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Thermal Management Solutions to Optimize the Efficiency of Electric Bus Propulsion

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Objectives

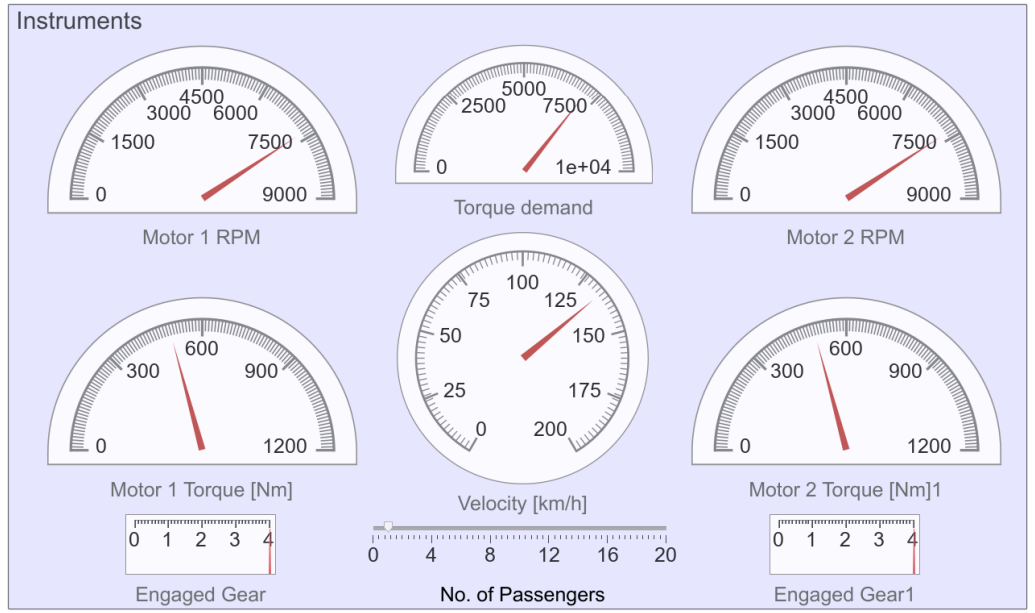
- **Introduction**
- **Simulation**
- **Twin-Drive model**
- **Thermal management**

