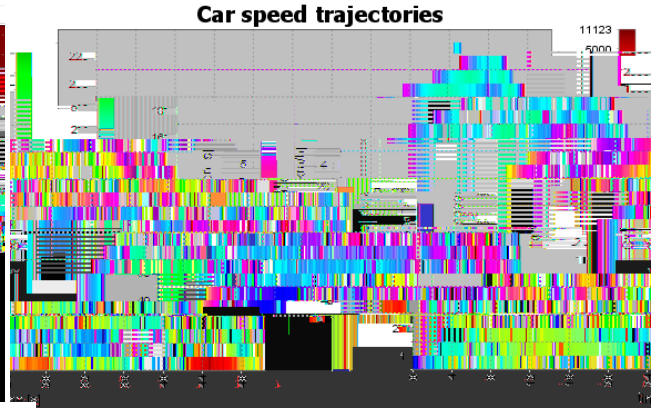
First case identified after 8 minutes

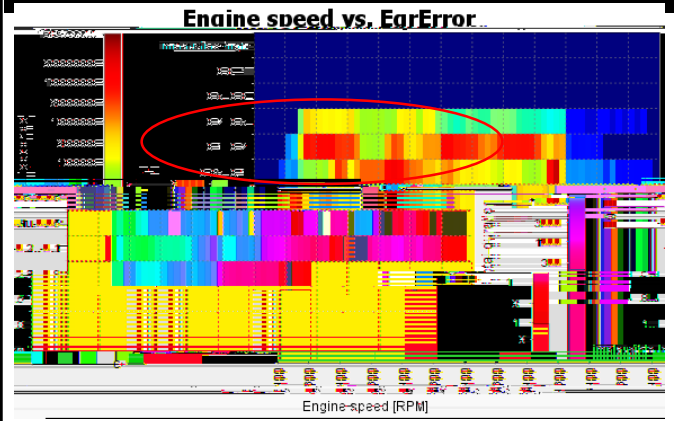


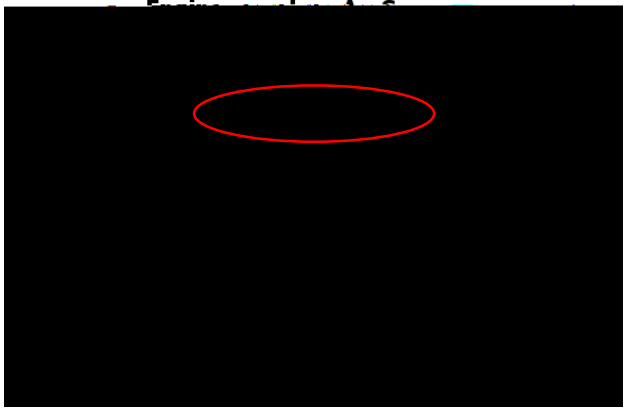
Alarm states

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

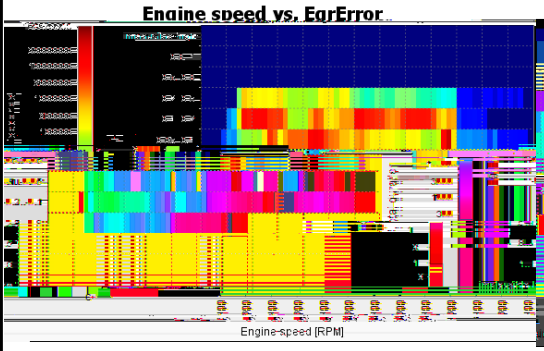
Explorative tests, timeline

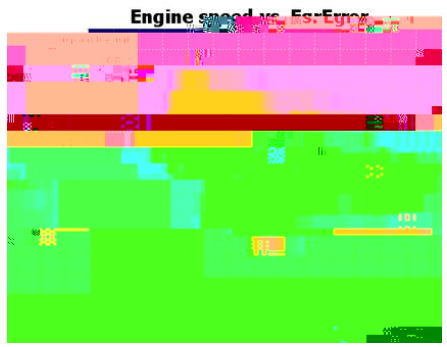
Second test

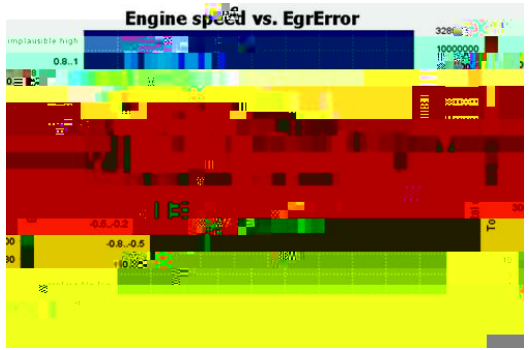
Third test

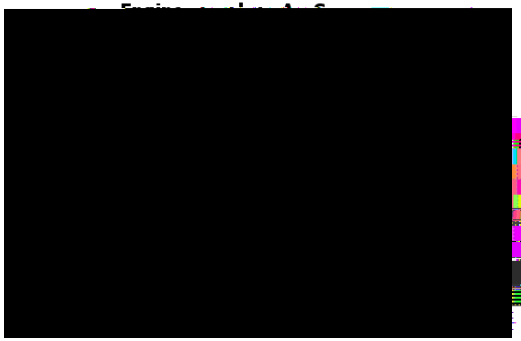
Third test

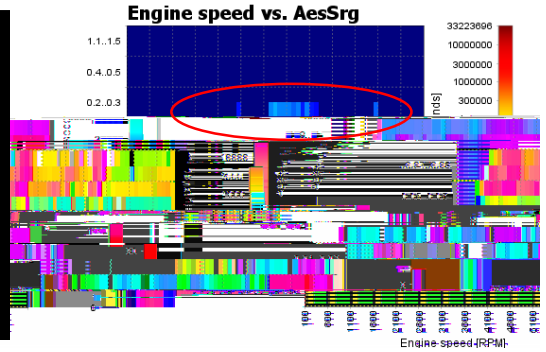
Fith test, New WCaC

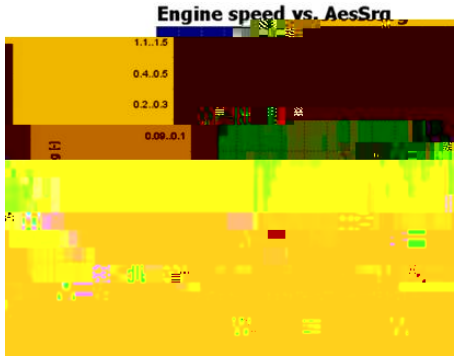


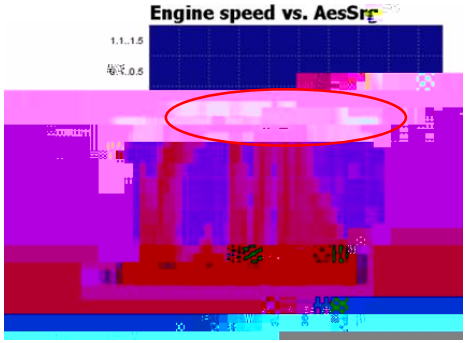












Explorative tests, Conclusions