# *A Java desktop application for Aircraft Preliminary Design*

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***Abstract* — The paper deals with the ongoing development of ADOpT (Aircraft Design and Optimization Tool), a Java-based desktop application conceived as a fast, reliable and user friendly computational aid for aircraft designers in the conceptual and preliminary design phases.**

***Keywords* — Java, Aircraft Design, Software Engineering, Application of Computer Science**

## I. Introduction

ADOpT (Aircraft Design and Optimization Tool) is a Java-based desktop application developed at the University of Naples Federico II, conceived as a fast, reliable and user friendly computational aid for aircraft designers in the conceptual and preliminary design phases. The ultimate goal of such a tool is to perform a parametric, multi-disciplinary analysis of an aircraft and then search for an optimized configuration. The search domain boundaries are usually defined by the user through a set of specifyed parameters.

The aircraft design process is well described in many books [1-7] that represent a fundamental know-how for engineers and professionals in the activity of design of airplanes. Since the end of 80's many software dealing with aircraft design (some of them based on the previous cited references) have been produced with the aim of having some design framework to be used for teaching and professional purposes in aircraft design [8-12]. Some new software [11, 12] have recently followed innovative approaches considering concepts like KBE (knowledge Based Engineering) and MDO (Multi-Disciplinary Optimization), have highlighted the necessity of an efficient graphical user interface and the importance of making the application results easily exploitable with external software. In the last decade the authors have been working on the development of a software tool for aircraft design named ADAS (Aircraft Design And Synthesis), to be used mainly for teaching purposes [13]. The software has been developed in Visual Basic making extensive use of an efficient and easy graphical user interface; also, it has been recently used in collaboration with other scientists for aircraft design application [14]. The development of ADAS provided a significant amount of experience in several fields, including software engineering, I/O best practices, GUI design and usability.

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The software presented here is an extended version of ADAS entirely rewritten in Java and designed for industrial purposes. The choice of the programming language was driven by several considerations. These include the following:

- the language should be widely supported; this to avoid the case of many valid aircraft design applications and libraries that became obsolete due to the aging of the programming language used to build them;
- the language should promote the use of open source libraries, especially for I/O tasks and for complex mathematical operations;
- the language and the companion IDE should provide a widely supported GUI framework and a GUI visual builder;
- the language should support and promote modularity.

The Java programming language meets all these requirements: it is backed by Oracle and by a huge community of developers so it is continuously updated (Java 1.8 and JavaFX). Also, advanced and free IDEs (such as Eclipse or Netbeans) allow programmers to streamline and simplify the development process. In particular, the Eclipse IDE and the SWT/JFace libraries have been chosen to develop ADOpT and its GUI.

Being Java a pure object oriented programming language, it greatly encourages and simplifies modularization. Each module (package) can be programmed quite independently so that it is relatively easy to divide the work among several programmers. This is essential since the amount of classes and calculations needed to abstract, manage and analyze the entire aircraft is very large (presently the whole project counts about 56000 lines of code). For such a reason the establishment of common practices and the adherence to fundamental principle of software development (Don't Repeat Yourself, Separation of Concerns, Agile software development) are equally important.

An important design requirement of ADOpT is related to its interoperability with other engineering analysis tools. In fact, the application can be easily integrated into a comprehensive aircraft optimization cycle. This is made possible because ADOpT can be launched both in GUI and command line mode. Much care has been given to input/output and configuration files to increase the possible uses of the software.

Some of the complexities of modern aircraft design are shown in the flow chart of Fig. 1, which summarizes the conceptual application domain of the software presented here.