IMAGE

Interoperable Management of Aeronautical Generic Executive software

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D 2.2 synthesis: Aeronautical Numerical Simulations Expressed Needs

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1 Introduction

IMAGE project aims at implementing a generic and universal environment (with a database of components as complete as possible) in order to make complex, distributed and heterogeneous integrated simulators able to co-operate.

In this document a single, consistent, synthesised description of needs for numerical simulation is given taking into account the fact that in numerical simulation, real time computing is not mandatory.

Owing to the large variety of numerical simulations we have identified the fields of applications (chapter 2) of the future requirements for the IMAGE Project.
We have then synthesized the present situation in each industrial operational domain common to all the identified fields (chapter 3) and pointed out targets for improvement.
Then, in chapter 4, needs (requirements) are summarised for numerical simulation to the intention of the IMAGE environment.

2 Industry Overview

2.1 Industry definition and segmentation

The product area is segmented into:

- Aircraft, Propulsion,
- C^4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance),
- Avionics,
- Aerospace Sciences.

3 POSITIONING AND SEGMENTATION

3.1 Position/Value statement for industry

A variety of positioning statements and improvement propositions do exist in the aeronautical industry. We have chosen to segment them in different user types.

3.1.1 Engineering

3.1.1.1 Positioning Statement

The market provides a set of tools used to assist the engineer in acquiring, analysing, and visualising data and to assist him in modelling, simulating complex mechanical, electrical, and control systems.

3.1.1.2 Value Proposition

The perceived value is a productivity enhancement, ease-of-use, and accuracy gain.

3.1.2 Engineering Manager

3.1.2.1 Positioning Statement

Several tools provide a common toolset for collaborative working that is used in a collaborative way, using intranet or Internet communication means.

3.1.2.2 Value Proposition

A simulation workspace will facilitate the calculation works and integrate them in enlarged Extended enterprise context. IMAGE environment will use common standards based on exchanged open standards and standard message handling.
The perceived value is productivity enhancement, engineering collaborative tool, the whole shared space will be stored on each member's device.

3.1.3 Program Level

3.1.3.1 Positioning Statement

The simulation tools assist engineers when analysing, designing, developing and deploying engineering systems related to the program or project level helping them in the engineering analysis or design process.

3.1.3.2 Value Proposition

The perceived value is productivity and accuracy gains for inter-group collaboration and reuse of verified completed work. Visualization of data and results with a common tool is critical; all data will be strongly encrypted.

4 NUMERICAL SIMULATIONS IDENTIFIED NEEDS.

The needs listed below is a synthesis on expected improvements in the numerical simulation domain, they represent the high level requirements for IMAGE environment.

4.1 Interoperability

- There is a need to allow heterogeneous simulations (in terms of hardware, software, data, network protocols, etc.) to co-operate.
- It should be necessary to allow distant simulations to co-operate with the illusion of being located in the same place.
- There is a need to provide methodology processes and tools that allow incompatible simulations to co-operate.
- Synchronisation: the system should integrate different simulations tools. Synchronisation for data coherency is needed, as well as asynchronous modules for speed.
- Consistency: all participants should be aware of each other's action on objects concerning them.
- Multi-physic simulations performance: many physical phenomena can be simulated and are being integrated within the design process. When these physical phenomena are not independent, the simulation tools have to be linked, the output of a simulation might be the input for another.

4.2 Heterogeneity

- To allow simulations to cooperate independently from the Operating System or from the type of platform used.
- Handling simulations with pure simulation modules, real equipment modules and man in the loop (through HCI- Human Computer Interaction).
- Simulation modelling different phenomena. It could be necessary to use different simulators to obtain the real representation of a phenomena under a wider range of constraints.

4.3 Cost Reduction

- Interfacing easily components from different simulation systems.
- Replacing real equipment by computerised elements.
- In a general way, replacing expensive dedicated platforms by several cheaper generic platforms (typically PC).
- Sharing computers and network resources on a distributed system.
- Keeping an acceptable level of performance in the time scale and quality.

4.4 Modularity

- Using existing simulators or simulation applications by encapsulating them to make them cooperate in a friendly way.

- Using simulation modules for other applications
- To handle simulation modules from different work domains (ATC modules, weather simulation modules, etc.).
- Normalising and standardising simulation components through development of rules and tools.

4.5 Flexibility

- An API (Application Programmable Interface) for the C and FORTRAN languages will open IMAGE to other domains.
- Allowing any module matching the IMAGE format to join or leave a simulation during the run, being aware of all other participants.
- To detect dynamically if a running module or service went down (survivability).
- To run several simulations one after the other (for Monte-Carlo methods).
- Being able to run a whole simulation on a single platform.
- Allowing the modules to run without being part of a simulation.
- Allowing modules to run sequentially and exploit each other's data.

4.6 Optimisation of the data exchange

- Exchanging data between simulations without common definitions of their objects.
- Handling important data workflow.
- Providing a generic format that all the users can understand/use but specific enough to satisfy them.
- Being able to exchange data both on LAN or WAN.
- Exchanging data among simulation packages with the minimum manual interaction.
- Availability of treated data.
- Sharing data via Internet

4.7 Security

- Access to the simulation: unauthorised hosts cannot join a simulation.
- Access to the simulation information: unauthorised hosts cannot access some information.
- Data exchange: unauthorised hosts cannot spy the exchanged data.
- Handling the interaction between secured/unsecured networks
- Making sure that the exchanged information is not changed altered or modified without authorisation.
- Provide multi-user distributed simulation data propriety protection capabilities.

4.8 Safety

- To increase the safety of the software and hardware modules by testing them extensively since the beginning of the development.
- To provide testing and controlling tools to automatically test and control modules and whole simulation behaviour.

4.9 Robustness

- To keep on running even if a simulation module goes off (handled by the supervision part).
- To detect and handle errors (handled by the supervision part). The implemented system must be fault tolerant.
- To follow part or all the simulation, to access data without perturbing the simulation.
- Being able to detect if a connecting participant has a sufficient power.

4.10 Learning and experimentation support

- To decrease the existing difficulty of learning packages (user-friendly interfaces and online help modules).
- To enhance guidance for simulation experimentation support.
- To allow better experimental design support.
- To improve of the simulation environment output design analysis facilities.

4.11 Administrative support

- To enable data management in distributed simulation environment,
- To provide off-line simulation resource management.
- To provide implementation constrains management capabilities.
- To allow simulation services management.
- To allow distributed and heterogeneous simulations interfaces management.
- To provide consolidated statistical facilities.
- To ensure distributed cross-referencing capabilities.

4.12 Configurability

- To ensure that the simulation environment can be configured to correspond to the users needs.
- To build simulation environment from library of distributed simulation systems to extract ready-built components of simulation.

4.13 Compatibility

- To provide facilities for compatibility of the various simulation packages used.

- To enable compatibility of user logic for cooperating simulations/simulators.

4.14. Time reduction

- To speed up the simulation computational time in order to be able to handle larger examples.