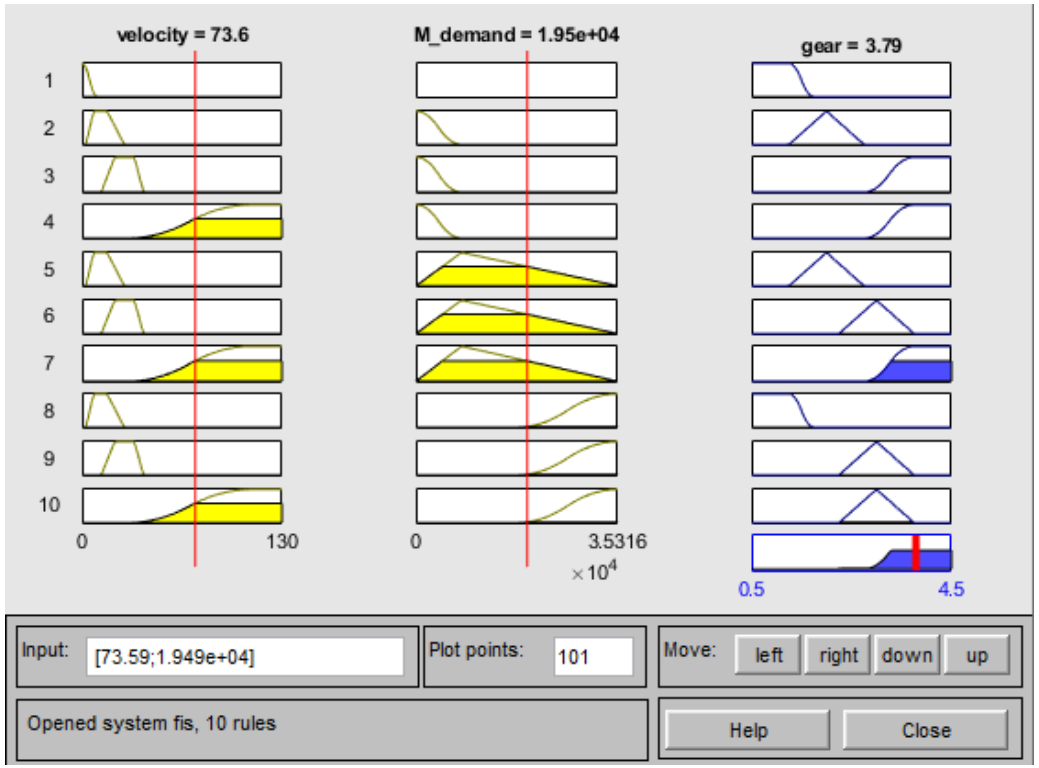
Introduction

- The main objective in our research project is to develop a thermal management system designed for twin-drives, utilizing the scientific results from previous years. The goal is to create a system that can efficiently harness the heat losses generated by the drive components.

Simulation

