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USER MANUAL - QUICK START	ISSUE 1.1
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Abstract

The present Technical Note (TN) presents the User Manual (UM), including a quick start, for the SPIS-UI framework. In the first part, this TN describes the User Interface (UI) and the various provided modules. In a second part, a complete simulation is followed step-by-step with a basic example. In the last part, the data structure of shared data and the advanced use of SPIS-UI are presented.

This TN is compliant with the version 3.6 of SPIS.

DOCUMENT STATUS SHEET

ISSUE	REVISION	DATE	REASON OF CHANGE
0.1	JF	2004/11/20	Creation
0.2	JF		
0.3	JF	2005/01/07	Extensions
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0.5	JF	2006/06/10	Update
0.6	JF	2006/08/20	Update according to new GUI
0.7	JF	2006/09/01	Update
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1. Introduction

1.1. Concept of Integrated Modelling Environment (IME)

SPIS-UI is the user interface of the SPIS system. The functions of SPIS-UI include the possibility of definition of all inputs parameters (CAD geometry, material properties, numerical settings...), during the pre-processing phase, the control of each step along the whole modelling chain (Fig.1) and the processing of outputs after the simulation. In parallel, the SPIS-UI framework offers the possibility to access to all shared data and dynamically edit and reload all models and processing modules.

1.2. Modelling chain

One of the main objectives of SPIS-UI framework is to help the user to follow the modelling chain and perform each step in a consistent approach in order to guaranty the results of the simulation as possible. The most common process starts with the definition of the geometry of the spacecraft (GEOM) with Computer Assisted Design (CAD) module and the attribution of surfaces properties and boundary conditions. This phase corresponds to the *pre-processing phase*. At its end, the system to model should be fully defined and ready to be loaded into the simulation kernel, SPIS-NUM, for the *Simulation Phase*. SPIS-UI provides several ways to run the simulation kernel, inside the framework, in interactive mode, or as independent jobs (under UNIX based systems) for large simulation or execution on a remote computer. The modelling process is closed by the post-processing phase with the access to several data analysis modules and 2D/3D visualisation tools. Fig.1 illustrates this principle.

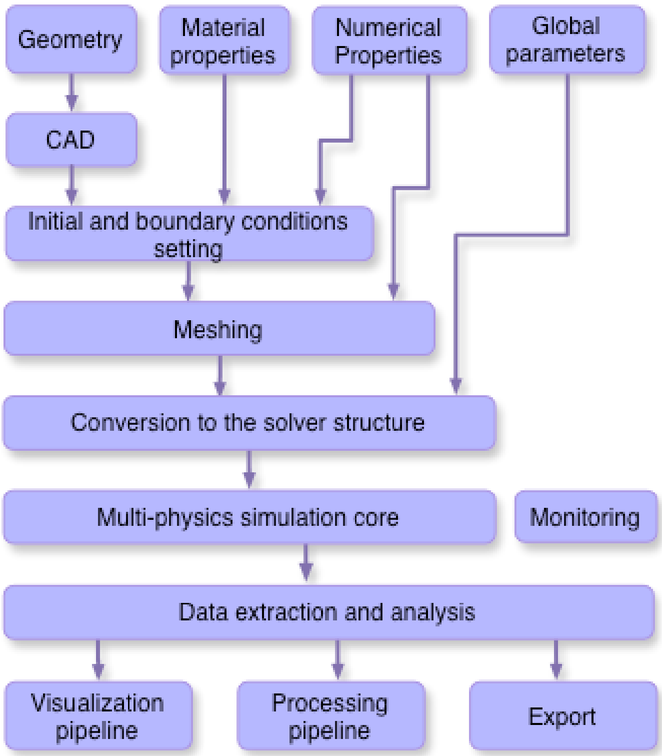


Figure 1: Schematic modelling chain.

1.3. Framework design

SPIS-UI is a modular framework building the functional link between all tools used along the modelling chain, from the pre-processing phase to the post-processing phase and including the simulation phase.

SPIS-UI is designed around a central kernel constituted of a **Common Data Bus**, to help the data exchange between components of the framework, and a central workflow, called ***TaskManager***. Each functional module, like CAD tool, mesher, simulation kernel or 3D viewers, are embedded into a generic container call **Task**, and dynamically loaded as a plug-in into the framework. Fig.2 shows the SPIS-UI structure.

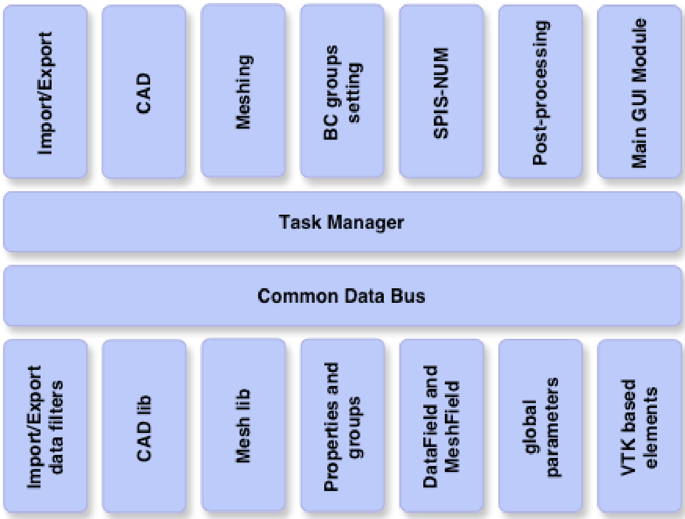


Figure 2: Structure of the SPIS-UI modelling framework

Technically, the SPIS-UI framework is written in Python/Jython script language and wraps sub-components in Java or native languages through a JNI interface. The Graphic User Interface (GUI) is fully written in Java Swing. Fig.3 illustrates this approach with several types of languages.

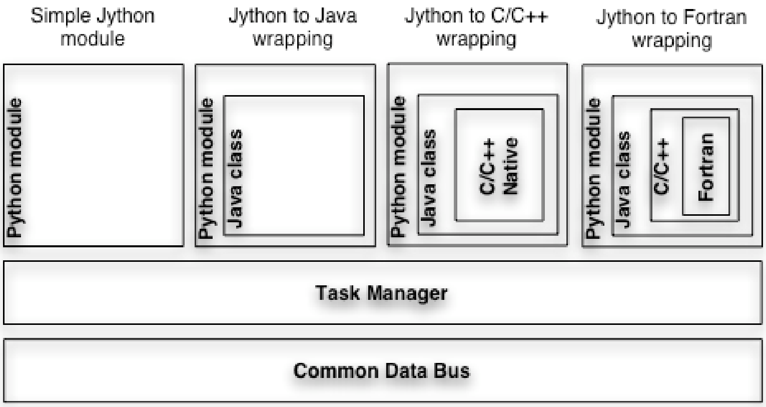


Figure 3: Principle of multi-language integration

This choice leads to a lightweight solution and allows a very high portability of the whole system. The SPIS-UI framework it-self can be run on almost all platforms with a Java Virtual Machine (JVM) 1.4 and higher. For each native component, a binary image is provided the most common OS (Windows, Linux, Mac-OSX...). The native modules are dynamically loaded into the framework through a mechanism of control (exception), allowing to still run the framework in degraded mode if one of them cannot be loaded. More information is available on the collaborative platform of the SPINE community [2].

The purpose of the *Task Manager* is to help the user to follow a correct order each step of the modelling according to a dependency tree between each task or pre-defined scenarios under the form Python scripts. The Task Manager works in a manner similar to a simplified workflow or a Make script. Fig.5 below illustrates this principle.

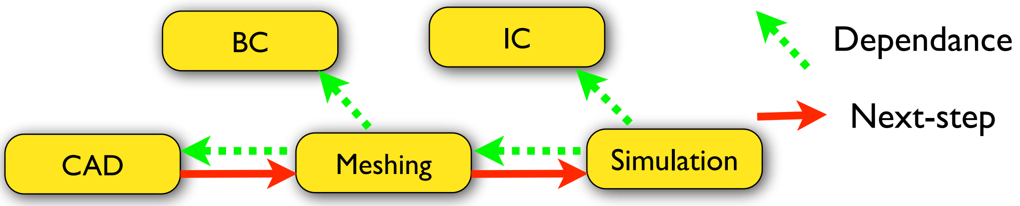


Figure 4: Illustration of the principle of the TaskManager: If a task (i.e module calling) is dependent on other ones (green arrows), these tasks will be automatically performed before in a correct order in order to generate consistent data. Scenarios, called SPIS tablatures, can be defined to perform each task auto

1.4. Multi-layer approach and data handling

The SPIS-UI framework has been designed to offer several levels of User Interfaces (UI) to access to tools and manipulated data:

- **A Graphical User Interface (GUI):** A rich GUI offer the possibility to run all functionalities of the framework through a set of menus, control widgets and graphical editors. This approach is especially useful for pre-built processes, as during a classic study. The GUI of SPIS-UI can be easily extended and adapted through an XML descriptor, without any compilation. Please see the TN 4.0 Developer Guide for further information [4].

- **A Script Language (SL):** In order the offer a prototyping capability and to facilitate the data handling, Jython, a Java based Python interpreter, has been integrated into the framework [1] [8]. Most of the the top level modules of SPIS-UI are written in Python/Jython and can be easily modified and manipulated. A plug-in based mechanism allows to dynamically editing and reloading most of the components of SPIS into the framework without any recompilation or necessity to re-start the framework. This feature is especially useful to prototype and dynamically test models on a set of data already loaded in the framework. The script capabilities are completed with the introduction of JyConsole, an advanced Jython console, providing an Object Oriented Completion Function (OOCF).

- **A Source Code Direct Access (SCDA):** As well as for the script layer, most of the low-level Java libraries (e.g SPIS-NUM) can be edited, re-compiled and dynamically re-loaded into the framework.

Some modules, like the 3D viewer Cassandra [3], and most of the external tools can individually be run as standalone applications or launched as independent demon.

2. SPIS-UI Quick Start

2.1. How-to-install SPIS ?

In default mode, SPIS does not require any specific installation. For the most common platforms, the standard release provides all needed elements, including external libraries, tools and JVMs in the `$SPIS_ROOT/ThirdPart` directory.

The SPIS releases are available on the SPINE's collaborative platform at the following address: http://www.spis.org [2].

The releases are archived as tar and gzipped or zipped files. For Linux, Mac OS-X and Windows systems, please just untar the release into your working directory. For other platforms, a JVM and native components should be installed specifically. Please see the SPINE platform for further information [2].

The untared image can be also copied on a CD-ROM and directly run from it.

Remark: In some cases, if another JVM was installed before on your computer, some environment variables can be set and interfere with the launching scripts of SPIS.

2.2. How-to-launch SPIS ?

SPIS is a Java based application called through a Jython script. SPIS can be run on almost all platforms with a JVM. Only native modules, such as VTK or the meshing tool, are platform dependent. If theses elements are not properly set, SPIS generally starts in degraded mode with only the Java based modules loaded.

Several launchers have been developed to facilitate the launching of SPIS on various platforms. Depending on the version of SPIS, there are available directly under the root directory of `$SPIS_ROOT` or in the `$SPIS_ROOT/SPIS-UI` directory. The table below summarises the launching scripts/platform configurations:

System	Launching script
Linux	spis_tasks_gui.sh
Apple MAC OS-X	spis_tasks_guiOSX.sh
MS Windows NT/2000/XP	spis_tasks_gui.bat

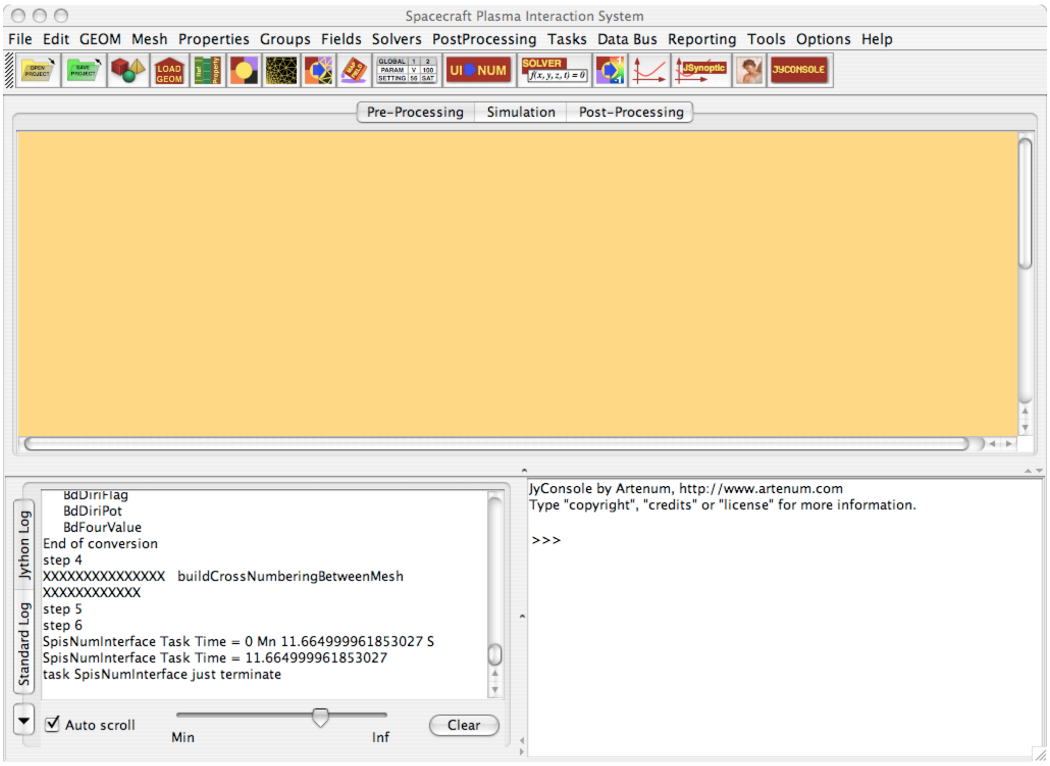
These scripts must be run in a shell (terminal). Basically, theses scripts define all required environment variables and paths toward sub-components (libraries and tools). The full SPIS releases are generally provides with all needed external components, such as CAD/mesher tools, viewer, editors, including JVMs for most common platforms. Please browse the `$SPIS_ROOT/ThirdPart` directory. By default, they are set with respect to components provided in the `$SPIS_ROOT/ThirdPart` directory for further details. They generally do not need any modification or specific settings. However, on some platforms or if you wish to optimise the global performances, the environment variables defined inside may have to be corrected manually. The launching scripts are largely commented and given in Annexe 1.

