ESPSS

European Space Propulsion System Simulation

ESPSS Software Transfer Document

Doc. 4000103800/11/NL/CP – TN-4110

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Main Contractor Empresarios Agrupados

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ABSTRACT:

The purpose of the Software Transfer Document (STD) is to describe the procedures to install the ESPSS EcosimPro® Libraries and the results of this installation, as well as a list of ESPSS components.

Revision table

Issue	Issue date	Modifications	Page
V1.0	23-01-08	*First Version*	
V1.4.1	05-06-09	*Version issued after the Industrial Validation Phase (ESPSS-II)*	
V2.0	01-02-10	*This Version corresponds to the final delivery of ESPSS-II with Version 4.6 of EcosimPro*	
V2.2	01-09-11	*Present version accounts for the upgrades and experience acquired since Version 2.0 was released, mainly due to the improvements derived from the user feed-backs* *New simple test cases have been added to this version, in such a way they can be easily compared with theoretical solutions.*	
V2.4	30-04-12	*Present version gains in robustness, includes new components for the mixture process of combusted gases, upgrades the TANKS library accounting for film boiling phenomena and better simulation of the generalized boiling process and includes new libraries for direct STEADY calculation designing cycles. New tips and comments have been added in the UM helping the user building models*	
V3.0	30-11-13	*This version includes new features as the simulation of solid/hybrid combustors, ramjets, scramjets and the convection/mixing of combusted gases downstream a chamber.* *It also includes new libraries for steady/quasi-steady models: The STEADY Library designing rocket engine cycles, the SATELLITE Library for orbital and attitude motion and the ELECTRICAL_PROPULSION Library.*	

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1. INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

This Software Transfer Document (STD) reports in summary form the Transfer Phase activities for the installation of the ESPSS Libraries under EcosimPro® 5.2

1.2 APPLICABLE DOCUMENTS

The following documents are applicable to this project:

- [AD-1] 086-038-XY-L-X1820 ESPSS Version 3. Management Proposal
- [AD-2] 086-038-XY-L-X1819 ESPSS Version 3. Technical Proposal
- [AD-3] 4000103800/11/NL/CP – TN-4130. ESPSS-3. ESPSS. Main libraries User Manual
- [AD-4] 4000103800/11/NL/CP – TN-4120. ESPSS-3. Software Verification and Validation Plan

2. INSTALLATION PROCEDURES

2.1 INSTALLING THE ESPSS ECOSIMPRO® LIBRARIES

2.1.1 Software Requirements

The following characteristics are required in order to install the ESPSS libraries:

- Windows® 2000, XP or 7
- One of the following compilers: Microsoft® Visual Studio® 6.0, Microsoft® Visual C++ .NET 2003, Microsoft® Visual C++ 2008 or Microsoft® Visual C++ 2010. By default, GCC 4.4 compiler is available with EcosimPro.
- EcosimPro® 5.2.
- A minimum of 1000 Mb of RAM memory should be available and 1 GB of free space on the local Hard Disk.

2.1.2 Software Version

All the following procedures are referred to version 3.0 of the ESPSS software, compatible with version 5.2 of EcosimPro®

2.1.3 Installation of the ESPSS Libraries

To install the ESPSS libraries on your hard disk follow these instructions:

- Run the installation executable file (.exe), that should be accessed by ftp under demand
- Select a directory of your choice (a default directory is suggested), such as EcosimPro_Install_Dir. The following libraries will be copied:
  - COMB_CHAMBERS
  - COMP_DATABASE
  - FLUID_FLOW_1D
  - FLUID_FLOW_1D_EXAMPLES
  - FLUID_PROPERTIES
  - OPTIMIZATION
  - ROCKETS_EXAMPLES
  - TANKS
  - TURBO_MACHINERY
  - OPTIMIZATION
  - EP
  - SATELLITE
  - STEADY
  - STEADY_EXAMPLES

- Open the program ECOSIMPRO
- Import a Workspace:

  File --> Open Workspace, and select the file "ESPSS.wsp.xml" which is located in the directory selected when the libraries were installed (i.e. EcosimPro_Install_Dir\ws\WS_ESPSS)

Then, a workspace called ESPSS appears with the following libraries loaded:

- MATH
- PORTS_LIB
- CONTROL
- THERMAL
- MECHANICAL
- FLUID_PROPERTIES
- FLUID_FLOW_1D
- COMB_CHAMBERS
- TANKS
- TURBO_MACHINERY
- FLUID_FLOW_1D_EXAMPLES
- ROCKETS_EXAMPLES
- EP
- SATELLITE
- STEADY
- STEADY_EXAMPLES

In case of manual loading of the libraries, previous order of loading respects the reciprocal dependencies of the libraries. Password for unlock ESPSS libraries is ESPSS. Normally, there is no need to compile the libraries. Nevertheless, in case they had to be compiled, the same order of the library loading should be followed.