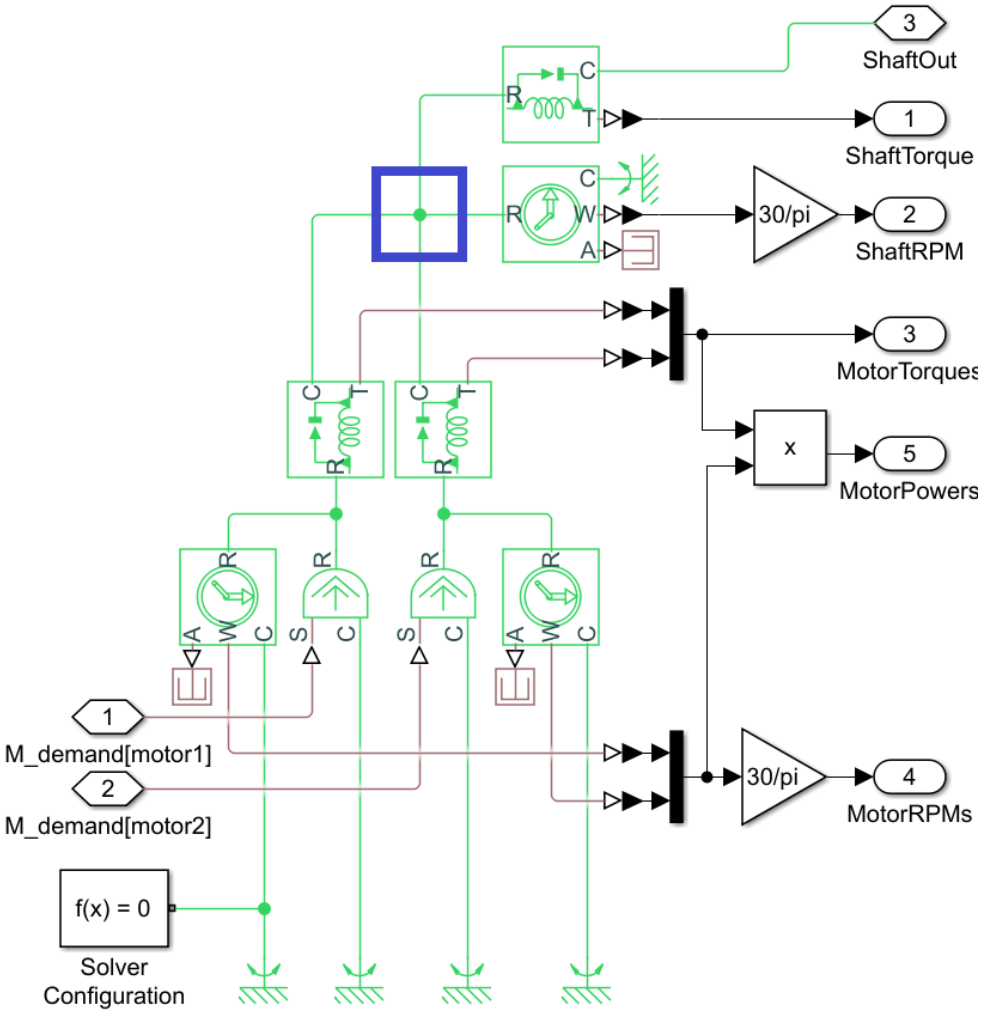
- MATLAB Simulink Environment
- Requirements:
  - Admission of Thermal Model
  - Simulation of Heat Generation
  - Heat Conduction and Dissipation
  - Overheating Protection
- Model Type: 1DOF
- Drive Type: EV
  - 2 Electric Motors
  - 2 AMT Gearboxes
  - Torque Summation
  - TCU: 2-variable FIS