Remark: Under Windows NT/2000, the DOS prompt command does not support environment variables longer than 256 characters and does not support the launching script. This problem can be solved by running the XP version of the prompt in place of the standard one or by running the Sygwin environment. Under MAC OS-X the VTK module is still experimental. A specific installation of the VTK library is needed. Please see the Cassandra's Web site for further information [3].

2.3. GUI Overview

The SPIS user interface is based on a Main Graphical User Interface (MGUI). The MGUI looks like an integrated desk, where all individual GUIs of each sub-module are projected. The MGUI provides a central menu and a tools bar to control and call all modules and components of the framework. On the tools bar, the order of buttons corresponds to the typical order to perform the tasks in a standard modelling process. Two internal sub-frames complete the GUI. The first frame is the logs window where all messages, errors and outputs are reported. This frame includes actually two different logs windows for each language layer (script and Java based modules). The second one is a Python/Jython console (i.e JyConsole), where you can write and execute all types of Python scripts and manipulate directly all object shared in the framework. JyConsole offers an object-oriented completion for both JAVA and Jython languages.

The main window is defined dynamically through a simple XML based descriptor and can be very easily extended and adapted without any JAVA coding or re-compilation. Please see the advanced section or the TN 4.0 SPIS-UI Developer Guide for more details [4].



```
    BdDiriFlag
    BdDiriPot
    BdFourValue
End of conversion
step 4
XXXXXXXXXXXXXXX   buildCrossNumberingBetweenMesh
XXXXXXXXXXXX
step 5
step 6
SpisNumInterface Task Time = 0 Mn 11.664999961853027 S
SpisNumInterface Task Time = 11.664999961853027
task SpisNumInterface just terminate
```

```
JyConsole by Artenum, http://www.artenum.com
Type "copyright", "credits" or "license" for more information.

>>>
```

Figure 5: General view of the main GUI of SPIS.

2.4. Project based approach

The persistence model of the SPIS-UI modelling chain stands on a project based approach, where all needed parameters and actions performed during each step are progressively saved. Before any new study, we recommend to define a new project first. This recommendation is especially true before performing large and complex simulations. A SPIS project links all needed data (CAD file, mesh, groups settings, material, global parameters...) needed to perform the simulation and recover computed data. Scalar and vector fields applied on the mesh (DataFields) are also saved and can be reloaded for visualisation and post-processing. VTK files produced in output of the post-processing modules (Cassandra, Paraview) can be also saved into a SPIS project.

Practically, a SPIS project is a directory with a set of pre-built subdirectories and files. It can be packaged with classic archives tools, like tar or zip, to be moved to another place or computer. Most of the data are saved under the form a Python/Jython scripts, obtained by serialisation of the corresponding SPIS objects. These scripts are in ASCII format and can be directly integrated in all Jython based programs with the classic Python `import` command.

The project structure is still very modular and each component can be loaded independently and new projects built by aggregation of existing components. The current project format is not stabilised and can be modified without any notification.

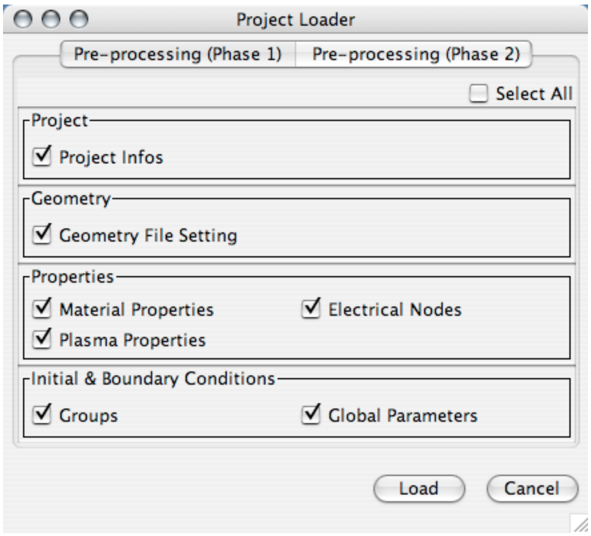
2.4.1 Creation of a new project

To create a new project, please choose the menu **File ->Save Project** or push the SAVE PROJECT button in the tool bar. A first directory browser should appear. You can directly write the name of your project directory or use the browser to choose a pre-existing directory. The project creation phase will build all needed sub-directories and files.

The project will progressively built and saved, element by element, along the modelling chain every time you click on the SAVE PROJECT button or on the **File->Save** Project menu.

2.4.2 Open an existing project

A project can be loaded at different levels, depending on the data you wish reload and the part of the pre-processing phase you want proceed again. First, click on the OPEN PROJECT icon or on the **File** -> **Load Project** menu. As illustrated in Fig.6, a dialogue window will appear.



Project Loader

□ Select All

Project
☑ Project Infos

Geometry
☑ Geometry File Setting

Properties
☑ Material Properties ☑ Electrical Nodes
☑ Plasma Properties

Initial & Boundary Conditions
☑ Groups ☑ Global Parameters

Figure 6: Dialogue window of the project-loading phase. Most of the project's components can be loaded individually.

The first index of the loading windows set whole minimum set of elements needed to define a complete system. They are enough to start the modelling process, i.e set the reference to the CAD file, the material and plasma properties, the group attribution and all global parameters. At the end of this phase the system is ready to be pre-processed, i.e meshed and local fields deployed.

Most of component can also be loaded individually. This approach can be used to recover one component only, like a property for example, or parts of a corrupted project. The second page corresponds to the elements produced during the second step of the pre-processing phase, such as the mesh structure and the local fields (i.e DataFields and MeshFields). This step is required is you wish recover results of a previous simulation (i.e DataFields). For large systems, this second step of the loading phase may be long. Please open the logs window and check if the loading phase is completed before to continue the modelling process.

At the end of the loading and if the system is fully defined, the framework is ready for a new simulation. Thanks to the TaskManager, you only have to push the **SpisToNum** button to perform automatically of the whole pre-processing phase. Only required tasks will be done. If the first loading step was done only, the TasksManager will call automatically the mesher and all tools needed to deploy the local properties (IBC). If the mesh and pre-processing DataFields are already reloaded (second part the loading phase), the TaskManager will only call the UI to Num data structure converter.

At this level, SPIS-NUM, the numerical kernel can be called by pushing the SOLVER $f(x, y, z, t) = 0$ icon in the tools bar.

Remark: The project loading procedure can be modified in the future. Please see the SPINE Web site (http://www.spis.org) for the possible evolutions.

2.4.3 Project structure

All data of a SPIS-UI project are gathered into a root directory and a set of sub-directories, as illustrated in Fig.8 below. The structure is design to be the most modular as possible and allow future extensions. Future versions may have additional sub-directories and data. Under the condition to respect the consistency to the stored model, each data is an independent entity. During the loading phase, the loading module of SPIS-UI will try to load each data individually. If one data is corrupted, this does not stop the loading of the other ones. However, the user must be careful. In this case the project may be incomplete and inconsistent to run a simulation.

In the current format (3.0), most of the SPIS-UI native data are saved under the form of ASCII Python scripts. They can be loaded independently in all Jython interpreter or console, like JyConsole. To change their settings, you can directly edit them with a standard text editor, without use the GUI of SPIS. This approach is useful in batch mode or to change the settings of a project on a remote computer.

A SPIS project is structured as follow:

- **__init__.py file:** This empty file is only present to indicate to the Jython interpreter this directory and the Python modules contained in it should be considered as a Python module.

- **DataField directory:** This directory contains all deployed local fields (i.e DataFields) and their corresponding set of mesh elements (i.e MeshFields). Each DataField is stored under the form of a set of Python scripts gathered in a dedicated sub-directory.

  Remark: DataFields and MeshFields require a pre-existing mesh structure to be deployed. You must then imperatively load the mesh into the framework before to load the DataFields. If the fields have been generated during a previous simulation, the mesh structured must also be exactly the same than during the initial construction. For a same GEOM structure, we notice that regenerated meshes , obtained by calling the mesher may differ, with as a consequences the impossibility to re-load the DataFields. We observe that the result of the mesher is sensitive on the OS (effect of round error) and its settings (conversion criterion).

- **Geom directory:** This directory contains all GEOM files describing the geometry of the system (spacecraft and computational domain). A Python based description file completes the settings of the GEOM workspace, setting the main GEOM file, for example. The contains of this directory is the image of the workspace of the GEOM manager.

- **Groups directory:** This directory contains all scripts setting and describing all geometrical groups.

- **Images directory:** This directory contains all images produced by the post-processing modules (Cassandra, 2D plot viewer).

- **NumKernel directory:** Because implemented the numerical kernel (SPIS-NUM) has specifics and additional parameters, like sources characteristics or the internal electrical , depending on the built model and not managed by SPIS-UI, an additional sub-directory has been added to the project structure.

- **Properties directory:** This directory contains all properties being deployed on the structure through the group description, like material properties or initial and boundary conditions. By default, three sub-directories correspond to the Plasma properties (i.e initial and boundary conditions), Material properties and Electrical nodes description.

- **Reporting directory:** This directory is dedicated to centralise notes and reports in future evolutions of SPIS-UI.

- **Log files:** These ASCII files contain all the outputs of the various consoles.

- **spis-global file:** This file contains the setting of all global parameters. Currently this file is obtained by serialisation. In future versions of SPIS-UI this file will be saved as Python script.

- **spis-names files:** This file is a reference and control file for the project. Please do not edit it manually.

- **spisSimulationDeamon files:** These files are scripts files to perform the simulation steps in batch mode. Please see the corresponding section for further information.

- **Tmp3D.msh file** is the default mesh file (Gmsh format [6]) generated or loaded by the framework.

- **VTK directory:** This directory contains all VTK data obtained after conversion from UI. These files can be loaded and processed independently on SPIS-UI.

Remark**:** The structure of SPIS-UI project can change without notification. Please see the SPINE's community Web site for further details and migration procedures.

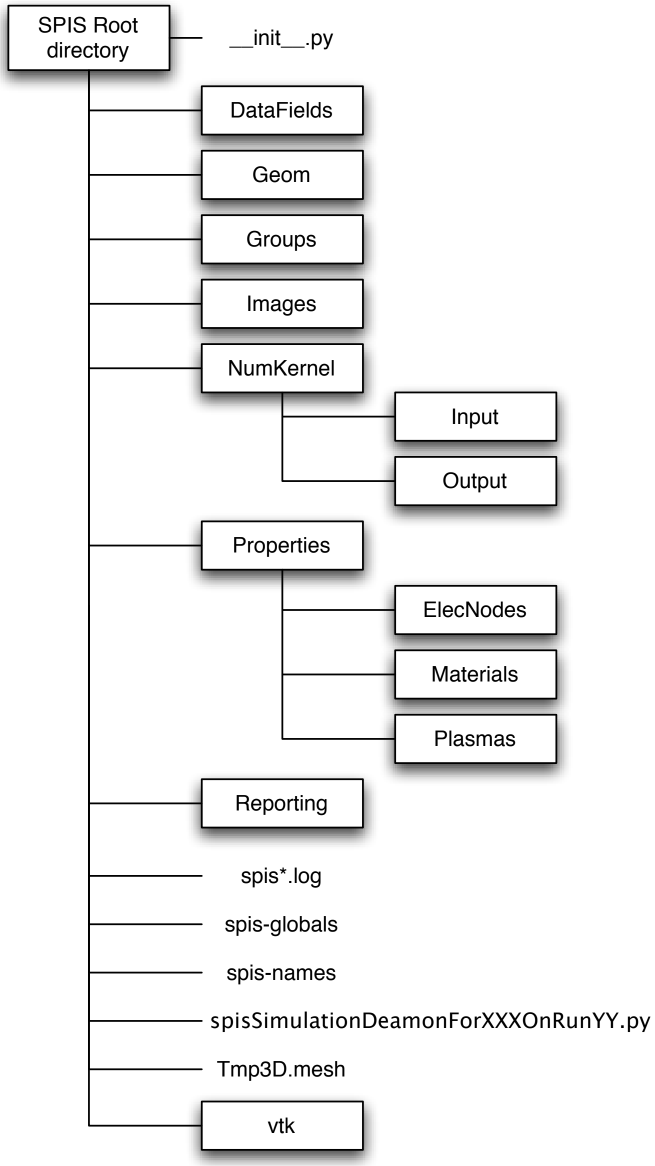


Figure 7: Structure of a SPIS project. Most of the components can be loaded individually and are Python based scripts.

2.5. Pre-processing

The pre-processing phase corresponds to the construction phase of the modelled system. This the phase where all parameters and settings needed by the simulation kernel are set. This includes the GEOM model, the local parameters, with a different value depending on the localisation on the mesh like IBC, and global parameters, with a value common to the whole system, like the time step. Fig.9 below summaries the pre-processing process.

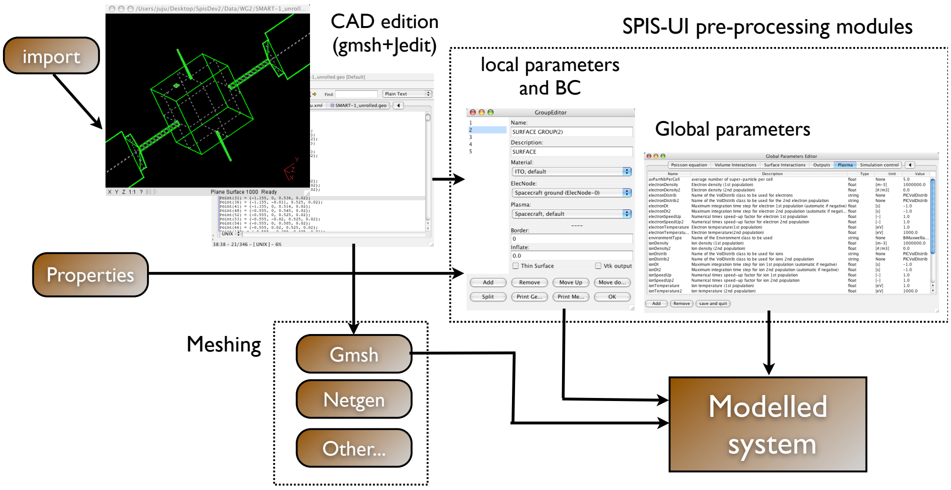


Figure 8: Synoptic scheme of the pre-processing phase.

