VEHICLE: VIRTUAL HYBRID COOLING

PER JACOBSSON, VOLVO CAR CORPORATION
PROJECT INFORMATION

Name: VeHICLe: Virtual Hybrid Cooling
Time period: 2016-02-10 to 2018-12-31
Project lead: Volvo Car Corporation
Project partner: Chalmers
Program: FFI energi & miljö
Financial support: 2.5 MSEK
PROJECT OBJECTIVES

- Improve energy efficiency
- Be prepared for future legislation
- Determine complete energy consumption in an electrified vehicle
- Reduce loss in an electric powertrain in colder climate
- Reduce number of test series.

- Improved thermal models of the electric powertrain
- Virtual product development
ELECTRIC DRIVE COOLING CIRCUIT

Work package 1
- System modelling
- System validation
- Lead: Volvo Cars

Work package 2
- Component modelling
- Component validation
- Lead: Chalmers

Work package 3
- Heat pick-up
- Measurements
- Lead: Volvo Cars

CIDD: Combined Inverter DC/DC
OBC: On-Board Charger
ERAD: Electric Rear Axle Drive
IEM: Inverter ERAD Module

Modelica
GT Suite
Matlab/Simulink

Heat pick-up
WP 2: COMPONENT MODELS

Model components at different fidelity levels: 3D, reduced-order model, lumped-parameter model

Example
• Reference interior permanent magnet (IPM) electric machine
• Coupled electromagnetic and thermal 3D model
• Ansys Maxwell + Ansys Fluent
• Iterative solution process until steady state

Coupled 3-D thermal and electromagnetic modelling of a liquid-cooled IPM traction motor
Sonja Lundmark et al.
Vehicle Power and Propulsion Conference (VPPC) 2017
WP 3: MEASUREMENTS

Wind-tunnel measurements

- Steady-state operating points (vehicle speed and ambient temperature)
- Surface temperature probes on components
- Flow temperature probes at inlet and outlet of cooling flow at components
- Comparison with CFD simulations

Measurements and CFD modelling of temperatures in the engine compartment of a hybrid electrical vehicle
Randi Franzke et al.
Vehicle Power and Propulsion Conference (VPPC) 2017
WP 3: MEASUREMENTS

XC90 T8
- Continuous measurements
- Real-world driving
- Varying environment

Rig at Chalmers
- Controlled sensor placement
- Controlled environment
- Controlled operation
WP 1: SYSTEM MODEL

System model
• Combine component models
• System-level validation
• Flexibility with respect to fidelity
• Parameter studies/optimization

Interfaces
• Internal: component parameters, fidelity variants
• External: existing and future modelling at VCC, supplier models, ...

Simulation software
• GT Suite
• Matlab/Simulink
• Dymola/Modelica
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2016 2017 2018
THANK YOU!

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