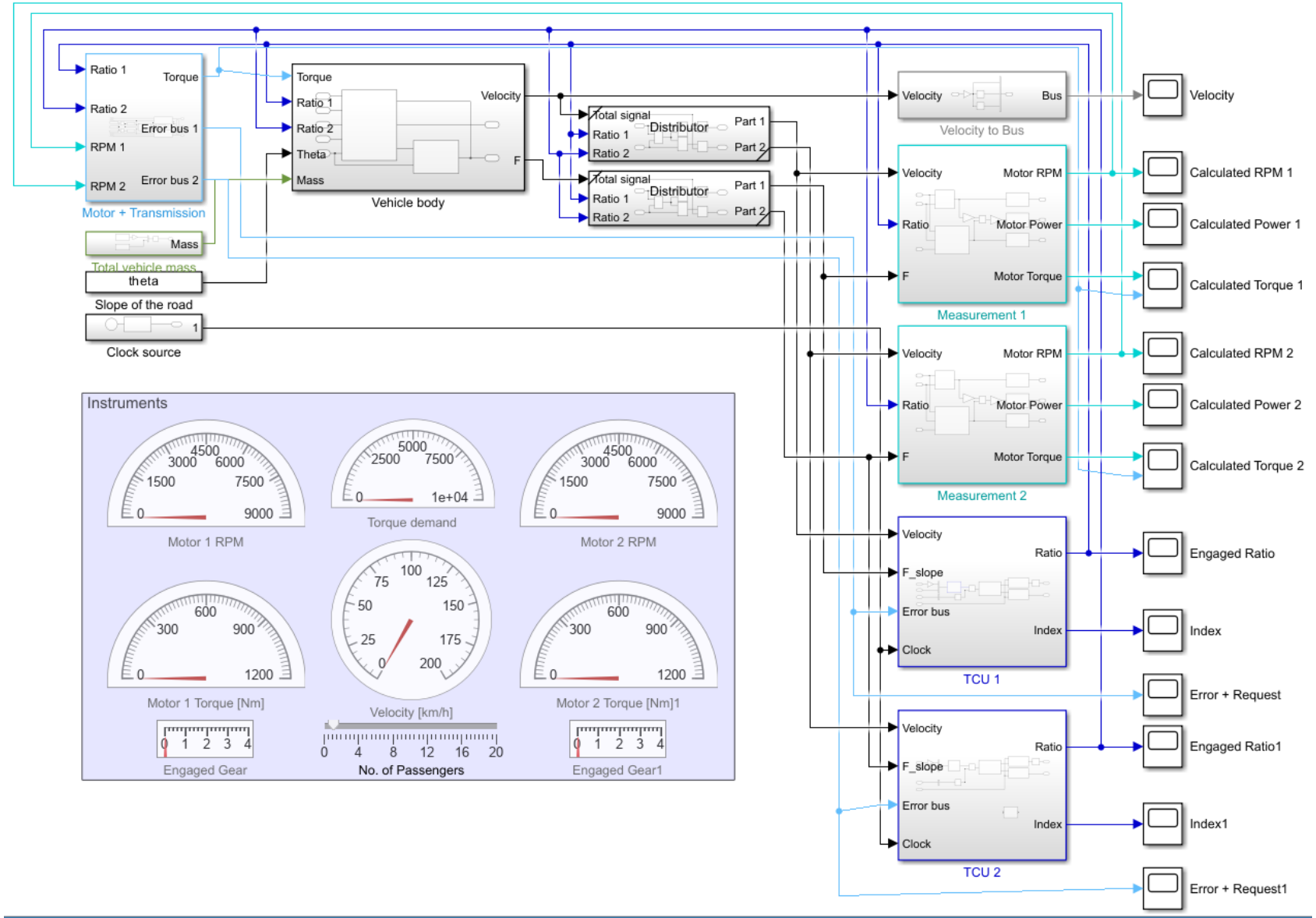


Twin-drive

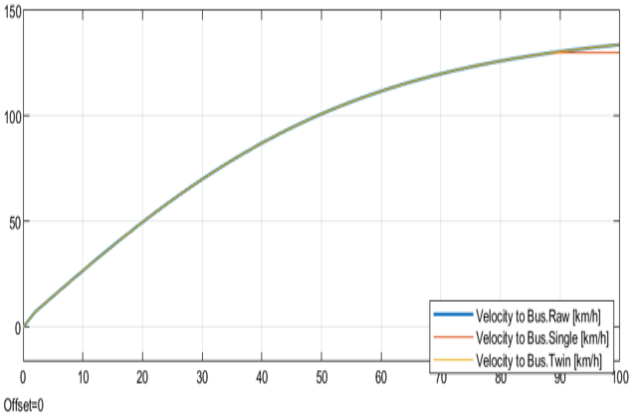
- Different RPM and different torque at the inputs of gearboxes
- Same RPM, but different torque at the outputs of gearboxes
- Torque summation
- The set of RPM, torque and ratio vectors are **linearly independent**, because none of them can be expressed as a linear combination of the other vectors!

