

## DESIGN & ANALYSIS TOOLS AND TECHNIQUES FOR AEROSPACE STRUCTURES IN A 3D VISUAL ENVIRONMENT

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### **Abstract**

*The main objective of this project is to develop a set of tools and to integrate techniques in a software package which is build on structure analysis applications based on Romanian engineers experience in designing and analysing aerospace structures, consolidated with the most recent methods and techniques. The applications automates the structure's design and analysis processes and facilitate the exchange of technical information between the partners involved in a complex aerospace project without limiting the domain.*

### **Introduction**

The tools and techniques (grouped in a system) are not limited only to make the design and analysis activities of the aeronautical structures more efficient in the design process of the new aeronautical product. These tools and techniques actually support all kind of activities that are taking place during the lifecycle of a specific structure (redesign, harness, maintenance, investigation after specific events, etc). So, the costs for an aeronautical investigation are very much lowered and also the time in which it is made is shorter as the information is related and attached to the investigated object.

For lightening the engineering activities, the tool design process of the project takes into account structuring data in order to gain transparency, consistency and also in order to have them available at a certain moment in time. By implementing the project results a reduction of analysis time with 12-15% is anticipated.

Considering, for example, an airplane wing designed with CAD tools, the database will include it as an entity with many other information attached (such as: geometric data, info about the used materials, proposed analysis method, results of a previous analysis, notes). This entity is associated with other information that may be interesting in different stages of its lifecycle. During an analysis process the user accesses a database through a visual interface that allows a better understanding of the specific structure and launch if need be, a new analysis process.

Although the collaborative environment, through the created infrastructure, ensures the communication between partners of a project and, in some cases, various tools for technical information access or transfer, the right use of them is sometimes difficult. The difficulties appear mainly because the procedures, technologies and software systems are usually implemented in different forms from partner to partner. In such cases, in order to ensure a full understanding of the information between partners, converters or other applications that may help, or notes and even re-make of some activities are used.

The project proposes a structure and hierarchy for structural analysis specific information related to any entity that contributes to a better collaboration between partners in an aeronautical project. The development tools of this project don't use expensive commercial codes. The component elements of the integrated system are: database, analysis applications and visual interface.

### **Main Stages of Development**

In stage I the analysis tools and techniques developed and integrated in the system are identified and systematized. Also, the functional and technological requests of the information management for the system applications are established. The aeronautic engineering standards are taken into account.

Stage II defines the system architecture: components and information flux. It is finalized

with database design on hierarchy's data and a macro scheme for architecture and functionality requests of the system. Also, the software platform of the developed system is configured and the software tools that may be used without a license are used to design the 3D environment and the browsers (Internet) for visualizing the 3D objects and others specific results.

Stage III defines the analysis models, the algorithms and methods for each and every application. The codes of all applications are being written. The stage ends with the independent tests for every application. If need be the stage II can be redesigned or conclusion corrected.

Stage IV builds the system applications interface taking into account the functions of the system. Its role is to provide the user with the possibility of initiate the implemented applications, and interact with the 3D objects from the visual environment, and also access, check and complete de database with information. The stages ends with programme codes that open control windows for activate the applications and simulate the visual 3D space or for interrogation.

Stage V is the validation and integration stage for all the functions of the functional requests of the developed system. It will be finalized with a

complete testing through the interface and will be encapsulated as a stand-alone product that may be implemented on the analysis platform.

Stage VI represents the stage of conclusions and results dissemination. The conclusion main target will be the possibility of implementing the developed techniques and tools. The final rapport will include the users guide manual .

For the time being we developed only the first two stages.

The designed system is going to be able to extract a 3D CAD object together with all/a part of associated information from a certain database. The object is placed in a visual environment with which the user may interact. This operation is very useful for a good visual examination that contributes to a better understanding and correlation with related information. The system launches structural analysis processes using different scenarios based on the entry data and writes the results in the database.

From this short presentation results the product components: the background of data, the analysis applications, the control applications for the entire system which are controlled through an interface (figure 1).

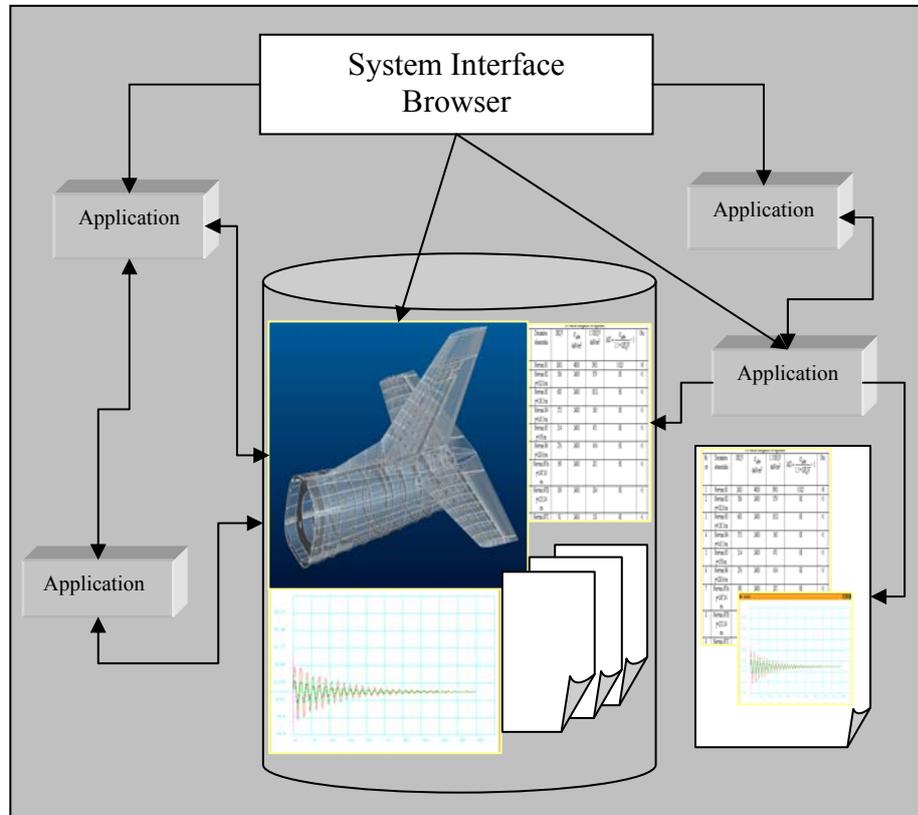


Fig.1

The data background or the database contains various entities like: text documents, images, 3D CAD objects, Office documents, etc. The database attribute of being heterogeneous is given especially by the above diversity and therefore cannot be used as a classic system for database administration. In order to meet the system requests a hierarchy structure and a suitable index are necessary. A linked-indexed hybrid system is built in a specialized programming language like C++ or Visual Basic, which includes dialog controls and browser launchers, used for database management. If the 3D objects are in wrl format, internet browsers can be used for visualization. In this case the dimension of the files is very large and therefore the use through the internet is not very easy, due to the communication bandwidth.

The applications are launched through the system interface. In order to build this interface the programmers access new object oriented programming technologies which offer a multiple windows working environment, events administration in time, etc.

Beside the classic programming languages there also will be used the VRML language and the resource of OpenGL library.

### Conclusion

The new codes may be used for faster developing new projects. The static and fatigue analysis are also possible. The procedures can also be used for other mechanical structures.

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