AIRCRAFT DESIGN SOFTWARE

doc. Ing. Naqib Daneshjo, PhD.
Ing. Andreas Kohla
Ing. Christian Dietrich
Technická univerzita v Košiciach
Katedra leteckého inžinierstva
Rampová 7, 041 21 Košice
e-mail: naqib.daneshjo@tuke.sk
dipl.ing.kohla@t-online.de

Abstract

Aircraft design software(ADF) is a software product which has been specifically developed for use in aircraft design. Planes large and small can be designed with this software, and the software can include an assortment of powerful tools which are intended to aid the designer. Several commercial products are available, along with freeware versions intended for use by students and hobbyists. Some aerospace companies have even developed their own aircraft design software to meet the needs of particular projects.

Key words: Aircraft design software(ADF), CAD/CAD, design,

1 INTRODUCTION

This software is part of a larger family of computer assisted design (CAD), also known as computer aided design, products. These products allow people to use computers to create design schematics, three dimensional models, and other tools which will help them assemble a design. Using such software can create a great deal of flexibility for a designer, in contrast with more traditional design methods, which involve the creation of paper mockups and real world models. Engineers, architects, and many other designers of a wide range of products all take advantage of CAD software and the extensions which can be added to increase functionality, such as a component which will communicate with a fabricator to build objects in real life to the specifications of the software program.

One feature which can be included in aircraft design software is a physics engine which will explore the properties of the proposed aircraft. This can be used to identify problems, to run calculations, and to simulate real world situations to determine whether or not the design will actually be functional. Aircraft design software can also be used to run a wide variety of calculations involving the estimated weight of the aircraft, the max fully-laden weight, and so forth.

While most programs can generate blueprints and schematics, some aircraft design software can take things a step further. Specialty products can directly design machining parts for building the aircraft being designed with the software. The software can also design and lay out a manufacturing facility, based on the needs of the aircraft, and designed to maximize efficiency. In addition to being used to design new aircraft, aircraft design software can be utilized when renovations or overhauls are planned.

The software is also used by people who work with simulators to design custom aircraft to play with. Enthusiasts may enjoy the opportunity to enjoy the aviation field vicariously, even if their aircraft will never be produced in the real world. Such software can also be used in simulations of crashes, mechanical failures, and other problems, to explore how and why things went wrong.

2 VERSIONS AVAILABLE

Aircraft design software can be used to:

- **Understanding** the design process of products in general.
- **Understanding** more specifically the design process of an aircraft.
- **Trying out** new ideas or new concepts,
- **Exploring** all the flight conditions of an existing aircraft.
- **Studying** the impact of modifications on an existing aircraft.

5 versions available Aircraft design software:

1. ADS Maker
2. ADS Homebuilder
3. ADS Education
4. ADS Light
5. ADS Professional

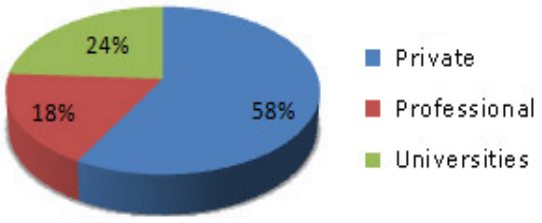

Fig. 1 ADS customer profile

ADS is particularly suitable for aircraft designers, homebuilders, university staff and students, as well as for pilots and future aircraft owners.

*If you are an homebuilder***,** ADS is the tool you need. You want to design or modify a light aircraft and you need an efficient and inexpensive work tool. You do not wish to spend time learning to use complex software and you are looking for something user-friendly. ADS makes it possible for you to size the dimensions of your future aircraft,

without any fuss and at a very low cost, while ensuring the greatest chance of success.

If you are a professional aircraft manufacturer, ADS is the tool you need above all others. You want to design aircraft and you need an efficient, fast and accurate tool to analyse the market and design the best product in the least possible time; the product which best meets your specifications. ADS enables you to achieve optimisation, i.e. to find the best configuration of the aircraft at the planning stage so that it meets the requirements of the specifications with maximum efficiency and in as short a time as possible.

If you are student or teacher, ADS is a tool perfectly tailored to your needs. You want to understand and explain. ADS is of considerable assistance in providing a better understanding of the aircraft design process, viewing the effects of a parameter variation on aircraft geometry and performances, apprehending aircraft design in a comprehensive way, teaching both the interest of the analytical approach where everything is broken down to the smallest detail and the synthetic approach where all the details form a whole.