One of the key setting is the link between the geometry of the system (spacecraft and computing space) and the initial and boundary conditions. In the SPIS-UI framework, these parameters are generally called "local parameters", in reason their value may differ on their localisation. These global parameters are Properties associated to the GEOM model through a set of geometrical zones, called "physical" in the Gmsh format or GEOM groups in SPIS-UI. SPIS-UI provides a set of tools to attributes properties to groups (i.e Group Editor) and to deploy these properties on the mesh (i.e MapFields functions and Fields Manager), as illustrated Fig.9.

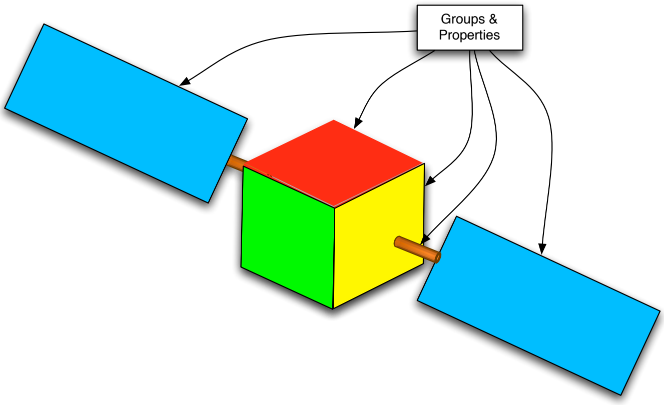


Figure 9: Example of groups and properties setting. The spacecraft will be sub-dived into several "Gmsh Physicals" to which ones, the user can associate properties, using the Group Manager of SPIS-UI. In a second step, these properties are converted into local fields (DataFields) deployed on the mesh and passed to the simulation kernel SPIS-NUN as Initial and Boundary Conditions (IBC).

CAD model, groups edition and settings of local properties is a very delicate and complex phase. This is generally the main source of mistakes or failures in the modelling process. Takes must be done step after step and settings consistent with the mathematical model of the solver. The internal ***TaskManager*** of SPIS-UI must help the user to perform ***Tasks*** in the right order. If a ***Task*** is called in downstream all (*) needed ***Tasks*** in upstream will be called automatically by the ***TaskManager***.

(*) Remark: This is done if all Tasks are linked by an explicit dependence tree and can be automatised. Some ***Tasks***, like as the ***Group Manager*** cannot be done automatically.

2.5.1. CAD model edition and loading

SPIS-UI supports complex geometrical descriptions with a multi CAD files description. To help the CAD files edition and the management of geometry and CAD file, SPIS-UI provides a GEOM Manager, which gathers into a common workspace all relevant CAD files and associated document. Currently SPIS-UI import Gmsh file format only. By clicking on the 🟥 icon, a control frame must appear as illustrated in Fig.10.

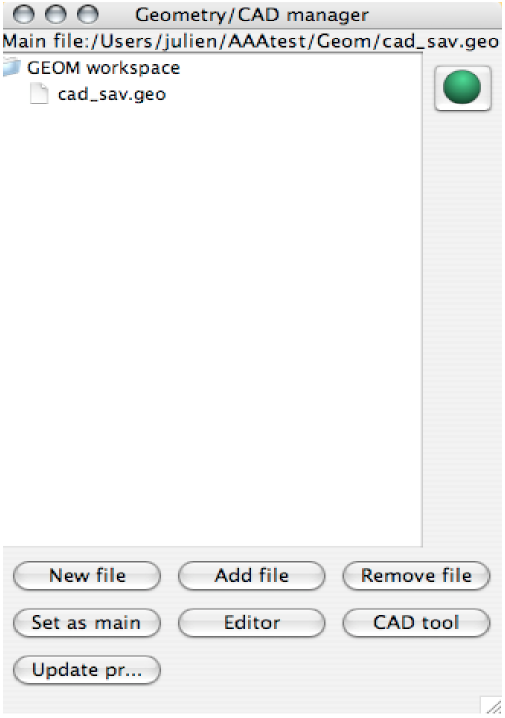


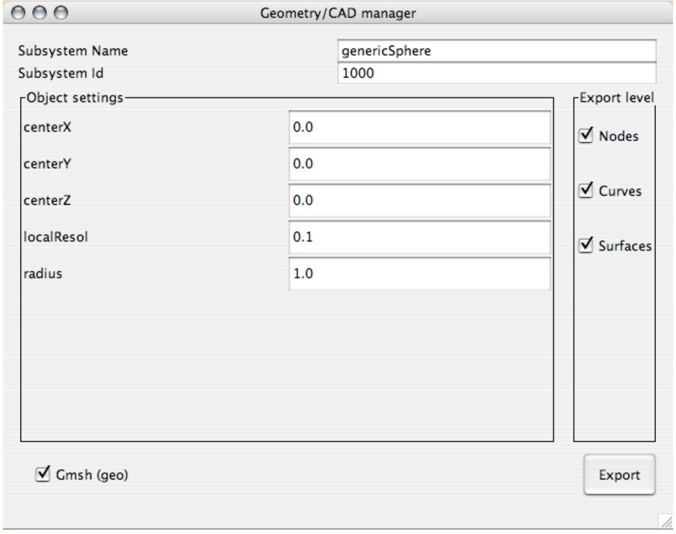
Figure 10: View of the GEOM Manager.

The purpose of the GEOM Manager is to help the user to edit, modify and organise all relevant CAD files of this current project. The **New File** button will create a new empty file. It is then possible to select it in the tree and edit it ether with the default CAD tool, by clicking on the **CAD Tool** button, or with the default ASCII editor, by clicking on the **Editor** button. It is also possible to add an existing CAD file to the workspace by clicking on the **Add File** button.

Important: In the same logic than with Gmsh, the whole geometry can be defined through several CAD files using the Gmsh “include” command in a main file (please se the Gmsh

Technical Documentation for further information). However, SPIS-UI will import only this main file and unrolled the whole structure. For this, you must absolutely defined this file as “main file” for the framework, by selecting the relevant file in the tree and clicking on the **Set As Main** button. This operation must be absolutely done before the loading procedure.

The **Geom Manager** provides also a set of pre-built CAD components. For example, to click on the icon ● will open a GUI for the generation of a pre-built sphere. This sphere can be translated and scaled. This tool does not provide any Boolean operations between generated objects. However, it is possible to export ether nodes or wires only or the whole CAD structure.



Geometry/CAD manager

Subsystem Name genericSphere
Subsystem Id 1000

Object settings
centerX 0.0
centerY 0.0
centerZ 0.0
localResol 0.1
radius 1.0

Export level
☑ Nodes
☑ Curves
☑ Surfaces

☑ Gmsh (geo)

Figure 11: View of the pre-built CAD objects editor (here a pre-built sphere).

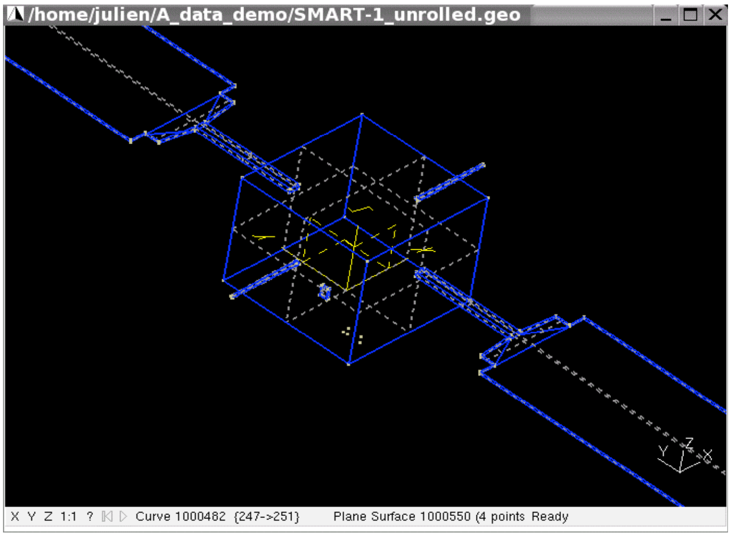

/home/julien/A_data_demo/SMART-1_unrolled.geo
X Y Z 1:1 ? Curve 1000482 {247->251} Plane Surface 1000550 (4 points Ready
Y Z X

Figure 12: Example of CAD geometry, model of the ESA/SMART-1 mission

As introduced above, we outline the fact that several "***Physicals***", in the Gmsh sense, must defined to set all Boundary Conditions (BC) needed by the solver. This generally depends on the system to model and the constraints of the numerical kernel. However, at least, the three following ***Physicals*** must be defined.

Object or zone to be marked	*Type of physicals*
Spacecraft surface	Surface
External boundary of the computational volume	Surface
Computational volume	Volume

For more details regarding the CAD edition, please read the "Gmsh User Tutorial for CAD and Meshing" and the SPIS-NUM Documentation “How to control Num from UI” [6][13].

The edition of the various CAD file will only define the geometry of the system in the workspace of the GEOM manager. At this stage, the CAD structure is not loaded into the framework. At this stage a **Main GEOM File** must be set, with the **Set As Main** button, the corresponding CAD structure must be loaded into the framework by clicking on the LOAD GEOM button.

NB: The GEOM Manager edits and modifies file in is own workspace in the temporary exchange folder of SPIS and not directly files in the project. For this reason, we recommend to update your project regularly by clicking on the **Update Project** button.

2.5.2 Properties edition and loading

In SPIS-UI, the notion of properties corresponds to definition of local parameters, like boundary conditions, used in the definition the model. This includes material, physical and numerical properties. As introduced above, the purpose of the pre-processing part is to attribute these properties to each specific parts of the spacecraft or the computational domain, convert them into fields (i.e DataFields) mapped on the mesh.

A large set of properties is pre-defined in the `$SPIS_ROOT/SpisUI/Modules/Properties` directory and can be loaded by clicking on the icon in the tools bar or through the **Properties->Load Default Properties Catalogue** menu. It is also possible to load individually external properties through the **Properties->Load Default Property** menu. Properties are divided into three categories:

2.5.2 1 Material properties

Material properties define the physical characteristics properties of the material. This includes basic properties like as conductivity or secondary emission factors, but also advanced definition like as the characteristics of a source of particles. Typically these properties are attributed to the spacecraft only. They can be edited and extended using the ***Material Editor*** (menu **Properties** -> **Edit Properties** -> **Material Editor**).

2.5.2 2 Electric properties

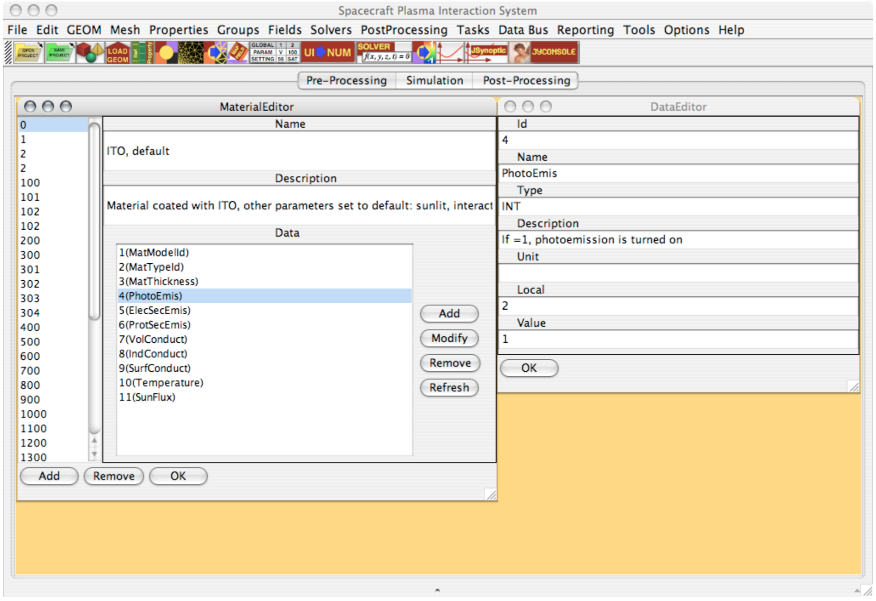
The electric properties are related to the definition of the internal charging balance and, more specifically the attribution of main electric node in the spacecraft model. There setting can be done using the ***ElecNode Editor*** (menu **Properties -> Edit Properties ->**

ElecNode Editor*)*. Typically these properties are attributed to the spacecraft only.

2.5.2 3 Plasma properties

The ***Plasma Properties*** correspond to the numerical setting of boundary and initial condition of the plasma numerical model. Its structure and use is strongly dependent on the used model and its numerical constraints. A wrong definition or attribution of the ***Plasma Properties*** can lead to forbid to run the simulation kernel or to lead to a corrupted simulation. Please read carefully the SPIS-NUM documentation for more details [13]. These properties must be defined for the whole computational domain. They can be edited and extended using the ***Material Editor*** (menu **Properties** -> **Edit Properties** -> **Plasma Editor**). Because they are strongly dependent on the structure of the simulation kernel, we strongly recommend to do not edit them without a deep knowledge of the SPIS-NUM design and models.

All properties can be edited and corrected using the Properties Editor, which can be called with the **Properties->Edit Properties** menu. Fig.13 show an example of property edition.



