Development of System Models for the Evaluation of Unmanned Airborne Early Warning Aircraft

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This collaborative project between Linköping University and SAAB Aeronautics aims to deliver tools that will enable the preliminary sizing and evaluation of Unmanned Aerial Vehicles (UAVs) as Airborne Early Warning (AEW) platforms. In this light, the two challenges that have been undertaken by our research group is to first identify a number of potential UAV concepts, and second to develop a model-based multidisciplinary analysis framework that can be used to perform a design space exploration.

Our current challenge is in respect to system modeling. More specifically, the existing sizing tools are based on either statistical regression equations or empirical formulas that in general can have a limited applicability to UAV design. In addition to this, the fidelity of the above tools has a low level of prediction accuracy, and therefore, this raises an issue of whether the results can be trusted beyond the conceptual development stage. Finally, the available aircraft analysis frameworks have been built around general aviation aircraft, and as a result, those tools do not have adequate functions for representing the operation of the AEW systems and they are missing the fine tuning that is required to capture the performance of unconventional configurations.

Consequently, we have identified that there is a clear need to expand the analysis capabilities. At a system level, it is essential to have models of the utility, airframe, avionics, and mission-specific systems, and in particular, it is critical to be able to assess the demands of the above systems on the power generation as well as cooling systems, and in turn to propagate those need to the propulsion system in order to identify the impact of the losses on the mission. At the vehicle level, it is important to have an aerodynamic model that can capture the design details of unconventional configurations, while accordingly, there is also a need for a higher fidelity geometry representation in order to extract information on aspects such as the weight and balance, the radar accessibility and FoV, the integrity of the structures, and the feasibility of component placement.

In view of the above, this submission aims to present the status of the existing framework. Overall, there are three main improvement directions which are presented visually in the figure below. The first direction is about the enhancement of the system level models; the second direction is about the improvement of the aerodynamic calculations; and lastly the third is about having a higher fidelity geometry that can be used as a support for all the above models as well as for further investigations. Apart from the above enhancements, this paper will also raise the issue of enabling a faster design space exploration, and hence, a further dimension of work will be in respect to model integration and in particular on how the analysis process can be automated.

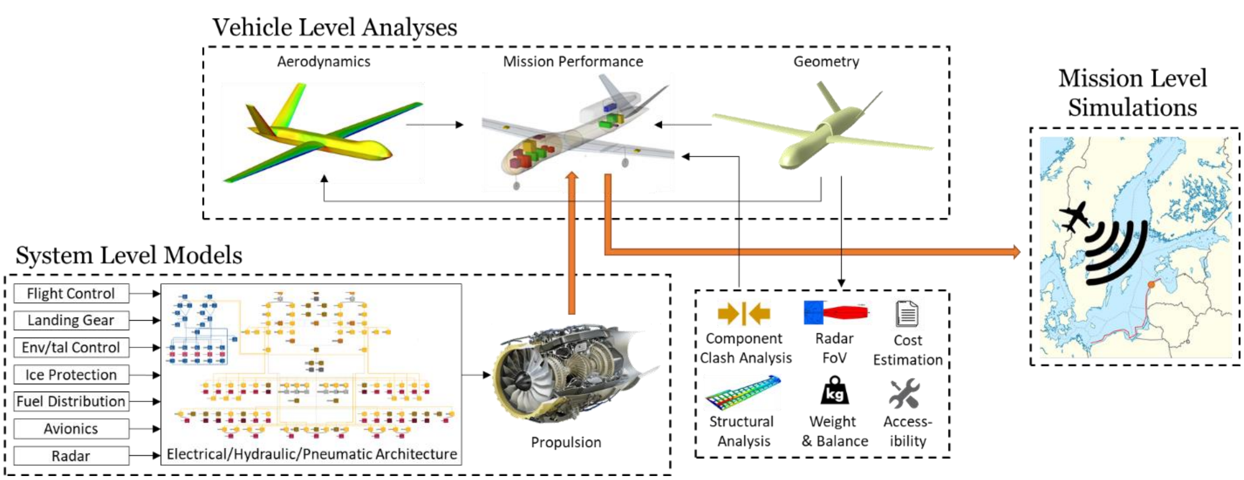

Figure 1 Overview of the envisioned multilevel analysis framework.