Future Aircraft Energy Management Systems

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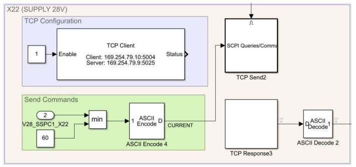
Introduction

The aircraft industry is moving towards More Electric Aircraft (MEA). Electrification is expected to help the industry reach objectives such as reduced aircraft weight, increased efficiency, lower maintenance and higher safety. Systems possible to electrify include the hydraulic systems which are used to power the actuators that manipulate the control surfaces of the aircraft. To control the increased electric power levels, an efficient and safe energy management system is necessary.

This project is part of a larger research project at Saab AB. Included in this project is a test rig called Iron Bird which is a research platform developed in collaboration between Saab AB and Linköping University. The purpose of the test rig is to evaluate future control systems, control strategies and energy management systems.



Client: 169.254.79.10:5004
Server: 169.254.79.9:5025

Hardware & Communication

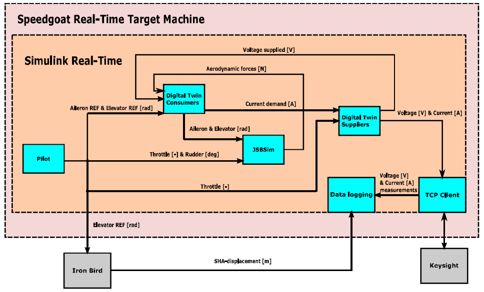
In the figure above, the Keysight which is used to simulate HIL is shown. The Keysight is used to emulate the generated power and consumption in the aircraft. The voltage level in power system is sent to the Keysight from Speedgoat via a TCP client in Simulink. The TCP block in Simulink that is required for Simulink to be able to send signals through Ethernet is also shown above.

Project Goals

- Develop a Digital Twin of the power generation system.
- Develop an effective and safe energy management system.
- Develop a hardware in the loop (HIL) simulation environment where different control strategies can be evaluated.
- Develop interfaces for communication and data logging.

System

The main part of the energy management system consists of the Vehicle Management System (VMS) and the Solid State Power Controllers (SSPC). The VMS manages the prioritization and control of power distribution. The SSPC performs the power transfer and secures power levels distributed to components to prevent overloading. The VMS can be considered the brain of the operation and the SSPC the muscle.

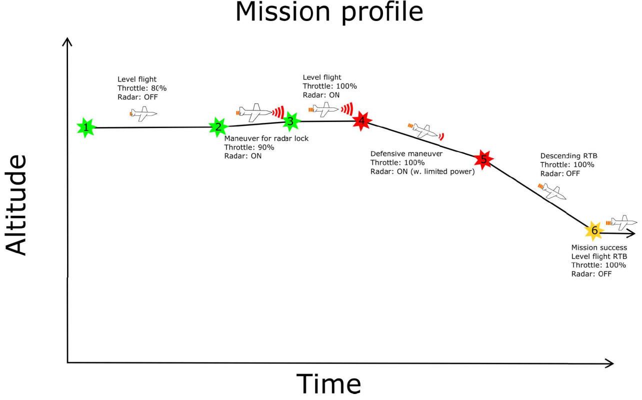


Management strategies

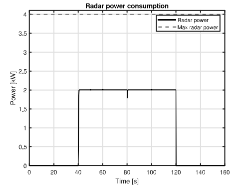
Power to actuators are prioritized over power to tactical systems (e.g. radar). When excess power is available the radar may be operated. In case of failure of the power generation system, the aircraft battery is switched on to maintain power supply to the actuators. To conserve available power, the radar can not be operated in this mode.

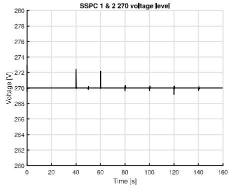
Results

The flight mission for the real-time simulation is shown in the figure below.

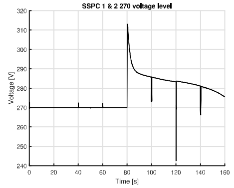


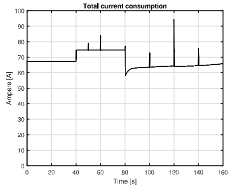
The radar behaved as predicted in the flight mission, as can be seen in the figure below. It does not reach full power since it is not available in the system and reduces power $@t = 80s$ when the actuators require more power. The voltage is kept fairly constant at 270 V, the various spikes occur when the pilot manoeuvres the aircraft.

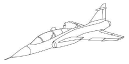




The figures below show the voltage and current consumption when the battery starts to supply the aircraft with power.







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