0
1
2
2
100
101
102
102
200
300
301
302
303
304
400
500
600
700
800
900
1000
1100
1200
1300

Name
ITO, default

Description
Material coated with ITO, other parameters set to default: sunlit, interact

Data
1(MatModelId)
2(MatTypeId)
3(MatThickness)
4(PhotoEmis)
5(ElecSecEmis)
6(ProtSecEmis)
7(VolConduct)
8(IndConduct)
9(SurfConduct)
10(Temperature)
11(SunFlux)

Id
4

Name
PhotoEmis

Type
INT

Description
If =1, photoemission is turned on

Unit

Local
2

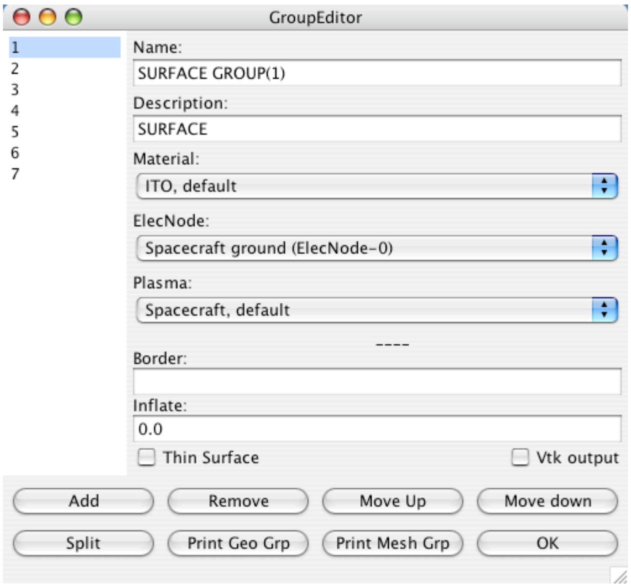
Value
1

Figure 13: Properties Editor.

2.5.3 Groups settings and properties attribution

In order to define the properly the needed IBC, the various properties should be attributed to there respective Physicals in order to build groups of CAD or ***CAD groups***. This should be done using the Group Editor (**Edit Groups** button). Physicals related to the spacecraft require all properties types defined (Materials, Electrical and Plasma). Physicals related to the computational volume and the external boundary require only the Plasma setting only.

Caution: An inconsistent attribution of groups will automatically lead to errors or a crash during the mapping phase or the simulation. The pertinence of the simulation is strongly dependent on a correct definition of groups.



Name: SURFACE GROUP(1)

Description: SURFACE

Material: ITO, default

ElecNode: Spacecraft ground (ElecNode-0)

Plasma: Spacecraft, default

Border:

Inflate: 0.0

□ Thin Surface □ Vtk output

Figure 14: View of Group Editor. This Task is used to set the attribute of each group and the mapping priority. It is also used for the specific pre-processing of 2D thin elements.

The group manager allows also the possibility to re-define the priority in the properties mapping procedure. This is useful for the specific setting of elements owned by two groups. Value finally mapped will correspond to the group of higher priority. In the group manager, the priority is decreasing from the top to the bottom. The priority of a group can be changed using the **Move Up** and **Move Down** buttons. At the loading phase, groups are loaded according to the Ids of their respective Gmsh physicals.

Remark: If the group of volume corresponding to the whole computational domain has the higher priority, its values will be applied everywhere. The BC will then crashed and the system corrupted. The group of volume must always be defined in last. A wrong priority setting can lead to crash or blocking errors during the initialisation phase of the numerical kernel.

The following table gives a minimal and default setting for groups:

Physical	***Material***	***Electric***	***Plasma***
Spacecraft surface	ITO	ElecNode-0	Spacecraft, default
External boundary	None	None	Boundary default
Computational volume	None	None	Plasma Model in Volume, default

Groups can be visualised using the ***Group Viewer*** and **Cassandra** by clicking on the **Groups** -> **Show Groups** menu. A Cassandra viewer will be launched. Each group can be individually displayed by selection in the *View* control panel of Cassandra.

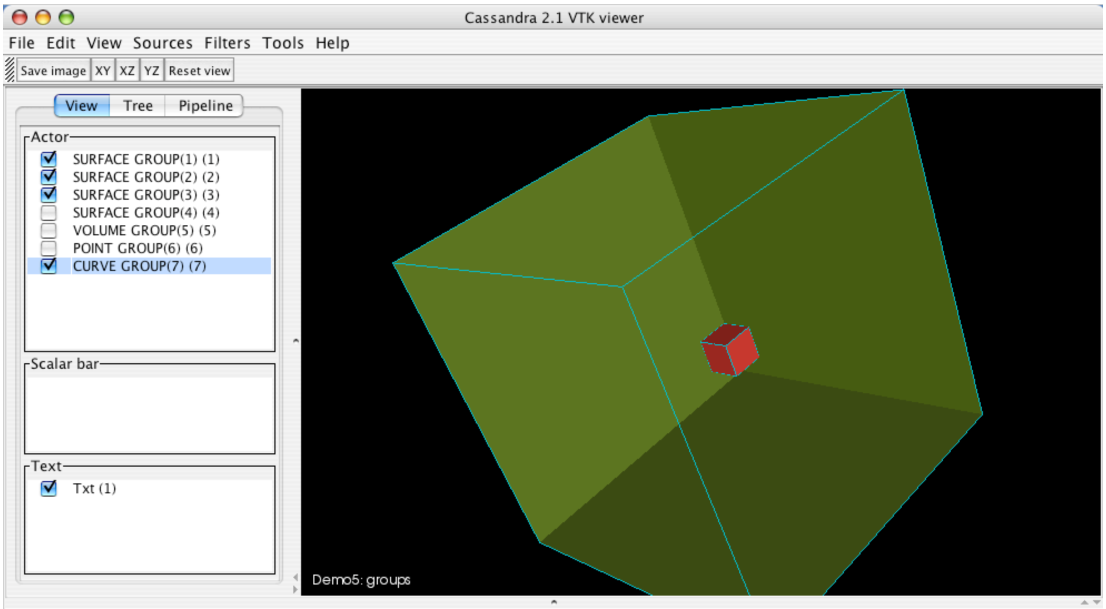


Figure 15: Visualisation of mesh groups with the Cassandra viewer.

2.5.4 Meshing

The quality of the simulation results and the stability of the solver are strongly dependent on the mesh quality. This last one may be dependent on the topology of the inner objects and the physical constraints of the modelled system.

Currently the meshing of performed using Gmsh as external tool. The resulting mesh is then loaded into the internal ***Common Data Bus***. The meshing is done by clicking on the **3D Mesh** button symbolised by the following icon . You can visualise the resulting mesh through Cassandra, selecting the **Mesh->View Mesh** menu in the main menu bar.

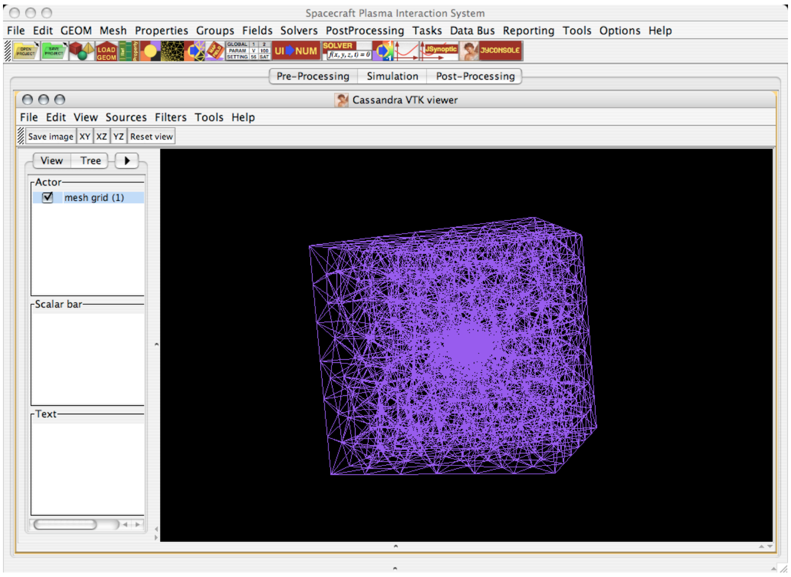

Spacecraft Plasma Interaction System
File Edit GEOM Mesh Properties Groups Fields Solvers PostProcessing Tasks Data Bus Reporting Tools Options Help
Pre-Processing Simulation Post-Processing
Cassandra VTK viewer
File Edit View Sources Filters Tools Help
Save image XY XZ YZ Reset view
View Tree
Actor
☑ mesh grid (1)
Scalar bar
Text

Figure 16: Visualisation of the mesh structure.

2.5.5.Groups conversion and fields mapping

For the correct deployment of local parameters, the ***GEOM groups*** must be converted into ***Mesh Groups*** before. This operation will mark individually each ***Mesh Element*** according to their respective GEOM groups. Marked mesh elements become ***Skeletons*** inside the ***Common Data Bus***. The group conversion is done pushing the icon in the tools bar or through the **Groups->Convert Groups** menu.

This will allow the Mapping of properties related to each group on the whole mesh. The fields mapping itself is done when you push on the icon or through the **Fields->Map** menu. This phase will convert the logical attribution of various properties to each ***Mesh Elements*** into a set of continuous fields properly defined on the whole mesh. These fields are stocked into the ***Common Data Bus*** as ***DataFields***. They can be visualised using the ***DataField Manager*** and the 3D VTK based viewers (Cassandra, Paraview…), as illustrated below.

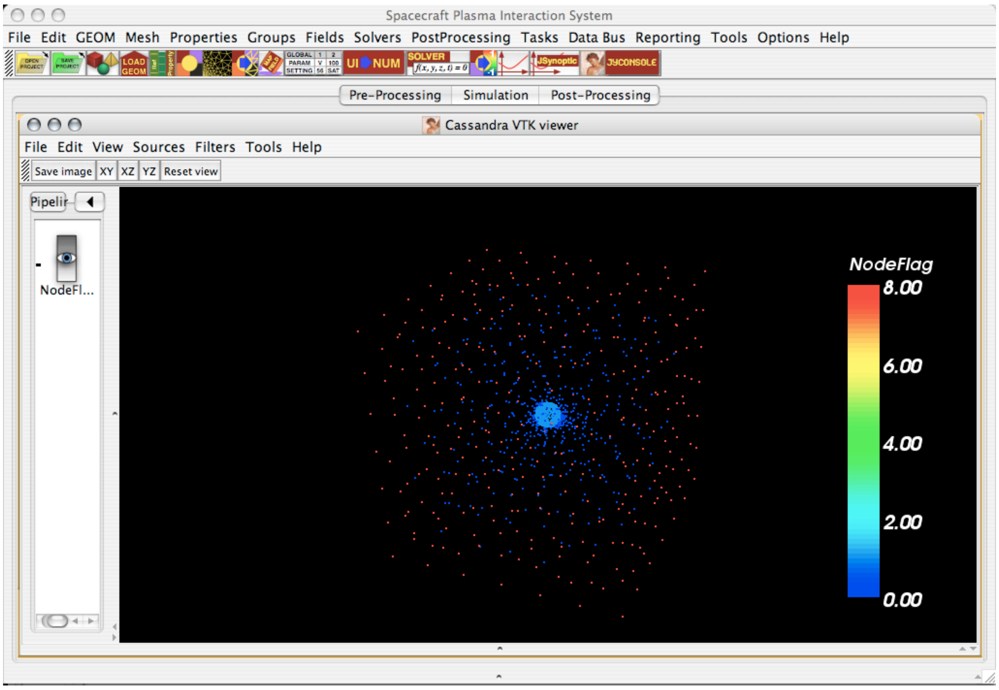
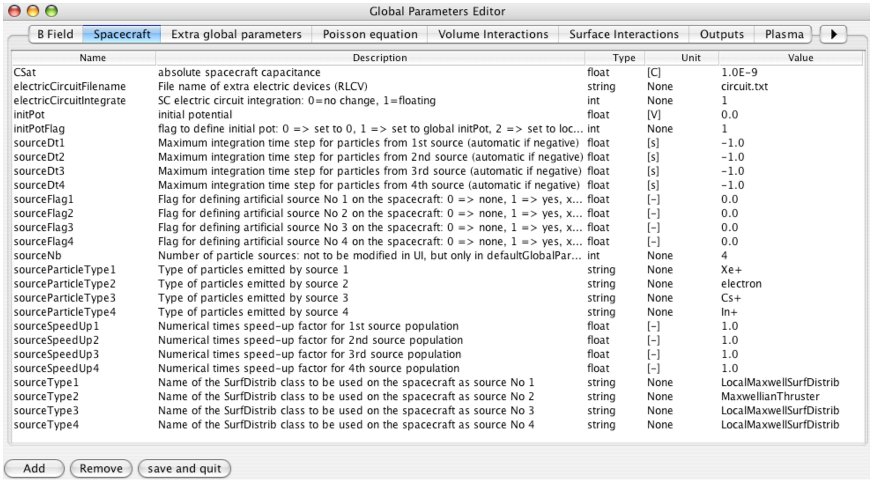


Figure 17: Example of pre-processing DataField after deployment (i.e SPIS-NUM NodeFlag). The value is set according the GEOM groups and the properties initially defined. Here NodeFlag equals 1 on the spacecraft, 0 inside the computational domain and 8 for the external boundary. The mapping is done according to the priorities of groups.

Meshing, group conversion and mapping are linked by the dependence tree of the **Tasks Manager**. Clicking on the button will automatically call the three *Tasks* in the right order.

2.5.6 Global parameters settings

Global Parameters correspond to parameters like global physical values of the space environment (e.g. Temperature) or numerical (e.g. simulation duration). They can set using the ***Global Parameters Editor*** (**Global Parameters Editor** button). Many categories of parameters are defined and available through several indexes and tables. Please see the SPIS-NUM Documentation “How to control Num from UI” [13].

