ADENEAS Newsletter 5

Measuring the potential of disruptive technologies

Greetings! We are Ronald Hageman and Asterios Souftas, Research engineers at Fokker Elmo Research and Technology Department. Within the ADENEAS project, Ronald is the lead developer on the design automation platform and Asterios is coordinating the Fokker Elmo research on network architecture and reliability.

One of the main objectives of ADENEAS is to develop technologies that minimize the weight of the total aircraft data network and reduce the design lead time. To accomplish this ambition, there is a variety of candidate communication media (conventional wiring, power line communications and wireless technologies). Such media have different strengths and weaknesses and different specifications, targeted to become deployed for several thousands of digital signals for future applications. This complexity motivates the development of automated tools to evaluate the impact of all types of communication technologies with respect to weight, determine the cases where each type of media excels and ultimately lead to an optimized network involving a combination of all data network technologies. With the ambition to maximize the weight efficiency of the final data network, Fokker Elmo is developing such a tool within ADENEAS WP6.

The main development challenge is the design space. The potential data network topologies and architectures, different concepts and metrics to describe reliability and the variety of communication technologies are the main cause for the increased design space. Furthermore, there are other constraints that have to be taken into account such as the size, shape and geometry of the aircraft, the safety signal separation requirements and computational complexity.

To address similar design goals, Fokker Elmo is already relying on an in-house tool to automate aircraft's wiring design. This tool takes into account all relevant requirements and generates optimal routes for all the aircraft signals. For our work, we build upon this foundation to incorporate all other disrupting media types. The updated design automation tool is called Extended Signal Routing Application or ESRA.

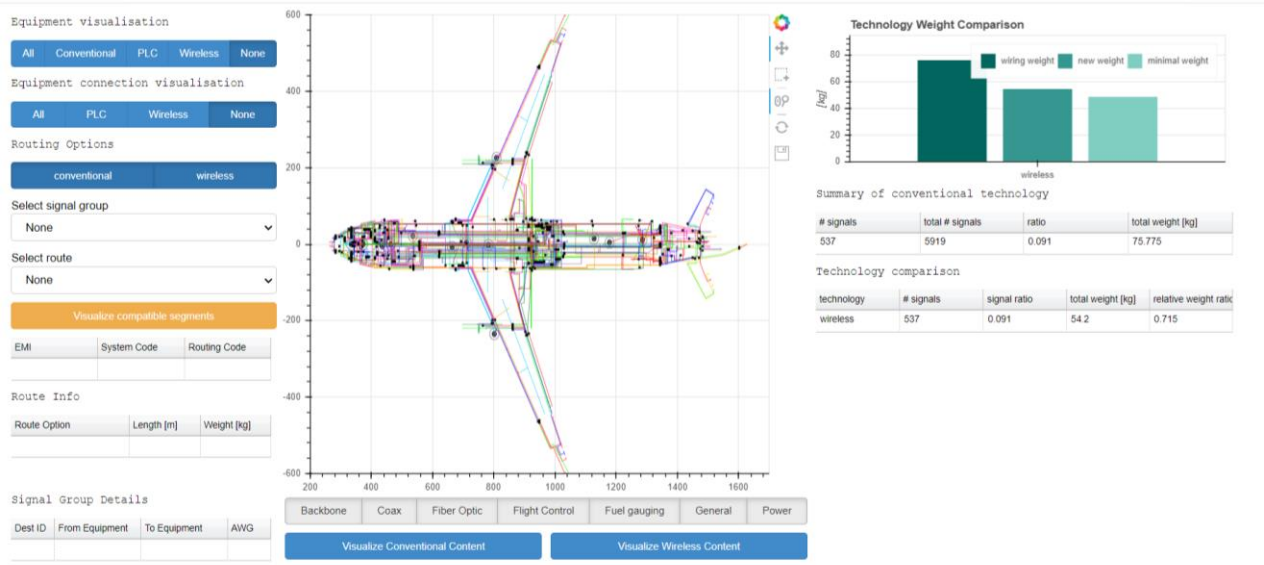
The design of ESRA is based on incorporating the novel communication media to the existing automation tool. The reference cases built on WP1 are used as input to our model. ESRA then routes each signal from the reference case aircraft for each media type and calculates the impact on weight and reliability. The calculated weight is then used to evaluate the optimal communication medium for each signal.

The method used to incorporate wireless technologies was relying on a wired backbone. Upon reaching the backbone, a wireless signal can be routed to its destination. The design assumption is based on current existing avionics design standards. A wireless signal generated in conventional equipment needs a wireless module to broadcast which adds a small weight penalty. The wireless signal then is routed to an assigned Gateway, which is connected to the backbone.

The Gateway is the interface between the wireless signal and the backbone. The total weight of the wireless module, the gateway and part of the backbone are calculated and compared to the equivalent weight of the conventional wiring.

The Gateway positioning and signal assignment to Gateways problems were solved by relying on machine learning. The workflow starts with using clustering algorithms to identify groups of signals that are routed close to each other. After the signal clusters have been formed, a machine learning algorithm takes over to distribute the gateways according to the signal requirements and place the gateways were all wireless modules are in reach.

Power Line Communications require a different approach. A PLC signal is defined as the multiplexing of one or more data signals over a power line. To determine if a plc signal can be routed over two equipment, ESRA checks if there is a data and a power connection between them, based on the reference signals. Additional constraints such as voltage levels, PLC modulation platforms and bandwidth levels are also taken into account by the tool.



Combining the routing output of all communication media an approximate understanding on the strengths and weaknesses of each technology can be formed. This approach has already indicated that important wiring savings can be accomplished by implementing a backbone.

ESRA is to be further expanded to support a complete and optimized design automation for hybrid future aircraft data networks.