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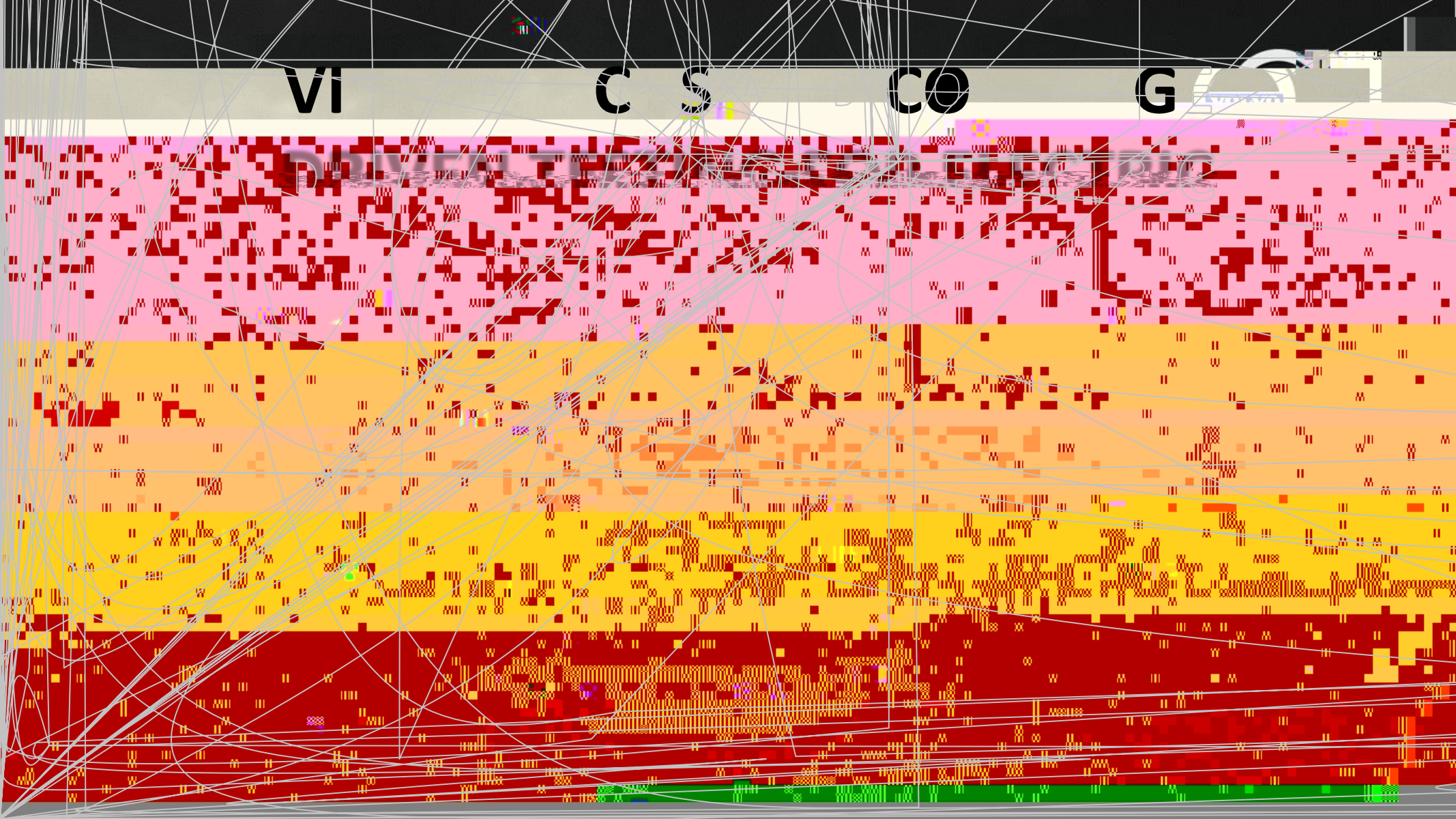
C

S

CO

G

POWER TRAIN SYSTEM





- Electrical Machines & Inverters (propulsion/regeneration)
- Battery
- On-board chargers

## **Inhouse SW Development & Testing**

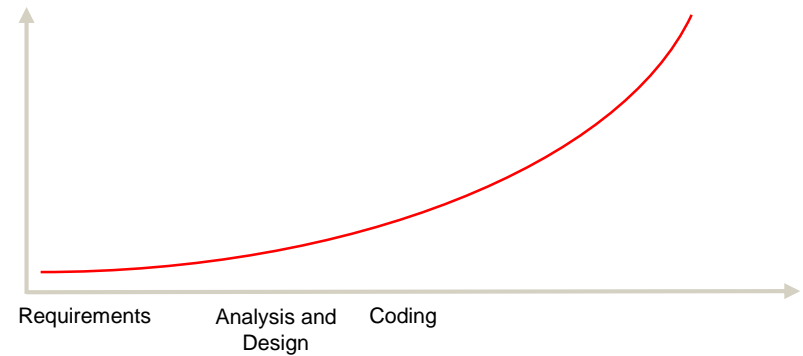
- Model-Based Design & Testing – MIL Simulink & SIL Silver vECUs
- Aim for Continuous Integration

