

WHY WE BUILD VEHICLE THERMAL MANAGEMENT MODELS

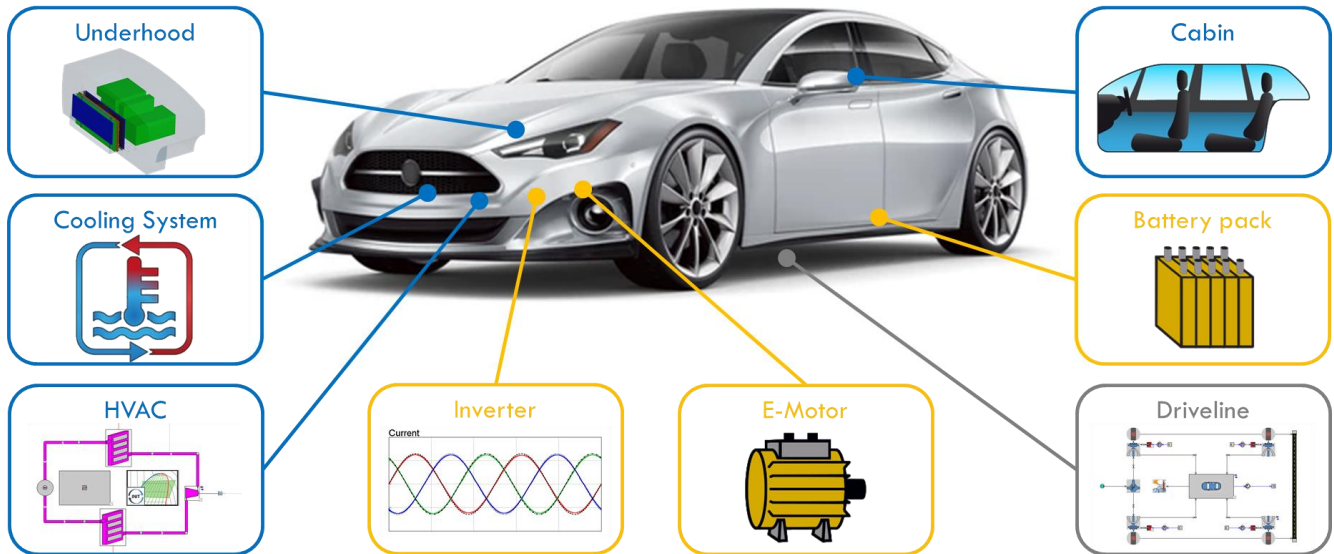
GT-SUITE system-level Vehicle Thermal Management (VTM) models are

- the **industry-standard** for a wide range of CAE applications:
 - Component sizing, selection and optimization; control development and testing; ...
- an effective **Virtual Test Rig** for OEMs and Tier1 supplier
- RT capable for **Validation & Verification** and **XiL** applications

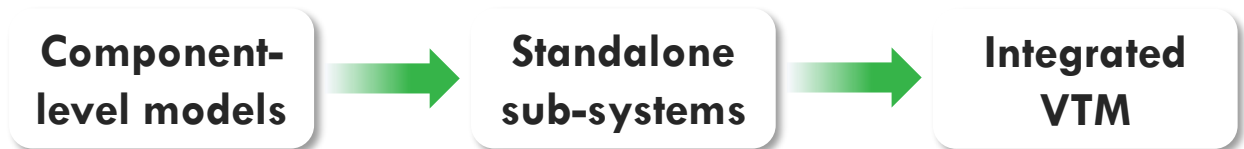
SWIPE!



Vehicle Thermal Management (VTM) models are system-level, integrated platform models encompassing different sub-domains

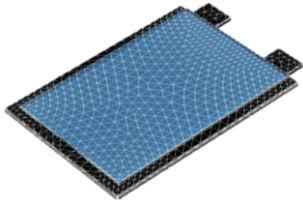


Building process

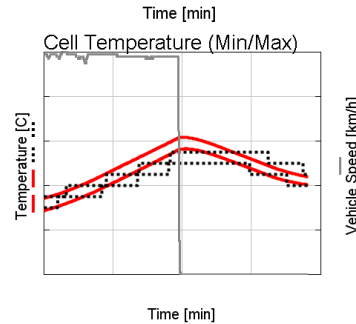
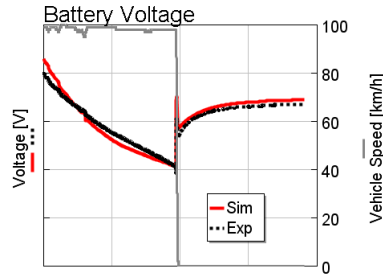