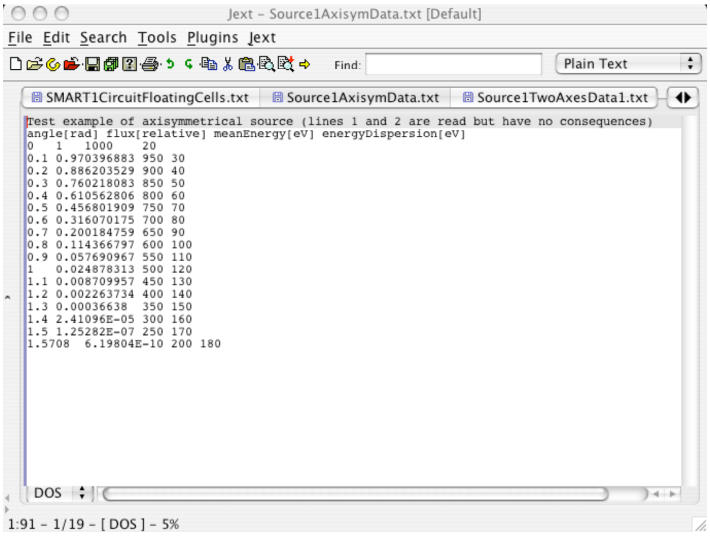


Name	Description	Type	Unit	Value
CSat	absolute spacecraft capacitance	float	[C]	1.0E-9
electricCircuitFilename	File name of extra electric devices (RLCV)	string	None	circuit.txt
electricCircuitIntegrate	SC electric circuit integration: 0=no change, 1=floating	int	None	1
initPot	initial potential	float	[V]	0.0
initPotFlag	flag to define initial pot: 0 => set to 0, 1 => set to global initPot, 2 => set to loc...	int	None	1
sourceDt1	Maximum integration time step for particles from 1st source (automatic if negative)	float	[s]	-1.0
sourceDt2	Maximum integration time step for particles from 2nd source (automatic if negative)	float	[s]	-1.0
sourceDt3	Maximum integration time step for particles from 3rd source (automatic if negative)	float	[s]	-1.0
sourceDt4	Maximum integration time step for particles from 4th source (automatic if negative)	float	[s]	-1.0
sourceFlag1	Flag for defining artificial source No 1 on the spacecraft: 0 => none, 1 => yes, x...	float	[-]	0.0
sourceFlag2	Flag for defining artificial source No 2 on the spacecraft: 0 => none, 1 => yes, x...	float	[-]	0.0
sourceFlag3	Flag for defining artificial source No 3 on the spacecraft: 0 => none, 1 => yes, x...	float	[-]	0.0
sourceFlag4	Flag for defining artificial source No 4 on the spacecraft: 0 => none, 1 => yes, x...	float	[-]	0.0
sourceNb	Number of particle sources: not to be modified in UI, but only in defaultGlobalPar...	int	None	4
sourceParticleType1	Type of particles emitted by source 1	string	None	Xe+
sourceParticleType2	Type of particles emitted by source 2	string	None	electron
sourceParticleType3	Type of particles emitted by source 3	string	None	Cs+
sourceParticleType4	Type of particles emitted by source 4	string	None	In+
sourceSpeedUp1	Numerical times speed-up factor for 1st source population	float	[-]	1.0
sourceSpeedUp2	Numerical times speed-up factor for 2nd source population	float	[-]	1.0
sourceSpeedUp3	Numerical times speed-up factor for 3rd source population	float	[-]	1.0
sourceSpeedUp4	Numerical times speed-up factor for 4th source population	float	[-]	1.0
sourceType1	Name of the SurfDistrib class to be used on the spacecraft as source No 1	string	None	LocalMaxwellSurfDistrib
sourceType2	Name of the SurfDistrib class to be used on the spacecraft as source No 2	string	None	MaxwellianThruster
sourceType3	Name of the SurfDistrib class to be used on the spacecraft as source No 3	string	None	LocalMaxwellSurfDistrib
sourceType4	Name of the SurfDistrib class to be used on the spacecraft as source No 4	string	None	LocalMaxwellSurfDistrib

Figure 18: View of the Global Parameter editor.

2.5.7 Additional parameters of the numerical core

Some numerical kernels request specific and additional parameters, not editable with the global parameter editor, such as the definition of the internal electric circuit. These parameters are defined in text files. They can be edited with the embedded file editor by clicking on the **Solver -> SpisNum -> Edit Additional Param**.


Jext – Source1AxisymData.txt [Default]
File Edit Search Tools Plugins Jext
Find:
Plain Text
SMART1CircuitFloatingCells.txt
Source1AxisymData.txt
Source1TwoAxesData1.txt
DOS
1:91 – 1/19 – [DOS] – 5%

```
Test example of axisymmetrical source (lines 1 and 2 are read but have no consequences)
angle[rad] flux[relative] meanEnergy[eV] energyDispersion[eV]
0   1   1000    20
0.1 0.970396883 950 30
0.2 0.886203529 900 40
0.3 0.760218083 850 50
0.4 0.610562806 800 60
0.5 0.456801909 750 70
0.6 0.316070175 700 80
0.7 0.200184759 650 90
0.8 0.114366797 600 100
0.9 0.057690967 550 110
1   0.024878313 500 120
1.1 0.008709957 450 130
1.2 0.002263734 400 140
1.3 0.00036638  350 150
1.4 2.41096E-05 300 160
1.5 1.25282E-07 250 170
1.5708  6.19804E-10 200 180
```

Figure 19: Edition of additional parameters with the embedded editor (Jext)

2.5.8 Final conversion UI to Num

The last step of the pre-processing procedure is the conversion of fields from the SPIS-UI data structure to the SPIS-NUM one. This Task will also build the corresponding numerical model (see the JyTop4.py script given in Annexe 3).

If a project is properly loaded at the beginning, the UI●NUM button will automatically call the each upstream tasks required to build the model. Error messages at this stage mean that the system definition is incorrect and must be corrected.

2.6. Numerical model generation and control of the simulation kernel

2.6.1 Multi-model approach and simulation process

The simulation runs themselves are performed by the selected numerical kernel. SPIS-UI can integrated and control several numerical kernels, with as default SPIS-NUM. All models are available through the **Solvers** menu. The simulation phase depends on the possibilities offered by the selected kernel. The description below corresponds to the use of SPIS-NUM. With SPIS-NUM, the simulation phase is typically decomposed into four phases:

- **Init solver**, which will instantiates the solver and converts needed data.

- **Build Simulation**, which will build the whole modelling system, including the deployment of the mesh and need local fields (i.e boundary and initial conditions). At the end of this phase, the whole model is built and ready for a new simulation run. According an Object Oriented Approach, this model should be seen as a complete virtual world modelled by SPIS-NUM.

- **Run Simulation** will perform the simulation run with the pre-built model. This step can be run several times, in order to extend the total simulation time.

- **Extract Data** allows the possibility to recover computed data, i.e 3D fields and time dependent data. This action is typically done at the end of the simulation run. However, it can also by done in parallel, to extract regularly updated data during a long simulation run without waiting its issue. Then, the corresponding DataFields can be processed with the DataFieldManager (see next section).

The **Run Solver** button, with the SOLVER $f(x,y,z,t)=0$ icon, will perform the whole simulation process and automatically these four steps.

Please see the SPIS-NUM Documentation “How to control Num from UI” [13].

2.6.2 Simulation daemon and local/remote simulation run

With SPIS-NUM, SPIS-UI (3.7 and higher) offers two different ways to launch the simulation process:

- **As local Internal Task:** In this case, the simulation kernel is launched internally to the framework. The corresponding job is launched in an independent thread (as daemon for the SPIS-UI), in order to do not lock the framework, but in the same JVM. In this approach, the framework keeps a pointer toward the simulation thread, allowing the possibility to dynamically interact with it. In this case, you can regularly extract updated data clicking on the **Solvers->SPIS-NUM->Extract** Data menu. In this approach, the framework should not be closed before the end of the simulation.

This approach is useful for small and medium size modelled systems (e.g typically less than 2.10^5 mesh elements) and during a prototyping phase. For large systems, the cost of the numerical kernel and deployed fields may become prohibitive and slow-down the framework or overtake the memory limits of your system.

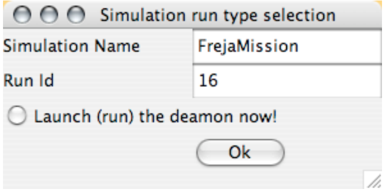
Remark: Thanks to the multi-thread based design of SPIS-UI, on multi-processors/multi-core computers, the simulation thread is generally run on another node than one used for the framework.

- As External Job or OS based daemon: In this approach, SPIS-UI generates a simulation launching script, called spisSimlationDeamonForXXXOnRunYYY.py, corresponding to the UI-NUM and Run Solver tasks. These scripts are stored in the root directory of the current project. They can be run independently by SPIS-UI in batch mode as follow:

```
./spis_tasks_gui.sh $PROJECT_DIR_PATH/spisSimulationDeamonForyyyyOnRun8.py
```

As illustrated below, SPIS-UI can also directly run this script, just by checking the relevant check-box. In this case, you can quite the framework without stopping the simulation run.

The SPIS simulation daemon will extract the data as usual and save them in its related project. Data and results can then processed "*a posteriori*" just opening the project and loading the mesh structure and all data fields.



Simulation Name: FrejaMission

Run Id: 16

○ Launch (run) the deamon now!

Figure 20: Settings of the simulation daemon. A simulation name and a run number (Id) must be defined. It is possible to launch directly the daemon or not.

The daemon approach allows also the possibility to run large simulations on a remote computer. We recommend the follow approach:

A. Build and model the system locally in graphical mode with SPIS-UI;

B. Test the modelled system in interactive mode (i.e Internal Task) with a small system and short simulation duration;

C. Set the real mesh size and all parameters, like simulation duration, for the realistic run and generate the simulation daemon without launching it;

D. Tar or zip your project directory and copy it to your remote computer;

E. Untar or unzip you project on your remote computer;

F. Run the daemon in batch mode on your remote computer, as described above.

Remark: Naturally, the SPIS system must be installed on the remote computer too. Data and results can be recovered through the project as usual.

2.6.3 Dynamic edition and reloading of numerical kernels

Thanks to its modular structure and introspection capability, SPIS-UI offers the specific feature to allows a dynamical edition and reloading of your numerical kernel, without restarting the whole framework.

At any time during the modelling process, you can edit, modify and recompile your Java simulation kernel and reload it dynamically with the **Solvers->SPIS-NUM->Reload Solver** menu.

2.6.4 Others parameters and settings

To edit additional parameters of SPIS-NUM, such as internal circuit or source definitions, please click on the Solvers->SPIS-NUM->Edit Additional Param menu. This will open the embeded editor (Jext) [10]. Modified files must be saved individually.

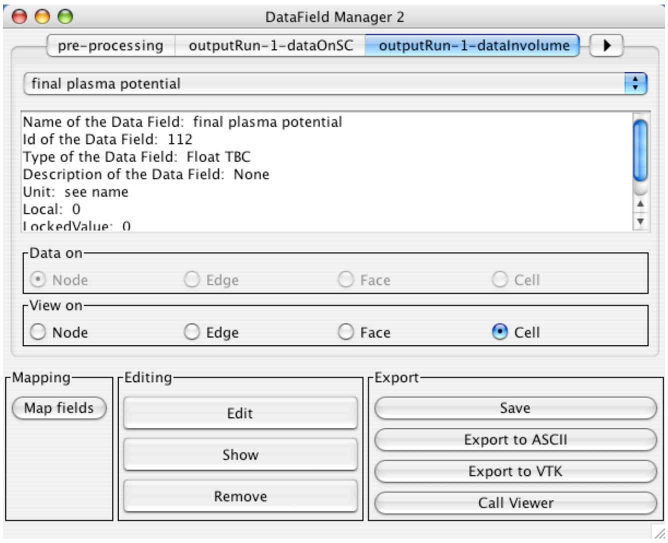
2.7. Post-processing and data analysis

2.7.1 3D Data analysis

All 3D ***DataFields*** can be converted into VTK unstructured data sets (see VTK page). This approach allows a very large set of post-processing pipelines and tools.

2.7.1 1 DataFields Manager and grid conversion

The ***DataFields*** conversion is done using the ***DataFields Manager*** (**Fields -> DataFields Manager** menu). You can select a ***DataField*** by the combo box. Several data and information are directly displayed.



Name of the Data Field: final plasma potential
Id of the Data Field: 112
Type of the Data Field: Float TBC
Description of the Data Field: None
Unit: see name
Local: 0
LockedValue: 0

Data on: ● Node ○ Edge ○ Face ○ Cell

View on: ○ Node ○ Edge ○ Face ● Cell

Figure 21: View of DataField Manager used to display and convert DataFields for the post-processing.

The DataField Manager allows to visualise, edit and convert the DataFields. DataFields are organised in various categories, available through a set of indexes. The **Show** action will print the values and the Id of the mesh elements associated to the DataFields.

Because the localisation on the computational grid and the type 3D representation may be different, a cell type conversion is needed. For instance, the potential computed on nodes (localisation 0) but must be displayed as continuous field on cells (localisation 3) with a linear interpolation between nodes. The DataField Manager performs these conversions. The table below summaries the possible conversions.