2.1.4 Running the validation cases

FLUID_FLOW_1D_EXAMPLES and ROCKETS_EXAMPLES are EcosimPro® libraries containing the validation cases. They also contain useful application examples which can be run:

Launch EcosimPro®. Select a model to be run in the "Partitions" tab. Validate partition if necessary and run it in the "Experiments" tab with EcosimPro® Monitor.

The same results as in reference AD-4 should be found

2.2 INSTALLING THE ZOOMING FEATURE

2.2.1 Software requirements

- Windows® XP

- ANSYS® FLUENT® 6.3.26 (not delivered with ESPSS)
- GAMBIT® (any version) (not delivered with ESPSS)
- Microsoft® Visual Studio® .NET 2003 (VC7)

2.2.2 Installing Fluent

1. Install Fluent following the installation instructions that can be found on www.fluentusers.com.
2. Install Gambit following the installation instructions that can be found on www.fluentusers.com.

2.2.3 Running an experiment

1. Create a partition involving a *Fluent_component* of the FLUID_FLOW_1D library. An example of system is given in library FLUID_FLOW_1D_EXAMPLES, component *fluent_test.el*.
2. In the experiment file, see example below, set the variable *TABLE_PATH* to the folder containing the EcosimPro® fluid tables (i.e. usually *EcosimPro_install_dir/PROP_TABLES/).*
3. Also in the experiment file, set the variable *RUN_PATH* to the folder where you want the output files to be placed.
4. Create a mesh using GAMBIT and modify the variable *casefile* according to the name you give it. Place the file in *RUN_PATH*.
5. Copy the files *fluent_udf_lib.dll* and *setup_fluent.scm* in *RUN_PATH*.
6. Set the parameters of your external component. An example of experiment file is shown below, and the meaning of the parameters is given in the User Manual.
7. The experiment can now be run as a simple EcosimPro experiment.

```
EXPERIMENT exp1 ON fluent_test.default

        DECLS (...)
        INIT (...)
        BOUNDS (...)
        BODY

        Fl_nozzle.TABLE_PATH = "C:/EcosimPro/PROP_TABLES/"
        Fl_nozzle.RUN_PATH = "C:/EcosimPro/USER_LIBS/FLUID_FLOW_1D/
                        experiments/fluent_test.default/exp1/"
        Fl_nozzle.casefile = "nozzle2D.cas"
        Fl_nozzle.init= ""
        Fl_nozzle.dim = 2
        Fl_nozzle.axi = 1
        Fl_nozzle.order = 2
        Fl_nozzle.n_steps = 5
        Fl_nozzle.dt_com = .05
        Fl_nozzle.m_o =0.01
        Fl_nozzle.alpha =1
        Fl_nozzle.A_in =.25*3.14159*.05*.05
        Fl_nozzle.A_out =.25*3.14159*.05*.05

        IMETHOD = DASSL_SPARSE
        REPORT_MODE=IS_STEP
        TIME = 0
        REL_ERROR = 1e-4
        ABS_ERROR = 1e-4
        INTEG_TO(.25,.001)
        Fl_nozzle.n_steps =5
        Fl_nozzle.dt_com = .05
        INTEG_TO(2,.001)
        Fl_nozzle.n_steps = 1
        INTEG_TO(5,.001)
```

```
            VolPT_TMD_1.s_pres.signal[1] = 200000
            Fl_nozzle.dt_com = .2
            INTEG_TO(10,.01)
            VolPT_TMD_1.s_pres.signal[1] = 200000-(TIME-10)*20000
            Fl_nozzle.dt_com = .05
            INTEG_TO(15,.001)

END EXPERIMENT
```

2.3 INSTALLING THE OPTIMIZATION FEATURE

2.3.1 Software requirements

- Windows® XP
- Cenaero® Max Optimizer (not delivered with ESPSS)
- Microsoft® Visual Studio® .NET 2003 (VC7)

2.3.2 Installing the OPTIMIZATION library

Before running a particular study, the OPTIMIZATION library (containing the definition of the C++ class *ExternalOptimizer* needed for the optimization) must be loaded in EcosimPro.

This library contains the declaration in EL (EcosimPro® language) of the API for Max.

Additionally, the static library *MaxEcosimPro4.lib* and the C++ header file *MaxEcosimPro4.h* must be put in the following directories:

- *MaxEcosimPro4.lib* to EcosimPro\USER_LIBS\OPTIMIZATION\lib
- *MaxEcosimPro4.h* to EcosimPro\USER_LIBS\OPTIMIZATION\include

Max also requires two dynamic libraries: *blas_win32.dll* and *lapack_win32.dll.* These libraries should be copied in the EcosimPro/bin folder. To obtain the *blas_win32.dll* and *lapack_win32.dll,* please contact Cenaero.

2.3.3 Running an experiment

Before running any optimization problem, the OPTIMIZATION library should be explicitly called by:

USE OPTIMIZATION

Afterwards, the optimization problem can be easily run by following the guidelines given in the ESPSS User Manual.