World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:13, No:05, 2019

System-Driven Design Process for Integrated Multifunctional Movable Concepts

Authors : Oliver Bertram, Leonel Akoto Chama

Abstract : In today's civil transport aircraft, the design of flight control systems is based on the experience gained from previous aircraft configurations with a clear distinction between primary and secondary flight control functions for controlling the aircraft altitude and trajectory. Significant system improvements are now seen particularly in multifunctional moveable concepts where the flight control functions are no longer considered separate but integral. This allows new functions to be implemented in order to improve the overall aircraft performance. However, the classical design process of flight controls is sequential and insufficiently interdisciplinary. In particular, the systems discipline is involved only rudimentarily in the early phase. In many cases, the task of systems design is limited to meeting the requirements of the upstream disciplines, which may lead to integration problems later. For this reason, approaching design with an incremental development is required to reduce the risk of a complete redesign. Although the potential and the path to multifunctional moveable concepts are shown, the complete re-engineering of aircraft concepts with less classic moveable concepts is associated with a considerable risk for the design due to the lack of design methods. This represents an obstacle to major leaps in technology. This gap in state of the art is even further increased if, in the future, unconventional aircraft configurations shall be considered, where no reference data or architectures are available. This means that the use of the above-mentioned experience-based approach used for conventional configurations is limited and not applicable to the next generation of aircraft. In particular, there is a need for methods and tools for a rapid trade-off between new multifunctional flight control systems architectures. To close this gap in the state of the art, an integrated system-driven design process for multifunctional flight control systems of non-classical aircraft configurations will be presented. The overall goal of the design process is to find optimal solutions for single or combined target criteria in a fast process from the very large solution space for the flight control system. In contrast to the state of the art, all disciplines are involved for a holistic design in an integrated rather than a sequential process. To emphasize the systems discipline, this paper focuses on the methodology for designing moveable actuation systems in the context of this integrated design process of multifunctional moveables. The methodology includes different approaches for creating system architectures, component design methods as well as the necessary process outputs to evaluate the systems. An application example of a reference configuration is used to demonstrate the process and validate the results. For this, new unconventional hydraulic and electrical flight control system architectures are calculated which result from the higher requirements for multifunctional moveable concept. In addition to typical key performance indicators such as mass and required power requirements, the results regarding the feasibility and wing integration aspects of the system components are examined and discussed here. This is intended to show how the systems design can influence and drive the wing and overall aircraft design.

Keywords : actuation systems, flight control surfaces, multi-functional movables, wing design process
Conference Title : ICAS 2019 : International Conference on Aeronautical Sciences
Conference Location : Berlin, Germany
Conference Dates : May 21-22, 2019