DimOu ***DimIn***	0	1	2	3
0	OK			
1	OK	OK		
2	OK		OK	
3	OK			OK

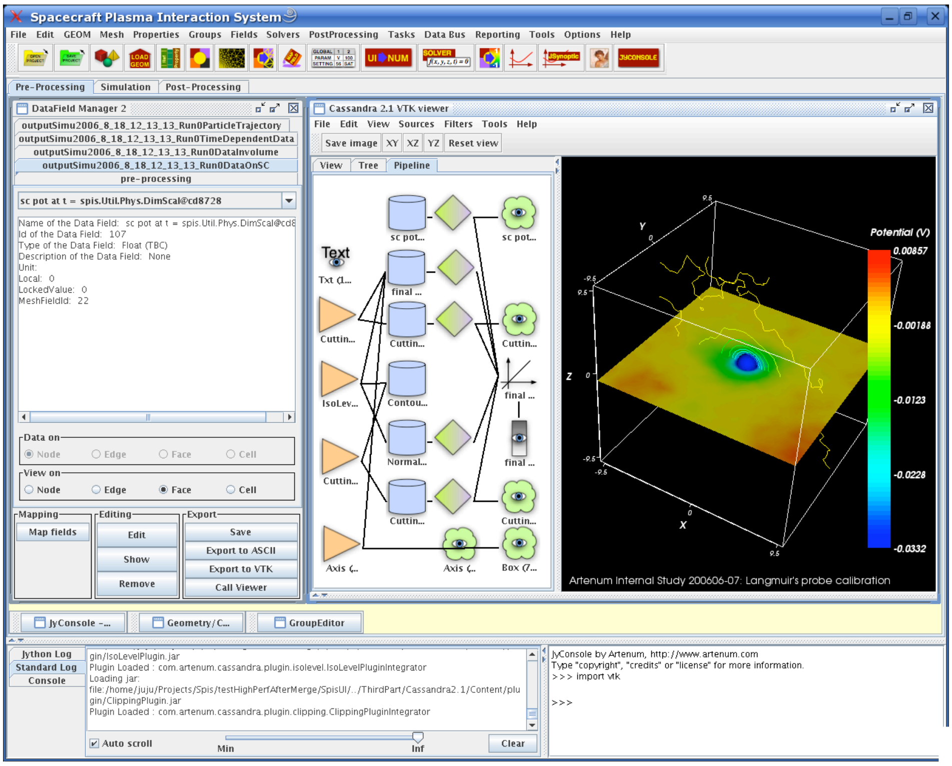
The conversion into VTK unstructured data set is done by selection of the corresponding radio box and clicking on the **Export to VTK** button. This will build the VTK data set and load it into the **Common Data Bus**. Output files are temporary saved into the exchange temporary directory. VTK outputs are saved into the project, when this last one is saved. Click on the **Call Viewer** button to launch the **Cassandra** viewer. To load the converted data, in **Cassandra**, open the **File** -> **Open** menu and select the VTK file corresponding to converted data.

Remark: The export of particles trajectories into VTK format is direct by clicking on the **Export to VTK** button and does not need any cell or data structure conversion. In this case, it is not necessary to select a visualisation cell type.

2.7.1 2 3D data analysis and visualisation tools

SPIS-UI provides several 3D viewers. The 3D viewers are available through the menu **Post-processing -> 3D View**. The basic SpisViewer is now deprecated and not used anymore. Please use Cassandra or Paraview instate of the old SpisViewer.

Fig. 20 shows an example of post-processing data (Final plasma potential) displayed with Cassandra. An example of post-processing is displayed with two cutting planes and an iso-level treatment.


Spacecraft Plasma Interaction System
File Edit GEOM Mesh Properties Groups Fields Solvers PostProcessing Tasks Data Bus Reporting Tools Options Help
Pre-Processing Simulation Post-Processing
DataField Manager 2
Cassandra 2.1 VTK viewer
File Edit View Sources Filters Tools Help
Save image XY XZ YZ Reset view
View Tree Pipeline
Potential (V)
0.00857
-0.00188
-0.0123
-0.0228
-0.0332
Artenum Internal Study 200606-07: Langmuir's probe calibration
Data on ● Node ○ Edge ○ Face ○ Cell
View on ○ Node ○ Edge ● Face ○ Cell
Mapping Map fields
Editing Edit Show Remove
Export Save Export to ASCII Export to VTK Call Viewer
JyConsole -... Geometry/C... GroupEditor
Jython Log Standard Log Console
☑ Auto scroll Min Inf Clear

outputSimu2006_8_18_12_13_13_Run0ParticleTrajectory
outputSimu2006_8_18_12_13_13_Run0TimeDependentData
outputSimu2006_8_18_12_13_13_Run0DataInvolume
outputSimu2006_8_18_12_13_13_Run0DataOnSC
pre-processing

sc pot at t = spis.Util.Phys.DimScal@cd8728

```
Name of the Data Field:  sc pot at t = spis.Util.Phys.DimScal@cd8
Id of the Data Field:  107
Type of the Data Field:  Float (TBC)
Description of the Data Field:  None
Unit:
Local:  0
LockedValue:  0
MeshFieldId:  22
```

```
gin/IsoLevelPlugin.jar
Plugin Loaded : com.artenum.cassandra.plugin.isolevel.IsoLevelPluginIntegrator
Loading jar:
file:/home/juju/Projects/Spis/testHighPerfAfterMerge/SpisUI/../ThirdPart/Cassandra2.1/Content/plu
gin/ClippingPlugin.jar
Plugin Loaded : com.artenum.cassandra.plugin.clipping.ClippingPluginIntegrator
```

```
JyConsole by Artenum, http://www.artenum.com
Type "copyright", "credits" or "license" for more information.
>>> import vtk

>>>
```

Figure 22: Example of data displayed with Cassandra in post-processing phase.

Please see the Cassandra tutorial for further information regarding 3D data analysis and post-processing [9].

2.7.2 2D data analysis tools and plotters

SPIS-UI provides two different viewers for Y=f(x) type data, like as time dependent data.

The internal 2D viewer (icon) is useful for standard and quick visualisation. Clicking with the right button of the mouse will open a contextual menu of setting of plot aspect and printing functions. Fig.21 shows a few examples of curves displayed with the 2D plot module.

For more advanced processing, the **JSynoptic** module can be used. JSynoptic can be called just by clicking on the **JSynoptic** button in the tools bar. For more details, please see the JSynoptic documentation [11].

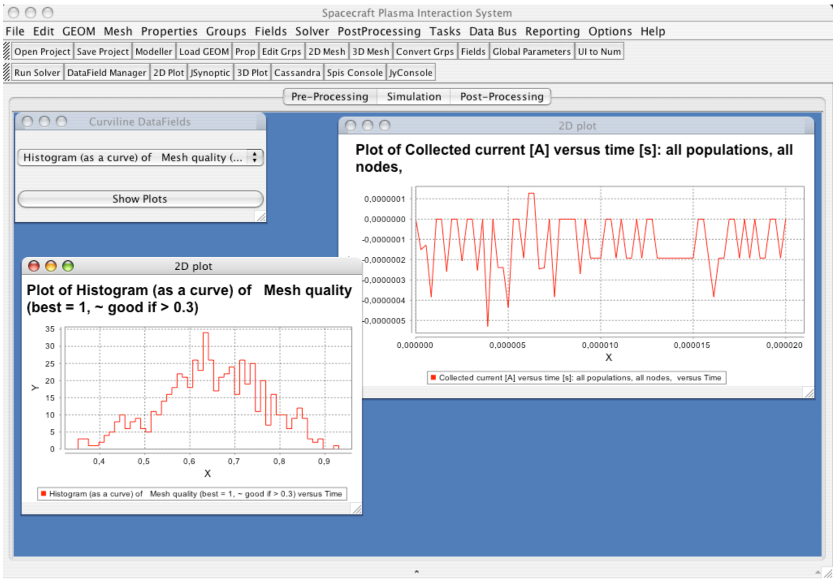

Spacecraft Plasma Interaction System
File Edit GEOM Mesh Properties Groups Fields Solver PostProcessing Tasks Data Bus Reporting Options Help
Open Project | Save Project | Modeller | Load GEOM | Prop | Edit Grps | 2D Mesh | 3D Mesh | Convert Grps | Fields | Global Parameters | UI to Num
Run Solver | DataField Manager | 2D Plot | JSynoptic | 3D Plot | Cassandra | Spis Console | JyConsole
Pre-Processing | Simulation | Post-Processing
Curviline DataFields
Histogram (as a curve) of Mesh quality (...
Show Plots
2D plot
Plot of Collected current [A] versus time [s]: all populations, all nodes,
0,0000001
0,0000000
-0,0000001
-0,0000002
-0,0000003
-0,0000004
-0,0000005
0,000000
0,000005
0,000010
0,000015
0,000020
X
Collected current [A] versus time [s]: all populations, all nodes, versus Time
2D plot
Plot of Histogram (as a curve) of Mesh quality (best = 1, ~ good if > 0.3)
35
30
25
20
15
10
5
0
Y
0,4
0,5
0,6
0,7
0,8
0,9
X
Histogram (as a curve) of Mesh quality (best = 1, ~ good if > 0.3) versus Time

Figure 23: Visualisation of y = f(x) type curves with the simple 2D plot module.

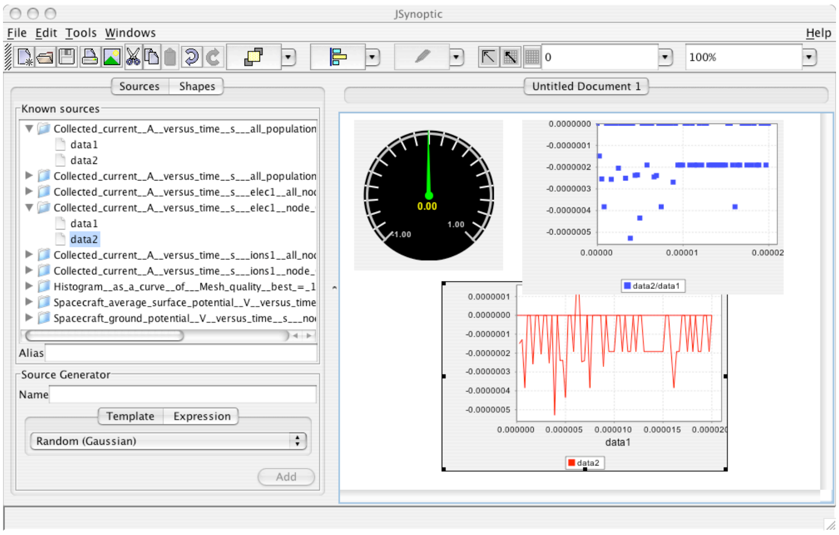
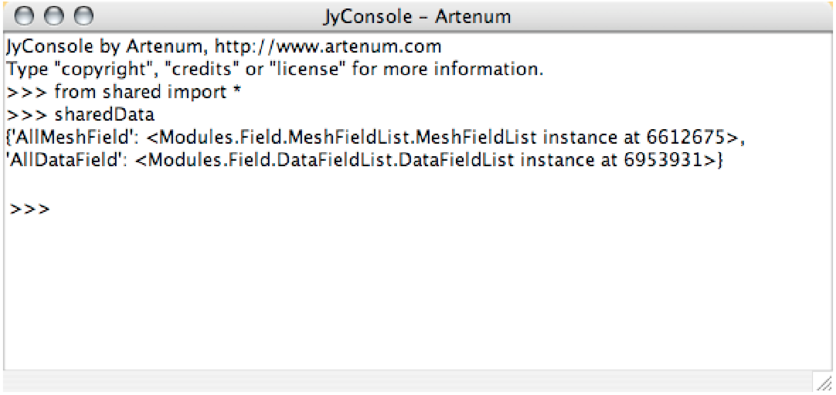

JSynoptic
File Edit Tools Windows
Help
0
100%
Sources | Shapes
Untitled Document 1
Known sources
Collected_current__A__versus_time__s___all_population
data1
data2
Collected_current__A__versus_time__s___all_population
Collected_current__A__versus_time__s___elec1__all_noc
Collected_current__A__versus_time__s___elec1__node_
data1
data2
Collected_current__A__versus_time__s___ions1__all_noc
Collected_current__A__versus_time__s___ions1__node_
Histogram__as_a_curve__of___Mesh_quality__best_=_1
Spacecraft_average_surface_potential__V__versus_time
Spacecraft_ground_potential__V__versus_time__s___no
Alias
Source Generator
Name
Template | Expression
Random (Gaussian)
Add
0.00
-1.00
1.00
0.0000000
-0.0000001
-0.0000002
-0.0000003
-0.0000004
-0.0000005
0.00000
0.00001
0.00002
data2/data1
0.0000001
0.0000000
-0.0000001
-0.0000002
-0.0000003
-0.0000004
-0.0000005
0.000000
0.000005
0.000010
0.000015
0.000020
data1
data2

Figure 24: Visualisation of y=f(x) type curves with the JSynoptic module.

2.8. Other tools

2.8.1 Tasks and Data Bus management

SPIS-UI provides a *Common Data Bus* to share all data between the various tasks. This Common Data Bus can be browsed and edited through the JyConsole as illustrated in Fig.25. This allows to directly edit, modify or remove each data present in the Common Data Bus. More information about JyConsole is available on the JyConsole Web site [7].



```
JyConsole by Artenum, http://www.artenum.com
Type "copyright", "credits" or "license" for more information.
>>> from shared import *
>>> sharedData
{'AllMeshField': <Modules.Field.MeshFieldList.MeshFieldList instance at 6612675>,
'AllDataField': <Modules.Field.DataFieldList.DataFieldList instance at 6953931>}

>>>
```

Figure 25: use of JyConsole to access to the shared data in the Common Data Bus.

The **Data Bus Manager** allows a simple access to the data, especially if you wish to remove some of items, in order to partially reset the framework. The **Data Bus Manager** is available from the **Data Bus** -> **Clean Data Bus** menu. An index is generated for each dictionary of the Data Bus. To reset a given data, please select it and click on the **Clean** button.

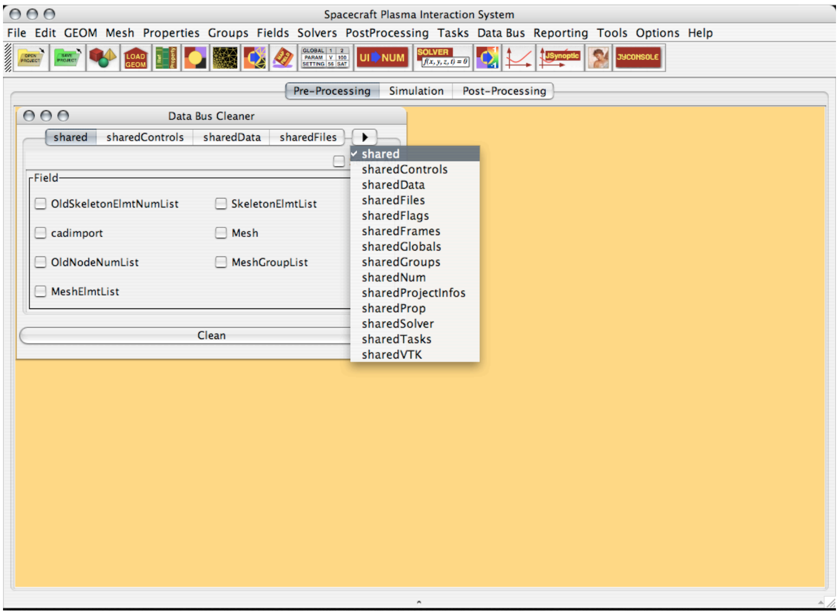


Figure 26: View of the Data Bus Cleaner

2.8.2 Controllers and loggers

SPIS-UI provides a *set of loggers like a memory logger to observe the memory cost evolution*. The memory monitor is available through the **Tools->Memory** Monitor menu. Please take care with this function that can become costly in memory and CPU resources.

