Aerospace Europe Conference 2023
Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX *(to be filled by the organizers)*
Preferred Topics: CFDMPS (DEFAINE session) / SYSINT / STRMAT
Corresponding author: VAN MANEN Bas
e-mail of corresponding author: bas.vanmanen@fokker.com
Type: Oral
Status of corresponding author: Regular

Title

A Multidisciplinary Modeling System for Designing Fuselage Structures: Extending the Multidisciplinary Modeler

Authors
Bas VAN MANEN [1], Tobie van den Berg [2], Ton van der Laan [3], Bram Timmer [4]*

** Corresponding author*
[1] GKN Fokker Aerostructures, PAPENDRECHT, 3351 LB, The Netherlands, Bas.vanManen@Fokker.com
[2] GKN Fokker Aerostructures, PAPENDRECHT, 3351 LB, The Netherlands, Tobie.vandenBerg@Fokker.com
[3] GKN Fokker Aerostructures, PAPENDRECHT, 3351 LB, The Netherlands, Ton.vanderLaan@Fokker.com
[4] GKN Fokker ELMO, HOOGERHEIDE, 4631 RP, The Netherlands, Bram.Timmer@Fokker.com

Abstract
With the upcoming electrical, hydrogen and urban air mobility (UAM) aircraft markets, unconventional aircraft configurations are considered more and more to reach a higher efficiency. Not only the conventional wing design is revised, also new fuselage designs are considered. For a tier 1 supplier like GKN Fokker, it is crucial to rapidly respond to new customer requests for aircraft components trade studies [1]. Because of these new markets, this does not only include wing-like structures, but the demand for fuselage structures is also increasing. To meet the demand for wing-like structures, a software package is developed at GKN Fokker to rapidly design and analyze wing configurations in a largely automated way. Such a software package is not yet available for fuselage structures.

The Multidisciplinary Modeler (MDM) package developed at GKN Fokker is used to design wing-like structures, such as wing boxes, wing movables and wing flaps [2]. The aim of the MDM package is to be used as a central product model, which can be integrated in optimization and analysis workflows. The software package is built from primitives, for example spar, rib or joint classes, making the package generically applicable to wing-like structures. The MDM package is continuously being developed, with the addition of holes and panel breakers in the structure as most recent developments and with the addition of a tip-to-tip wing box model as an upcoming development [3]. The package is being used within the AGILE 4.0 project to generate flap designs [4] and will be used within the DEFAINE [5] project to enable multi-architecture optimization [6].

This paper describes the advancements made to the MDM package to enable the design of fuselage structures using the package. The primitives used to design wing-like structures are reused to also work for non-wing-like structures, such as fuselages. The generic application of primitives should make it possible to link the current existing disciplinary models to the fuselage model and therefore analyze and size the structure with little effort in creating interfaces for these analysis tools. The aim

of this development is to use the existing codebase of the MDM package to make the design principles and knowledge also functional for fuselage structures. It should also enable the current existing interfaces to disciplinary models to be used on fuselage-like structures. The package will be tested on use cases within the DEFAINE project to determine and visualize signal routing for a parametrically defined fuselage structure. Furthermore, the package will be used within the Dutch Mobility Fund [7] to rapidly design and analyze thermoplastic fuselage skin panels.

Acknowledgement

The research presented in this paper has partially been performed in the framework of the DEFAINE (Design Exploration Framework based on AI for froNt-loaded Engineering) project and has partially been performed in the Dutch Mobility Fund project. The research has received funding from the *ITEA 3 programme* and the *Subsidieregeling R&D Mobiliteitssectioren (RDM)*.

References

[1] A.H. van der Laan, T. van den Berg, L. Hootsmans, "Integrated Multidisciplinary Engineering Solutions at Fokker Aerostructures", 5th CEAS Air and Space Conference, Delft, 2015

[2] T. van den Berg, A.H. van der Laan, "A multidisciplinary modeling system for structural design applied to aircraft moveables", AIAA Aviation 2021 Forum, virtual event, 2021

[3] T. van den Berg, H.S. van Manen, A.H. van der Laan, I. Ciobotia, D. Bansal, J. Sonneveld, "A multidisciplinary modeling system for aircraft structural components", submitted to 9th CEAS Air and Space Conference, Lausanne, 2023

[4] A.H. van der Laan et. al., "Bringing Manufacturing into the MDO domain using MBSE", AIAA Aviation 2022 Forum, Chicago, 2022

[5] M. Baan, et. al., "DEFAINE – Design Exploration Framework based on AI for front-loaded Engineering: Achievements and Open Challenges", submitted to 9th CEAS Air and Space Conference, Lausanne, 2023

[6] J. Sonneveld, A.M.R.M. Bruggeman, G. La Rocca, T. van den Berg, H.S. van Manen, "Dynamic workflow generation applied to aircraft moveable architecture optimization", submitted to 9th CEAS Air and Space Conference, Lausanne, 2023

[7] Samenvattingen Subsidieregeling R&D Mobiliteitssectoren (RDM) [online] URL: https://www.rvo.nl/subsidies-financiering/subsidieregeling-rd-mobiliteitssectoren/samenvattingen [retrieved 31 January 2023]