- Different levels of complexity/fidelity are possible for each sub-domain, suiting different use-cases and CAE requirements

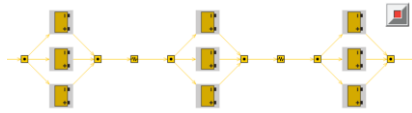
Battery Modelling (cell-to-cell)



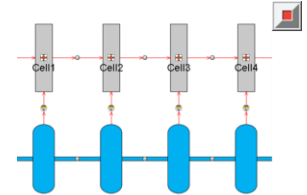
Starting Point: CAD, Cell Characteristics, Pack & Module Specs



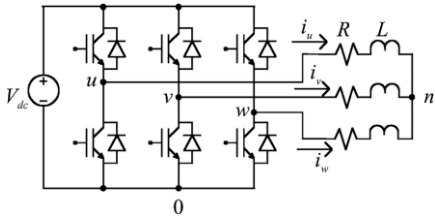
Electrical Model



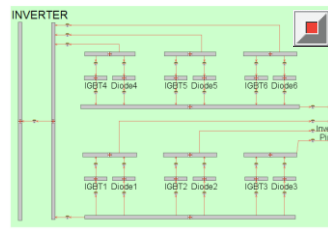
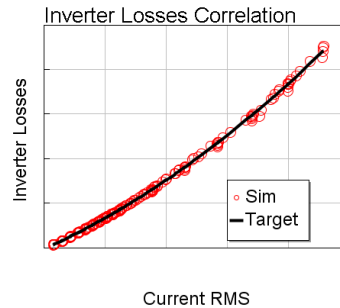
Thermal Model



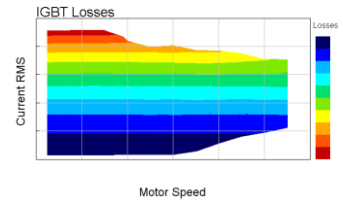
Inverter Modelling



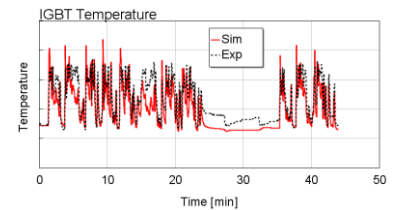
Starting Point: CAD, IGBT and Diode Losses or detailed electrical data



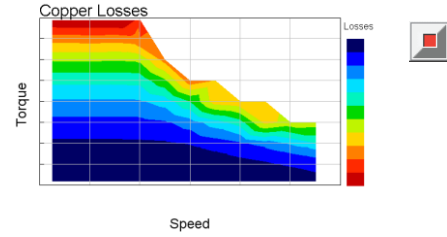
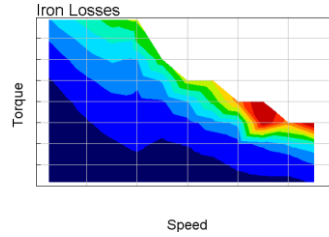
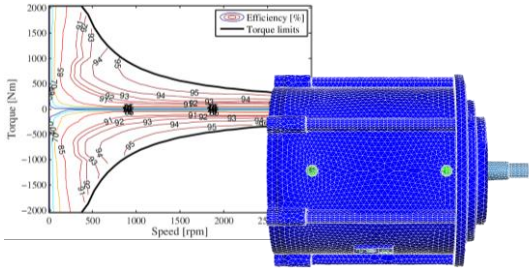
El. Losses Model



Thermal Model

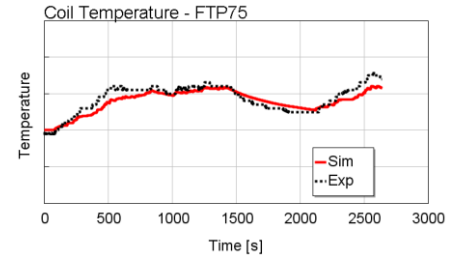
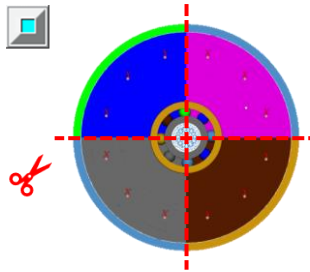


Electric Motor Modeling



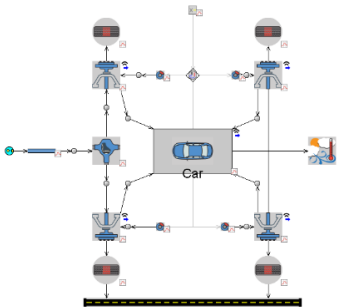
Electro-Mechanical Model

Starting Point: CAD, Efficiency Map, Datasheet (N° Poles, Freq. Flux etc.)