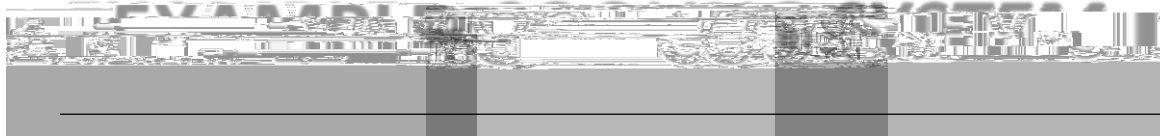


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- Functionalities for limiting Torque Request  
(temperature, current, power, speed ...)
  - Mode manager & Interface components (Standby, Torque/Speed Control ...)
  - Dynamics control (Anti-spin, Active Damping ...)
  - Integration & Complete SW
  - Diagnostics



- Verify integration of SWCs with Requirements-based verification
- Allows testing at early stages of the development cycle (coverage)
- Better use of Rigs/Cars (e.g. calibration, driveability)
  
- Cheaper/faster way to find bugs
- Reduce future quality issues
- ***Number of scenarios***  
***(complexity of the system)***
- ***Short-time events (~0.01-1ms)***





Fault injected in cooling system and applied maximum torque 1/F2 20.04







- Combination of *verified & activated* signals
- Automated for all projects
- All Requirement Models tested continuously





- Mode Status & Request
- Torque/Speed/Voltage Request
- Torque Allowed (propulsive and/or regenerative)
-

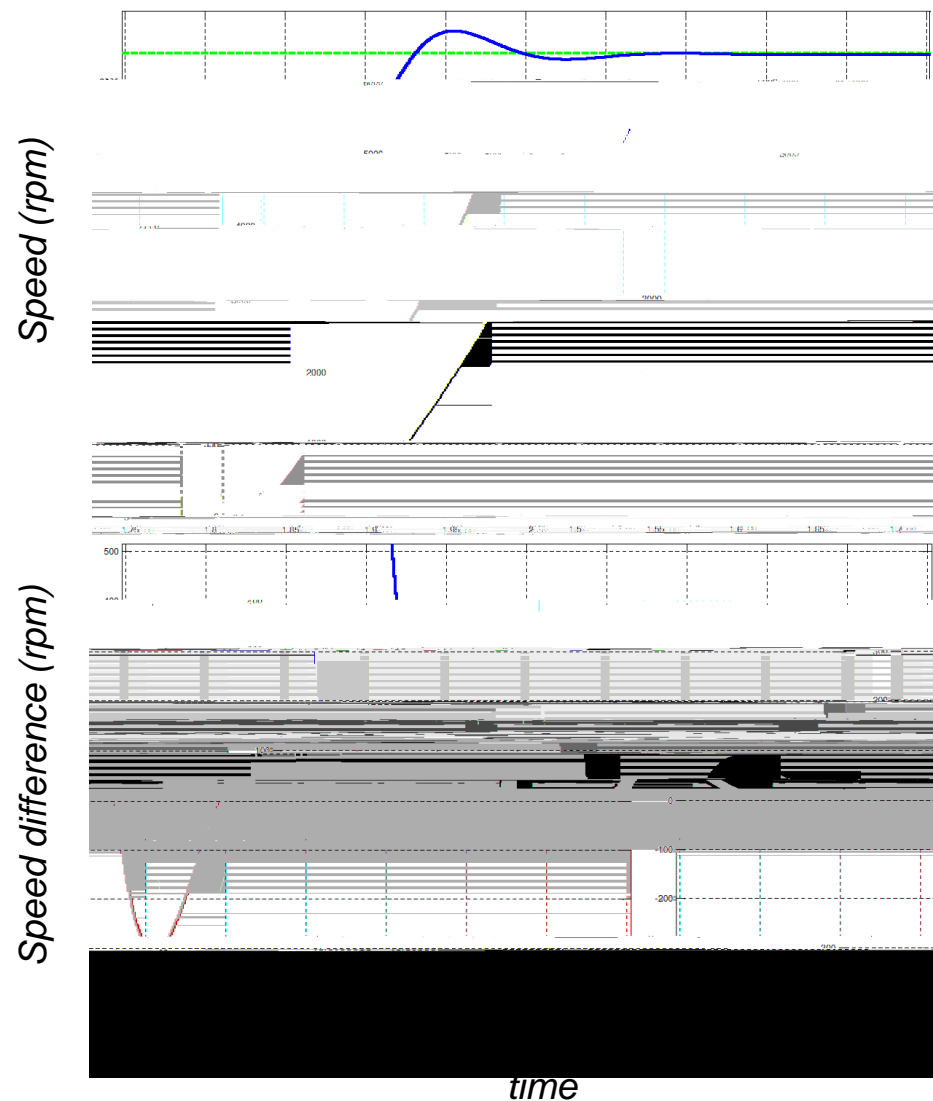


- Heat maps (e.g. Electric Machine Speed vs Power)