If you are a future owner, ADS is an excellent decision-making tool. You want to analyse to be better able to choose. ADS helps you to make the best choice from among all the aircraft available on the market and to choose the aircraft that best fulfils your wishes from the cost and performance point of view.

If you are a pilot, ADS will soon become an excellent companion. You want to understand to be able to fly better. ADS enables you to better understand the flight characteristics of your aircraft by providing you with clear and precise explanations through graphs and tables. ADS will also make it possible for you to plan flight tests and analyse their results.

3 ADS - DIFFERENT PACKAGES

ADSMaker is intended for the fan of the flight simulator X-Plane**.** It allows you, in a few minutes**,** to design your own aircraft or to reproduce an existing one and fly it in the flight simulator X-Plane**.**

The algorithms are the same as for the professional version. Only the modules used to compute the aircraft (geometry, aerodynamics, weight, stability) the engine and airfoil databases are included in this version.

ADS Light is intended for the pilot-builder who wants to design his own dream plane, for the student who is doing a design project for his research thesis, for the interested who want to understand the physics and principles of conceptual aircraft design, for the pilot who wants to find out about the flight and handling qualities of their aircraft, and for anyone interested in aircraft design**.**

The algorithms are the same as for the professional version.

The modules used to accelerate the design process and to enable a market analysis of the product are not included in the package. A limited technical support is available.

ADS Homebuilder is in the first place intended for amateur aircraft builders. Keeping in mind that a homebuilt project might one day turn into a commercial venture, it is important to have a correct idea of the qualities of the new design. In addition, it is equally important to know exactly what the "competing" products are capable of.

The algorithms are the same as for the professional version. The optimisation module is not included in the package. Reaction from technical support is guaranteed within 3 days.

ADS Professional is intended for the professional**.** Since time is money, this version has an optimisation module which is an easy and rapid tool to define and optimise the configuration of the airplane on the drawing board. The module for statistical analysis enables the user to perform the major part of the market analysis of the new aircraft. A maximum of technical support is available.

ADS Education offers the same features and functions as the professional version. This version is exclusively available for universities and academic institutions**,** and can be installed on 20 workstations.

Aircraft Design Software	ADSMaker	Light	Homebuilder	Professional	Education
List of modules included in each package					
Analysis		●	●	●	●
Statistical analysis			●	●	●
Design (1 - 3)		●	●	●	●
Design (2)	●	●	●	●	●
Optimization				●	●
Wing section optimization				●	●
Wing geometry optimization				●	●
Load analysis				●	●
Weight & Balance	●	●	●	●	●
Control & Stability	●	●	●	●	●
Mission profile				●	●
3D Module	●	●	●	●	●
Texture on 3D Model	●	●	●	●	●
Export files (CAD)				●	●
Export files (Flight Sim.)	●	●	●	●	●
Digitizer			●	●	●
Useful Tools	●	●	●	●	●
Databases	●	●	●	●	●
Technical Notes		●	●	●	●
Additional information					
Number of licences	1	1	1	1	20
Technical support	Web site FAQ			Gold	Gold
Delivery / Validity	Downloading + CD-Rom / Unlimited				

Tab. 1 Aircraft design software(ADF) modules

4 AIRCRAFT DESIGN SOFTWARE(ADF) MODULES

Optimisation Module: In the conceptual design stage of a product, it is important to begin by to considering the maximum feasible number of possible solutions, and then reduce this number systematically until at the end of the process, the only one solution is left over : the one which will meet the design specification as closely as possible.

ADS incorporates a dedicated optimisation module. In the optimisation module, the software asks for the parameters that you wish to 'float', together with a lower, an upper limit and the increment to work with. Each set of parameters forms a particular aircraft configuration. The current version of ADS is capable of handling up to 10.000 configurations simultaneously.

Analysis Module: For any product you want to design, an analysis of what exists is a key stage in the design process.

This analysis is essential for :

- Appreciating the actual state of the art of what is readily available.
- Get a feel for the typical magnitudes of dimensions, performances, qualitative criterions for mass and aerodynamic efficiency.
- Working out all design specifications for your new design.
- Positioning your new design with respect to competing aircraft and allowing you get the best out of it.

When designing a new aircraft, you are recommended to perform and analysis of a dozen similar aircraft. This will give you a good idea of the quality of your competitors and allow you to position your design amongst them.

Module for Statistical Analysis: The module for Statistical Analysis allows you to make a real time analysis of existing aircraft.