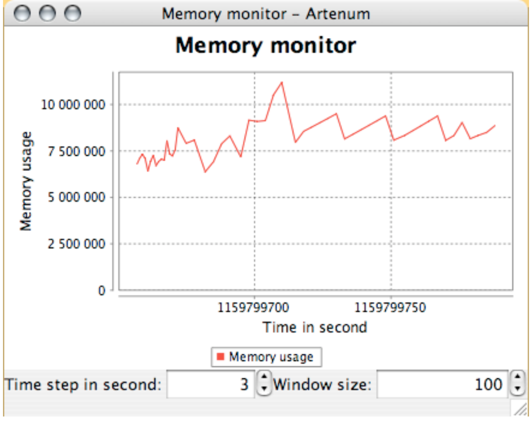
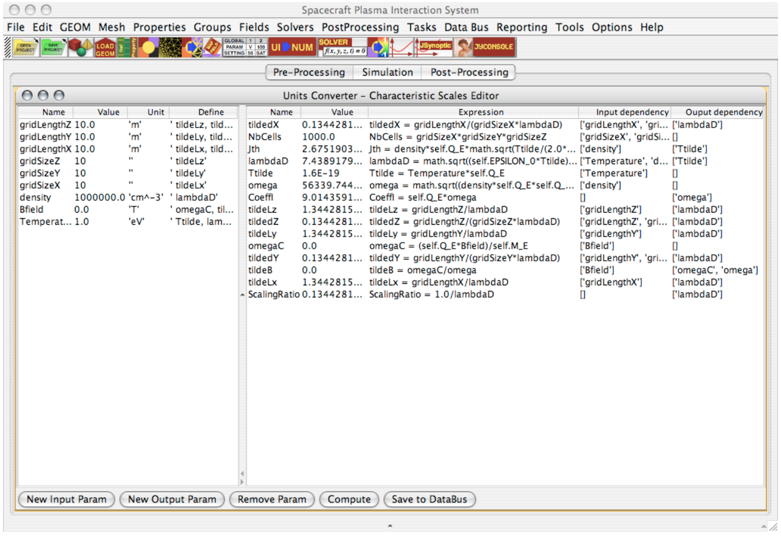


Figure 27: Example of monitors and loggers, the memory monitor. This monitor is useful to control the memory cost of large simulations.

2.8.3 Text editor and units converter

SPIS-UI includes an embedded multi-OS editor, based on the open-source project Jext. This editor can be used to edit and modify SPIS itself (scripts and source codes) and/or data and projects. The embedded editor can be called through the **Edit->File** Editor menu. Please see the TN 4.0 Developer’s manual for further information [4].

SPIS-UI provides also a unit converter, able to compute the characteristic scale of your plasma. This module performs the unit conversion between the SI system and the dimensionless units system of PicUp3D project [12]. This module is still experimental and can be modified without notification.



Name	Value	Unit	Define
gridLengthZ	10.0	'm'	' tildeLz, tild...
gridLengthY	10.0	'm'	' tildeLy, tild...
gridLengthX	10.0	'm'	' tildeLx, tild...
gridSizeZ	10	''	' tildeLz'
gridSizeY	10	''	' tildeLy'
gridSizeX	10	''	' tildeLx'
density	1000000.0	'cm^-3'	' lambdaD'
Bfield	0.0	'T'	' omegaC, til...
Temperat...	1.0	'eV'	' Ttilde, lam...

Name	Value	Expression	Input dependency	Ouput dependency
tildedX	0.1344281...	tildedX = gridLengthX/(gridSizeX*lambdaD)	['gridLengthX', 'gri...	['lambdaD']
NbCells	1000.0	NbCells = gridSizeX*gridSizeY*gridSizeZ	['gridSizeX', 'gridSi...	[]
Jth	2.6751903...	Jth = density*self.Q_E*math.sqrt(Ttilde/(2.0*...	['density']	['Ttilde']
lambdaD	7.4389179...	lambdaD = math.sqrt((self.EPSILON_0*Ttilde)...	['Temperature', 'd...	['Ttilde']
Ttilde	1.6E-19	Ttilde = Temperature*self.Q_E	['Temperature']	[]
omega	56339.744...	omega = math.sqrt((density*self.Q_E*self.Q_...	['density']	[]
Coeffl	9.0143591...	Coeffl = self.Q_E*omega	[]	['omega']
tildeLz	1.3442815...	tildeLz = gridLengthZ/lambdaD	['gridLengthZ']	['lambdaD']
tildedZ	0.1344281...	tildedZ = gridLengthZ/(gridSizeZ*lambdaD)	['gridLengthZ', 'gri...	['lambdaD']
tildeLy	1.3442815...	tildeLy = gridLengthY/lambdaD	['gridLengthY']	['lambdaD']
omegaC	0.0	omegaC = (self.Q_E*Bfield)/self.M_E	['Bfield']	[]
tildedY	0.1344281...	tildedY = gridLengthY/(gridSizeY*lambdaD)	['gridLengthY', 'gri...	['lambdaD']
tildeB	0.0	tildeB = omegaC/omega	['Bfield']	['omegaC', 'omega']
tildeLx	1.3442815...	tildeLx = gridLengthX/lambdaD	['gridLengthX']	['lambdaD']
ScalingRatio	0.1344281...	ScalingRatio = 1.0/lambdaD	[]	['lambdaD']

Figure 28: View of the experimental units converter (PicUp3D 3.0 project).

2.8.4 Configuration and online help

By default, all configurations variables are set to work with the provided third part components, including VTK and JVMs. However, if you wish set the framework for a specific platform, e.g optimised VTK installation or additional modules, you must edit:

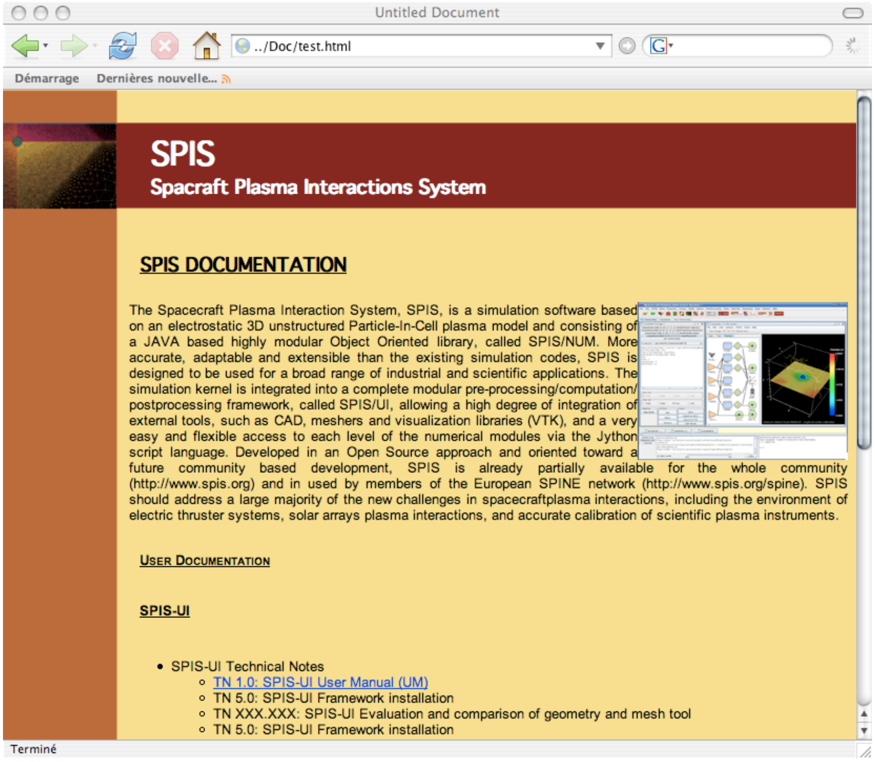
• `$SPIS_ROOT/Bin/config.py` file: This file set the path toward external tools such as the Gmsh modeller.

• Launching scripts spis_task_gui.sh and spis_task_gui.sh : These scripts set all path and environment variable depending on the OS.

Please make a copy of these files before any modifications. Please see the TN 4.0 Developer's manual for further information.

An online help is available through the Help->Online help. This will call you Web browser and open the main documentation page. This page will give you access to whole documentation (User Manual, Developer Manual, Technical Notes, How-to, API...) and to the LibreSource platform of the SPINE community.

Further information are available from the SPINE community Web site at the following address: http://www.spis.org



SPIS
Spacraft Plasma Interactions System

SPIS DOCUMENTATION

The Spacecraft Plasma Interaction System, SPIS, is a simulation software based on an electrostatic 3D unstructured Particle-In-Cell plasma model and consisting of a JAVA based highly modular Object Oriented library, called SPIS/NUM. More accurate, adaptable and extensible than the existing simulation codes, SPIS is designed to be used for a broad range of industrial and scientific applications. The simulation kernel is integrated into a complete modular pre-processing/computation/postprocessing framework, called SPIS/UI, allowing a high degree of integration of external tools, such as CAD, meshers and visualization libraries (VTK), and a very easy and flexible access to each level of the numerical modules via the Jython script language. Developed in an Open Source approach and oriented toward a future community based development, SPIS is already partially available for the whole community (http://www.spis.org) and in used by members of the European SPINE network (http://www.spis.org/spine). SPIS should address a large majority of the new challenges in spacecraftplasma interactions, including the environment of electric thruster systems, solar arrays plasma interactions, and accurate calibration of scientific plasma instruments.

USER DOCUMENTATION

SPIS-UI

- SPIS-UI Technical Notes
  - TN 1.0: SPIS-UI User Manual (UM)
  - TN 5.0: SPIS-UI Framework installation
  - TN XXX.XXX: SPIS-UI Evaluation and comparison of geometry and mesh tool
  - TN 5.0: SPIS-UI Framework installation

Figure 29: View of the main page of the documentation.

3 Step-by-Step how-to-drive a modelling process?

A modelling process in SPIS can be typically decomposed as follow, with no pre-existing project:

1. Create a CAD model with Gmsh, as independent tool or as integrated module. During this phase, you must defined at least three physical to define the both boundaries (inner and external) and the computational domain.
2. Load the CAD structure into the framework.
3. Set the properties, initial conditions and boundary conditions with the groups editor.
4. Mesh the computational domain using the meshing module.
5. Convert the groups and deploy the fields on the mesh.
6. Set the global parameters.
7. Convert the structure and inputs to the SPIS-NUM format
8. Perform the simulation
9. Extract and analyse the outputs results.

The Task Manager should help the user to follow this process by automatically calling for each task called by the user, all previous tasks needed for the data consistency.

4 Advanced use

4 1. Data structure, DataFields and MeshFields

Fields are stored into object oriented generic structure called DataFields. For each instance, i.e field, this class will define a name, a localisation on the cell (see below), the type of field (i.e scalar, vectors), a unit, an optional comment, an array of values and the reference to a MeshFields. The MeshField is the sub-set of the computational mesh on which one the DataField is deployed. In order to optimise the memory cost, several DataFields can refer to a same MeshField.

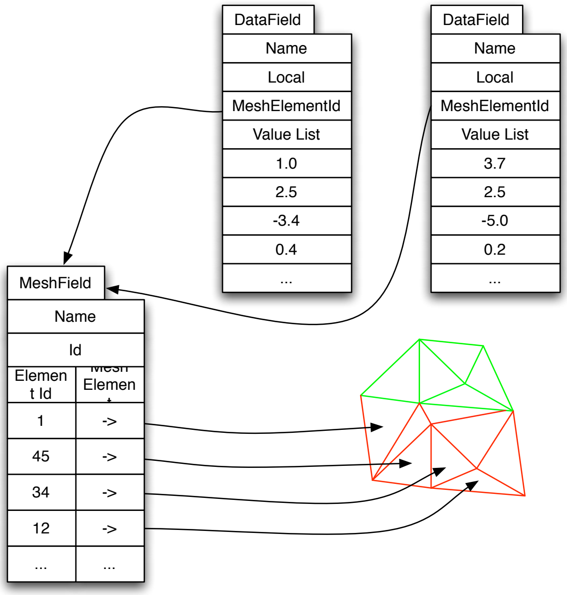
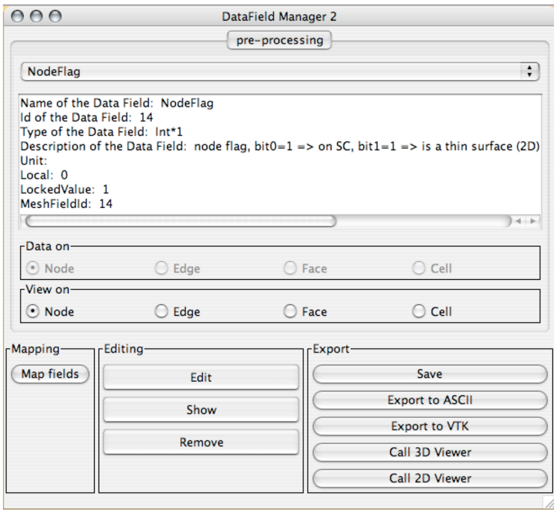


Figure 30: Principle of DataFields and MeshField.

Localisation flag	Localisation
0	Node
1	Edge
2	Face
3	Cell
4	Curvi (e.g time dependant)
5	Trajectories

DataFields and MeshFields are stored in the **Common Data Bus** and are available all the time along the modelling process. The **DataField Manager** offers a simple way to access to them and to plots their values.