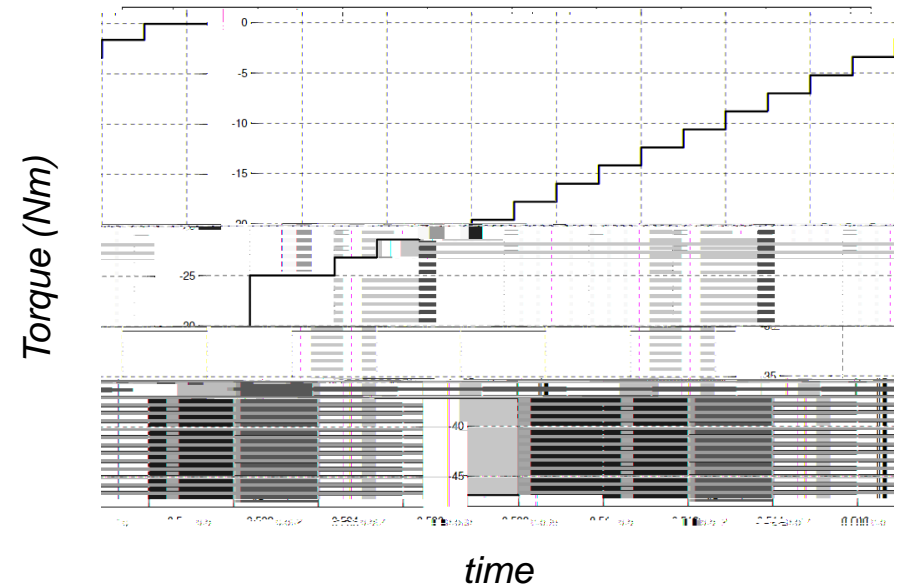
- Hybrids – gear change mode
- Margin as a Requirement
- Issue: over time tolerance
- ***Improvement of regulator***





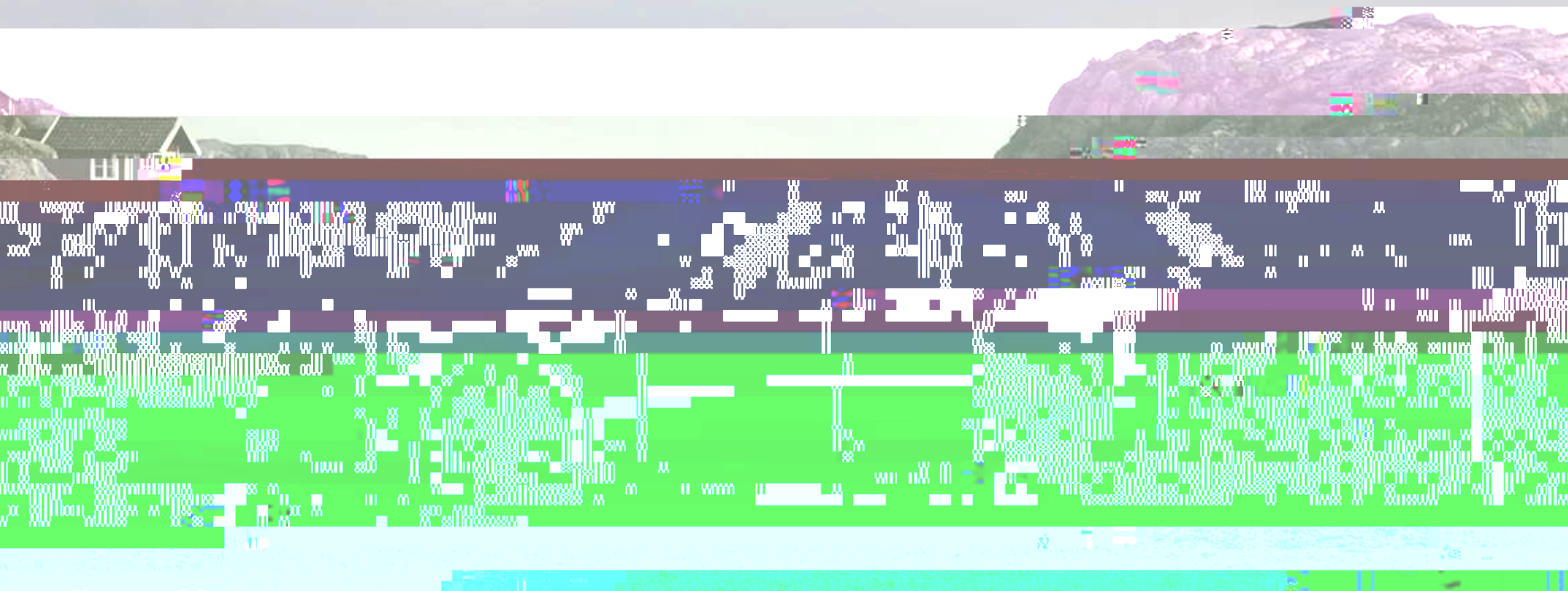
- Torque ramping rate as Requirement
- Ramping down tolerance included
- Update on Requirement & SW

(\*Agile way of working)









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