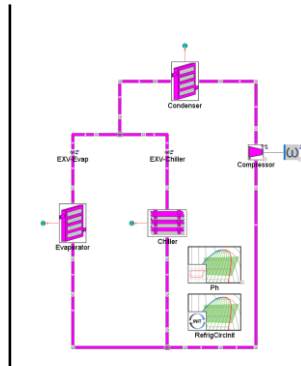


Thermal Model

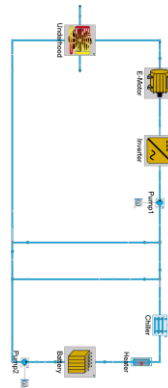
Vehicle & Cooling System Integration



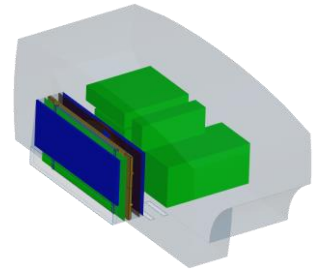
Vehicle & Driveline



HVAC & Cabin

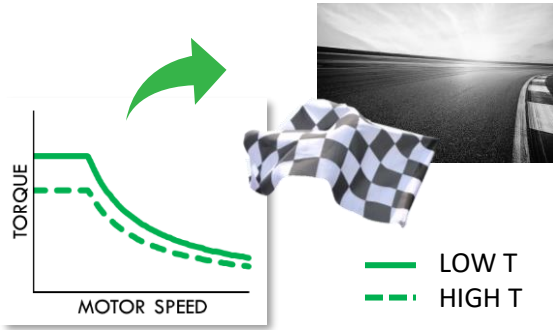


Coolant Circuit



Underhood

VTMs Ultimate Goals

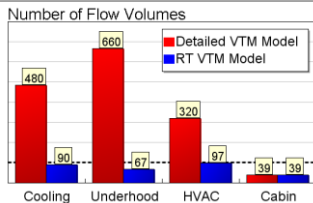
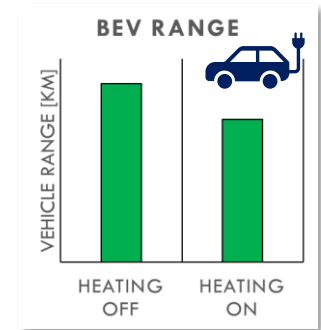
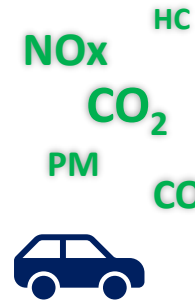


Vehicle Performance

- Powertrain Thermal State and Derating
- Lap-Time Assessment
- Vehicle Comfort: Cabin Heating

Energy Efficiency & Emissions

- Fuel Consumption and CO₂ Emissions
- Pollutant Emissions
- BEVs and PHEVs range prediction

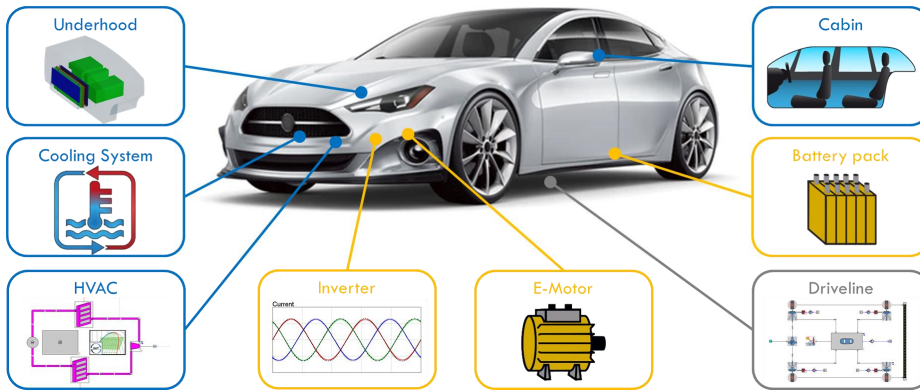


✓ Real-Time



Validation & Verification

- Deployment on Hardware-in-the-Loop
- Vehicle Control Unit (VCU) Development
- VCU Testing



PWT

**For more information
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