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Research on Multi-Specialty Coordination, Multi-Discipline and Multifunction Integration Oriented Modeling and Simulation Innovation Technology

Fan Lin* ,Cao Baohong,Liu Yifei,Yao Xionghua

AVIC the first aircraft institute，Shaanxi Xi’an, 710089,China

Abstract

The paper mainly covers the connotations, the functions and the key techniques of the Aircraft Digital Cooperative Robust Integration Optimization Performance Simulation Technology. The Performance Simulation Airplane Integration Design Platform, which has been established by the Performance Simulation Airplane construction analysis, a series of Standard Specification Establishing, the key modules development and a series of the supporting work implementation. It can be customized and be extended, and it is easy to be demonstrated. The platform contains the engineering database including the Performance Simulation Airplane model, simulation process data, simulation results data, and so on. It also provides the closed development process from the initial design to the optimized design, and end to the final detail design. It carries out the configuration selection and performance analysis for the airplane various configurations under the product development requirements in the entire process. It is applicable for the cooperative simulation analysis about the General Configuration research, the Aerodynamic design, the Structure design, the Strength design and some system specialties. This technique system has brought revolutionary changes to the traditional technological concept and Architecture, and it has been proved that the design period of the product is shortened by more than 25%, and the simulation test period is also shortened by more than 25%.

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Keywords: Performance simulation plane; Coordinated development; Robust integrated optimization; Value drivers;

* Corresponding author. Tel.: +86-29-86832975.
E-mail address: fanlin20000@163.com

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1. Introduction

Under the current background of product marketization and competition globalization, customer demand, environmental requirement, system policy and market expectation all require the manufactured airplanes to have more excellent overall performances, so we must weigh and decide various performances and the new technical applications that achieve such performances. Airplane, as an extremely complicated assembly involving multisystem operation and mutual effect, needs various multi-discipline and multi-specialty parameters to reflect the overall performance index thereof. During the whole R&D cycle of the airplane, a large number of scheme comparisons and reasonable trade-offs are needed due to the interrelation and mutual effect among various disciplines. Therefore, it is necessary to effectively manage all characteristics that present the performances of the airplane in order to prevent reworking and wastage of development cycle & cost. Generally speaking, airplane design includes six stages, namely, project argumentation, preliminary design, detailed design, experimental verification, test flight and delivery. Especially, at the early stage of design process, the multi-physics field analysis is needed to eliminate risk and accurately predict the functional characteristics of the detailed design stage. Furthermore, due to stricter requirements on test and certification, the advanced verification carried out through simulation is also needed. Additionally, most of our airplane design is discrete, isolated and non-systematic, and the design data have not been effectively shared till now and cannot form automatic cycle, thus causing a lot of duplication of labor, low design efficiency, long design cycle, high cost and in adaptation to the development task requirement under new situation. Accordingly, it is necessary for us to research multi-specialty coordination, multi-discipline and multifunction integration oriented modeling and simulation innovation technology.

2. Present Foreign and Domestic Research Status

Multi-specialty coordination, multi-discipline integration and multifunction integration oriented airplane development has become the development trend of airplane R&D in the future. Looking at the aviation product development mode in the whole world, cooperative development, discipline and performance integration have already become the most effective and powerful methods for comprehensively improving development quality and shortening development cycle as well as the technological base for supporting the aviation industry to rapidly strain and thus adapt to market. The innovative development mode firstly applied by the western developed countries represented by US in airplane development field has obtained obvious benefits. Under the support of digital technology, Boeing Co. and Airbus enable the developers at different regions to get together for airplane development project so as to support the global parallel airplane development and thus bring the global optimal airplane development capability into full play as well as achieve capability integration. Obviously, the advanced innovative development mode has already become the new mode for modern airplane development and the important part of industrial core competitiveness.

CRESCENDO (Collaborative & Robust Engineering using Simulation Capability Enabling Next Design Optimization) Project Research carried out by 59 partners in 13 EU countries aims at improving the airplane performance dataset management and the performance data generation process so as to respond to the great challenge of airplane development in future, thus ensuring the maturity (on all levels) of all products from the beginning to the operation process [1]. The goal of the project is to make a great progress in the field of the traditional modeling and simulating technology application through the cooperation among multidisciplinary teams of cooperative enterprises in order to obtain more product performance, time effectiveness and cost effectiveness during the development of new aviation products. CRESCENDO Project enables the R&D cycle of airplane in future to be reduced by 10% and enables the overall design and manufacture reworking rate to be reduced by 50% as well as enables the physical test cost to be reduced by 20%. Task and schedule of strategic research on aviation industry mainly influenced and changed thereby include the following three aspects: 1) make use of advanced digital analysis, design, manufacturing and maintenance tools, methods, means and process control to halve the market cycle of the new products; 2) strengthen the integration of the supply chain and the overall R&D process of products through network-based cooperative development; 3) significantly cut down the operation cost and continuously reduce travel expenses in a stable way through network-based cooperative development. Therefore, during various stages of R&D cycle of airplane products, CRESCENDO Project can provide effective management tool for