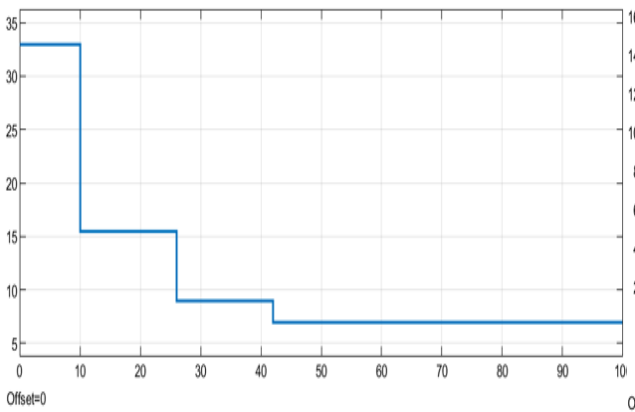


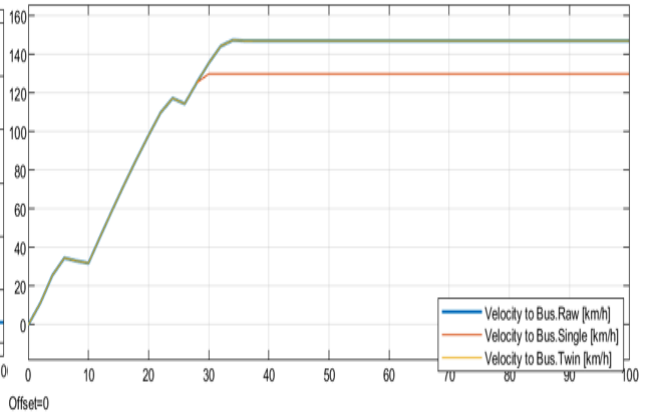
Twin-drive model

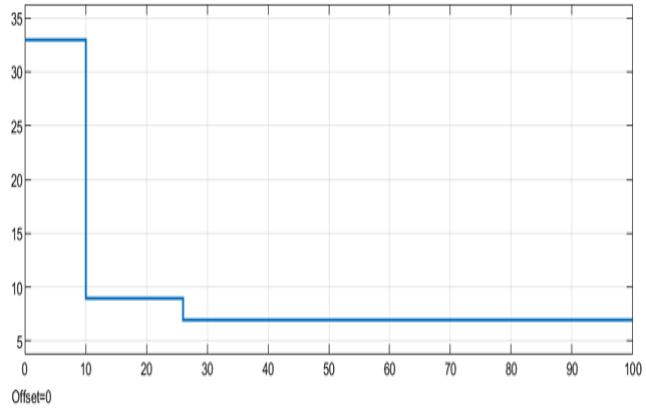


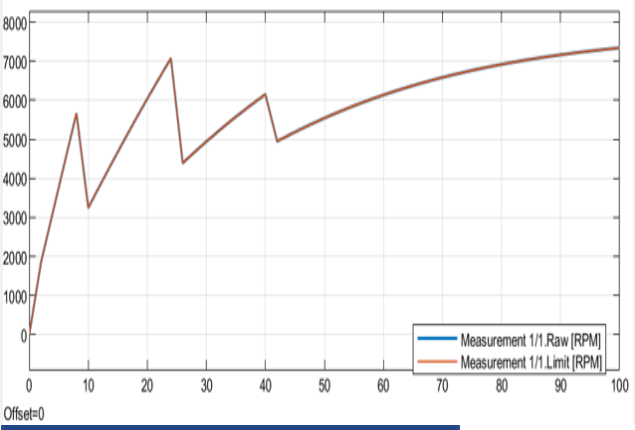
Torque Limitation for Thermal Runaway

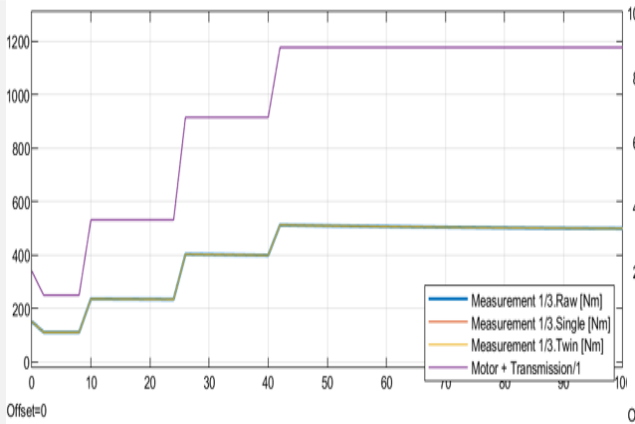


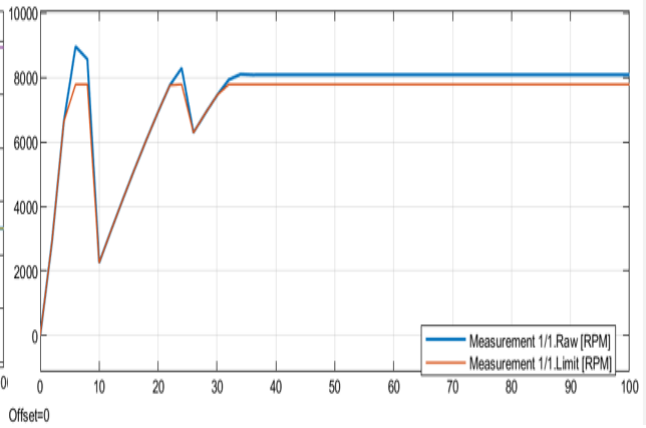


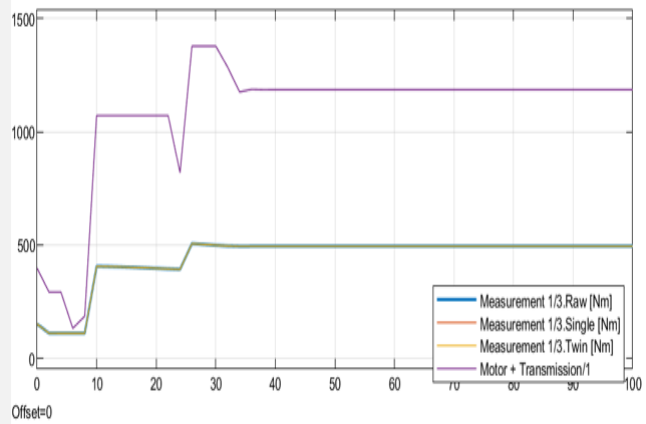






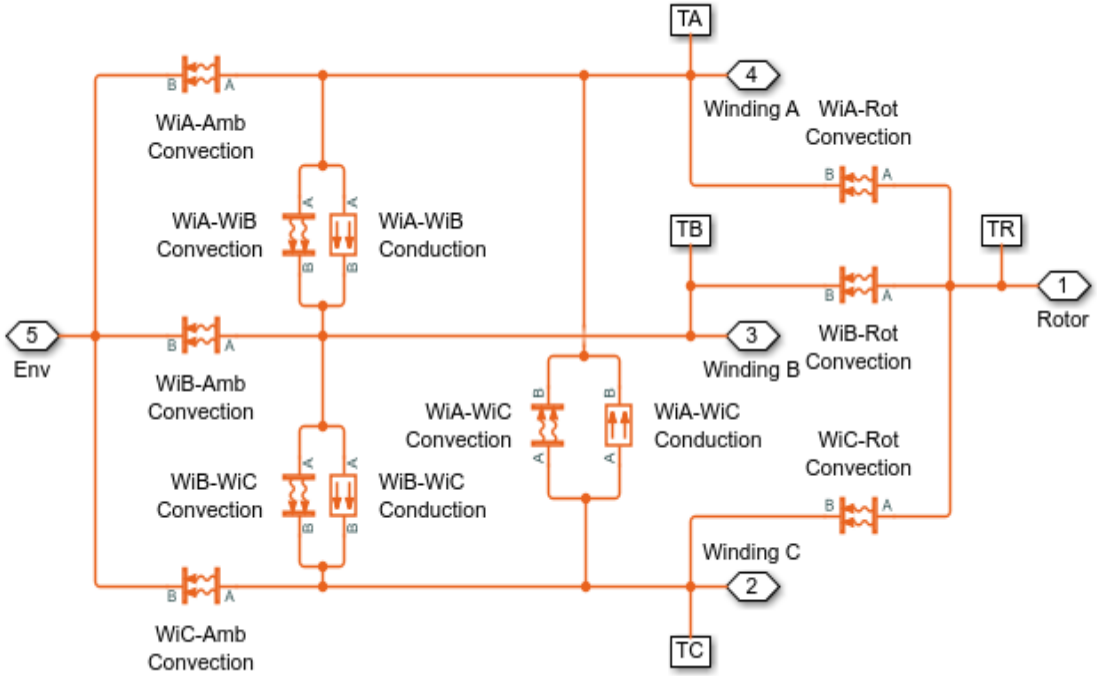






Thermal management

- Loss heat is generated on the motor, inverter, and battery.
- Utilization:
  - Cabin heating
  - Active heat exchange elements: Peltier-Seebeck elements or Heat Engines
  - Electrical energy recovery:
    - Interior lighting
    - Battery charging
- Targeted heat generation:
  - Warming up cold components
    - e.g., Battery, heat transfer fluid
  - External energy input:
    - Charging circuit
    - Heat exchanger



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Thank you for the kind attention!