Particularly in the conceptual stage of the design, this analysis is essential for :

- Evaluating the available level of current technology and positioning your design amongst its direct and indirect competitors.
- Finding realistic parameters as the best starting point for your new design project.

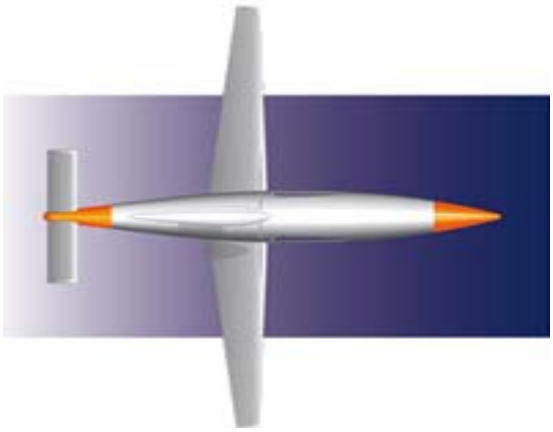

Fig. 2 3D Module

3D Module: The 3D Module allows you to make a real time visual analysis of the just obtained results of your conceptual design. It is also a convenient link to CAD. With a few mouse-clicks you can export the ADS generated geometry in a format which can be further used with almost any CAD software. The 3D Module works like a real Expert System**.** The 3D model generated corresponds to the results of the conceptual design and is made according to the 'rules of the game' in design and aerodynamics. And, maybe most important of all, a virtual 3D model of the aircraft will certainly be of great help for convincing investors, first customers or partners in your project.

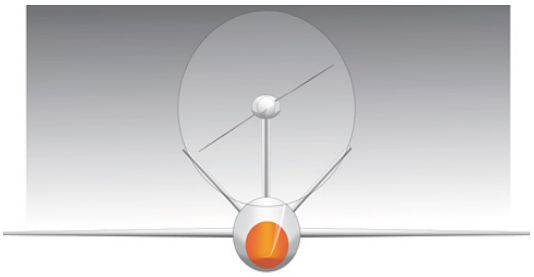

Fig. 3 3D Module

5 CONCLUSION

CAD/CAM technologies continue to provide growing opportunities for employment as companies seek out cost-efficient methods to develop new products. There are a number of professions associated with CAD/CAM, but the most common is probably that of industrial designers. Industrial design generally requires at least a four-year degree that includes computer based design course work. Designers are typically employed either at specialized design and engineering services firms or at large end-user corporations that require regular design work, such as car manufacturers.

Many CAD/CAM software tools are highly specialized, and thus a multi stage manufacturing process, such as is used for complex products like motor vehicles, airplanes, and ships, requires more than one CAD program to design and integrate the various parts. For example, in ship design manufacturers may use one CAD application for designing the vessel's steel structure and another for designing the propeller assembly. Such specialization ensures that designers have adequate layout and specification tools in the software to work with; however, the drawbacks are the need to learn multiple software packages and the need to eventually integrate pieces of the design that are coming from unlike systems.

BIBLIOGRAPHY

[1] Michal Fabian, Róbert Boslai, Jaroslav Šeminský Reverse engineering na báze 2D pohľadovpomocou intuitívneho modelára : Imagine&Shape v CATIA V5, 2010. - 1 elektronický optický disk (CD-ROM).

[2] TAHZIB, Baryalai Negatívne vplyvy letísk na životné prostredie. - 1 elektronický optický disk (CD-ROM). In: 2. vedecká konferencia doktorandov LF : zborník príspevkov z konferencie : 9. - 10.5.2012, Košice. - Košice : LF TU, 2012 S. 1-4. - ISBN 978-80-553-0914-9

[3] Pauliková, A.: Modelovanie dynamických systémov pracovného prostredia technologickej prevádzky, habilitačná práca, Košice, 2008. - 166 s.

[4] Mareš, A. - Senderská, K.: Ergonomické moduly programu CATIA V 5 a ich aplikácia. In: JOSRA : Journal of Safety Research and Applications. Vol. 4, no. 2 (2011), p. 1-7. - ISSN 1803-3687

[5] http://www.wisegeek.com/what-is-aircraft-design-software.htm

[6] http://www.referenceforbusiness.com/encyclopedia/Clo-Con/Computer-Aided-Design-CAD and-Computer-Aided-Manufacturing-CAM.html

[7] http://ibis.experimentals.de/links/software/software.html