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Title

A data driven approach to predict life cycle cost of commercial aircraft

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Abstract

With the development of aircraft Multi-disciplinary Design and Optimization (MDO) system, the inclusion of traditional disciplines such as aerodynamic performance and structural constraints cannot always satisfy the technical requirements of an aircraft. Especially when the life cycle assessment of the economic performance is shown a decisive influence on the aircraft competitiveness in the aviation market [1]. Therefore, it is necessary to build up a life cycle cost estimation module for the MDO system. Moreover, it is known that the development of an aircraft concept could define 85% of the aircraft life cycle cost although it only spends less than 20% of the total expenses. Thus, an efficient and accurate evaluation method is required to be applied at various levels of detail in the early phase of an aircraft life cycle. In addition, aircraft economic performance and other disciplines are often not tightly coupled in a MDO system due to the lack of physical links, so that a logical coupling strategy is needed to form a practical MDO paradigm [2].

This paper presents a new methodology of aircraft life cycle cost estimation and prediction using data driven techniques. It differs from the conventional parametric cost estimation and reduces the workload on extracting the physical linkage between aircraft parameters and the corresponding costs. It is a potential approach that avoids the intensive know-how processes during coupling. An aircraft life cycle contains hundreds of data-intensive activities from research and development to disposal and recycle, which forms the foundation of cost prediction via machine learning algorithms. Based on Artificial Neural Networks, aircraft life cycle cost is obtained by directly building the relationship between product design parameters, life cycle process parameters and its cost values. First, data models including cost driving parameters and cost values are built on the same level of fidelity. Next, based on the structure of the Radial Basis Function (RBF) neural network, a network model is constructed to simulate the training sample. The network model is then amended and verified by the test samples. Finally, the trained network is employed to predict the actual life cycle costs of commercial aircraft with different configurations. Results will be verified by error evaluations and sensitivity analyses. The cost estimation is established as a stand-alone module using Python, where application interfaces with MDO systems can be developed for system integration. An initial integration of the cost module and an in-house developed MDO system are built via the coupling of design constraints and cost drivers. It potentially provides costing capability in aircraft conceptual design phase and enables economic-impact-included design optimizations.

References

[1] Xiaonan C, Huang J, Mingxu Y I. Development cost prediction of general aviation aircraft projects with parametric modeling[J]. Chinese Journal of Aeronautics, 2019, 32(6): 1465-1471.
[2] Bodendorf F, Merkl P, Franke J. Intelligent cost estimation by machine learning in supply management: A structured literature review[J]. Computers & Industrial Engineering, 2021, 160: 107601.