Extending a Multicopter Analysis Tool using Modelica and FMI for Integrated eVTOL Aerodynamic and Electrical Drivetrain Design

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The Functional Mock-up Interface (FMI) standard for model-based systems engineering can be used to expand the capabilities of aerodynamic multicopter analysis tools to perform integrated design of electric vertical take-off and landing (eVTOL) systems. Well-defined multi-engineering models at various levels of modeling fidelity aids in the development of distributed electric propulsion systems and the understanding of its system behavior. Expanding domain specific tools to encompass all domains is difficult, so the FMI standard enables the interaction of models that do not exist in domain specific tools. The biggest benefit of this modeling approach is that it allows for collaboration between groups that have created domain specific tools that can be intergrated using the FMI standard. This fully integrates tools created for previous research and development, expanding and enriching simulation studies with relatively low effort.

The proposed eVTOL system was developed using Modelica and was exported to MATLAB/Simulink using model exchange to interact with a domain-specific tool specializing in calculating the aerodynamics of the aircraft. This configuration enables detailed simulation studies, allowing us to study the effects of various battery system architectures and drivetrain modeling fidelity on the handling quality of the aircraft.

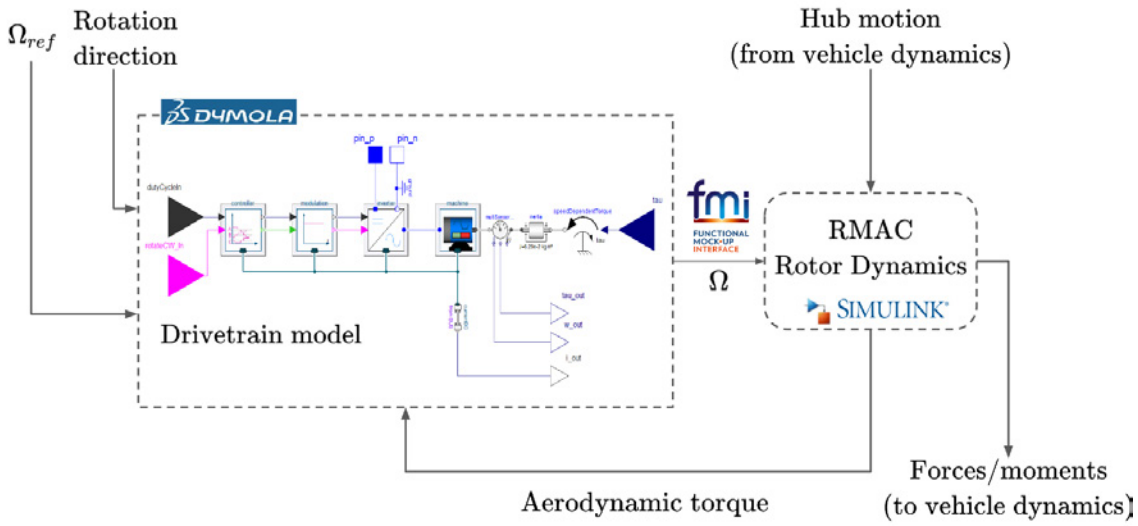

Figure 1. Coupling of drivetrain model in Dymola to RMAC rotor dynamic toolbox in Simulink via FMI.