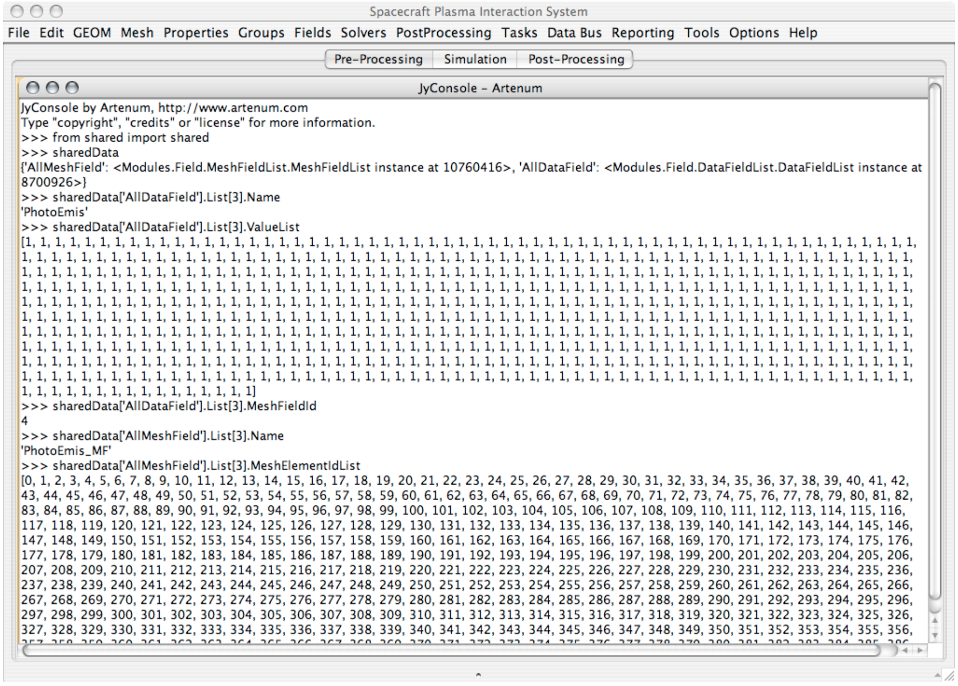
```
Name of the Data Field:  NodeFlag
Id of the Data Field:  14
Type of the Data Field:  Int*1
Description of the Data Field:  node flag, bit0=1 => on SC, bit1=1 => is a thin surface (2D)
Unit:
Local:  0
LockedValue:  1
MeshFieldId:  14
```

Data on: ● Node ○ Edge ○ Face ○ Cell

View on: ● Node ○ Edge ○ Face ○ Cell

Figure 31: View of the DataFields Manager.

For more advanced use we recommend to you the Python console and directly access to the data. All DataFields are stored in the sharedData dictionary of the Bin.Task.shared module. The screen shot below show to access to the DataFields using JyConsole.


Spacecraft Plasma Interaction System
File Edit GEOM Mesh Properties Groups Fields Solvers PostProcessing Tasks Data Bus Reporting Tools Options Help
Pre-Processing
Simulation
Post-Processing
JyConsole – Artenum

```
JyConsole by Artenum, http://www.artenum.com
Type "copyright", "credits" or "license" for more information.
>>> from shared import shared
>>> sharedData
{'AllMeshField': <Modules.Field.MeshFieldList.MeshFieldList instance at 10760416>, 'AllDataField': <Modules.Field.DataFieldList.DataFieldList instance at
8700926>}
>>> sharedData['AllDataField'].List[3].Name
'PhotoEmis'
>>> sharedData['AllDataField'].List[3].ValueList
[1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
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1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]
>>> sharedData['AllDataField'].List[3].MeshFieldId
4
>>> sharedData['AllMeshField'].List[3].Name
'PhotoEmis_MF'
>>> sharedData['AllMeshField'].List[3].MeshElementIdList
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42,
43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82,
83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116,
117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146,
147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176,
177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206,
207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236,
237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266,
267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296,
297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326,
327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356,
```

Figure 32: Access to the DataFields and MeshField using JyConsole.

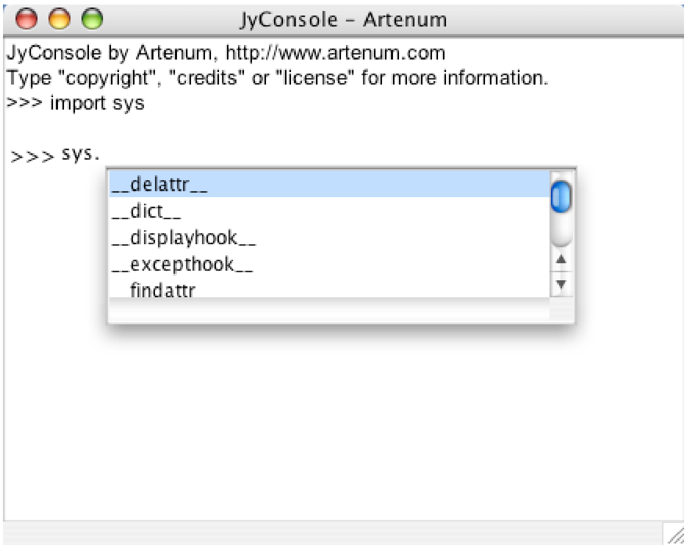
4 2. Handling objects and data from the console

All objects shared in the SPIS-UI framework are seen as Jython or Java objects independently of there initial languages. They are built in a common naming space and can be manipulated directly as simple instances of objects through the Jython console (Jyconsole console) included in SPIS-UI.

4 2.1 Jython completion

With respect to the standard Jython console, ***JConsole*** offers an object-oriented completion. This functionality allows an easy handling Jython and Java modules and objects present in the framework.

The completion is available by pressing together the CTR+SPACE keys. An internal window appears must appear. All objects already present in the framework are displayed. The illustration bellow displays this situation. You may choose that object you want just by selection. The corresponding object will appear in the Jython console and can be directly manipulated.



```
JyConsole by Artenum, http://www.artenum.com
Type "copyright", "credits" or "license" for more information.
>>> import sys

>>> sys.
```

Figure 33: Illustration of the object oriented completion capabilities of JyConsole.

The completion can be performed on both Jython and Java language. This includes also native languages wrapped in Java. Be careful, the result depends if the word correspond to a module or a class (in this case only the function members are retuned or if the word corresponds an instantiating of this class. In this last case, on the field members are returned.

4 2.2 Task building and execution

It is fully possible to launch all type of pre-defined tasks through the SPIS console. You only needed to choose a task with the Jython completion for example, built an instance of it as any type of Jython object and execute it with the run_task() method. The following example shows how to launch a Cassandra viewer through the Console:

```
>>> cas = TaskCallCassandra(Task)
>>> cas.run_task()
```

We must observe that the TaskCallCassandra constructor needs the Task object as parameter, because it is derived from this last one. The same approach can be use for Java based objects. Because the resulting instance is an independent thread, the completion gives all methods of the Python thread. The figure bellow shows the corresponding result.

The method described above instantiates and run directly tasks and modules without taking into account the dependence tree. However, tasks can be performed according the dependence tree using the *TaskManager* and passing in argument the keyword corresponding to the call task, as follow:

```
>>> from Bin.Taks.shared import sharedTasks
>>> sharedTasks['manager'].run_tasks('CADImporter')
```

For more detail, please see the SPIS-UI TN 4.0 Developer Guide [4].

4 2.3 Manual configuration, execution and manipulation of the SPIS-NUM kernel

The same approach can be used to set, launch and manipulate directly the solver after the pre-processing phase. This technique might be useful to build and try models and new types of simulation. The typical approach is the following one:

1. Load a project or a CAD object and define all elements needed to define the simulation (properties, groups...)
2. Maps all needed fields and define the global parameters
3. Convert the structures from UI to NUM by clicking on the corresponding button of the task bar or the Solver -> Convert UI to Num menu.
4. Load all needed fields into the data structures of SPIS-NUM using the Solver -> Init Solver menu.
5. Build the grids using the Solver -> Build Simulation menu.

At this level, all data needed by the simulation are built and stocked in the sharedSolver['jytop'] object of the data bus. It is useful to create a dummy variable to manipulate these data more easily.

```
>>> theTop = sharedSolver['jytop']
```

All fields are members of this object and can be handle using the completion.

To create a new simulation kernel, you need to import the corresponding Java class as follow:

```
>>> from spis.Top.Simulation import *
```

Path to the various inputs files might be also necessary:

```
>>> import Bin.config
>>> from Bin.config import GL_EXCHANGE, GL_DEFAULT_INPUT_PATH, GL_DATA_PATH
```

The simulation object can be now built and initialised, as follow, for example:

```
>>> theTop.simu = SimulationFromUIParams( theTop.volMesh,\
                                            theTop.bdSurfMesh,\
                                            theTop.scSurfMesh,\
                                           theTop.globalParameterArray,\
                                          theTop.localParameterArray,\
                                          GL_DATA_PATH,\
                                                    GL_DEFAULT_INPUT_PATH)
```

The detailed syntax depends on the constructor. This object can be manipulated link the corresponding Java object. The execution of the simulation loop is simply done as follow:

```
>>> theTop.simu.integrate()
```

After creation of the simulation object, it is possible at each step to recover at each step all data and generate the output DataFields just by clicking on the **Solver->Solver-> ExtractData** menu and using the DataField manager, as usual.

4 2.4 Automatic processes, use of the SPIS-UI tablatures

SPIS-UI tablature or scenarios can be run in two manners:

1) **As script in a JyConsole**: To load a script through JyConsole, you can use the classic import command of Python or click in the area of this console with the right button of your mousse. A contextual menu must appear with the load script command.

2) **As batch script**: Most of the SPIS-UI tablatures can be run in batch mode as follow:

```
spis_task_graph.sh -b path_to_myscript/myscript.py
```

Remark: In all cases, the loaded script must be in the Python path.

5 References

[1] Python Community Web Site, http://www.python.org

[2] SPINE Community's Virtual Lab, http://www.spis.org, 2002

[3] Cassandra's Web Site, http://www.artenum.com/cassandra

[4] Forest J., *SPIS-UI Documentation: TN 4.0 Developer Guide*, SPIS project 2006

[5] Gmsh User Tutorial for CAD and Meshing

[6] Geuzaine C., Remacle J.-F., *Gmsh User Guide*, http://geuz.org/gmsh/#Documentation

[7] JyConsole's Web site, http://dev.artenum.com/jyconsole

[8] Jython Community Web Site, http://www.jython.org

[9] Jourdain S., Cassandra's tutorial, http://www.jython.org

[10] Jext's Web site, http://www.jext.org/

[11] Jsynoptic's Web site, http://nicolas.brodu.free.fr/fr/programmation/jsynoptic/index.html

[12] Picup3D Project's Web site, http://dev.spis.org/projects/spine/home/picup

[13] Roussel J.-F., *SPIS-NUM Documentation : Controlling Num from UI*, SPIS Project, 2006

6 Annexe 1: Launching scripts

6 1. Linux

```
#!/bin/bash
# Modify the line above to match your shell (must be a bourne-shell).
#############################################################
#                                                           #
#      MAIN SCRIPT OF LAUNCHING OF THE SPIS FRAMEWORK       #
#                                                           #
#  Please see the Readme.txt file for settings and uses     #
#                                                           #
#  (c) Artenum, Paris, 2003-2004                            #
#############################################################
echo "Please, wait... "
cat ./Version

# If the following settings are not accepted by your shell,
# please set the corresponding environment variables and comment
# the following lines excepted teh las one.

#############################################################
# not mandatory. Needed only if you want to launch Spis     #
# from an icone in the KDE desktop or on in stand-alone     #
#############################################################
HERE=.
SPIS_HOME=$(pwd)/..
export JVM_HOME=$SPIS_HOME/ThirdPart/JVM/Linux-I386/
#export JVM_HOME=/user/shared/j2sdk1.4.2_06/

#############################################################
# Setting of the Jython interpreter                         #
# Please set the path of your Jython interpreter            #
#############################################################
export JYTHON_HOME=$SPIS_HOME/ThirdPart/Jython/jython-2.1
JYTHON_CMD=$JYTHON_HOME/jython
export CLASSPATH=$JYTHON_HOME/jython.jar:$CLASSPATH

#############################################################
# Setting of the VTK related elements                       #
# Please set these paths according you own installation     #
# (i.e. VTKHOME is where is the root directory of your VTK  #
# installation                                              #
#############################################################
# if you use the embeded VTK stuff in ThirdPart
export VTKHOME=../ThirdPart/VTK/I386-Linux/VTK/
# otherwise, if you have a VTK stuff already installed...
#export VTKHOME=/Users/juju/VTK/VTKOSX/CompilationSpace/
export LD_LIBRARY_PATH=${VTKHOME}/bin/:${LD_LIBRARY_PATH}
export CLASSPATH=${VTKHOME}/bin/vtk.jar:$CLASSPATH
export DYLD_LIBRARY_PATH=${VTKHOME}/bin/:${VTKHOME}/lib/vtk/:$LD_LIBRARY_PATH

#############################################################
# To access to the "Wrapping/Java" equivalent files         #
# Settings by default to the local version compiled with    #
# JVM 1.3                                                   #
# export CLASSPATH=./vtk_local/vtk1.3/:$CLASSPATH           #
# otherwise comment the previous line and use you onw       #
# VTK installation as follow                                #
#############################################################
```

```
export VTKJAVAWRAPPING=${VTKHOME}/Wrapping/Java
export CLASSPATH=${VTKJAVAWRAPPING}:$CLASSPATH

#############################################################
# Setting of the JFreeChart Lib                             #
# Normally do not need any modifications                    #
#############################################################
export JFCHOME=../ThirdPart/JFreeChart/jfreechart-0.9.16/
export JFCCLASSPATH=${JFCHOME}/jfreechart-0.9.16.jar:${JFCHOME}/lib/jcommon-0.9.1.jar:$
{JFCHOME}/lib/servlet.jar

#############################################################
# Setting of the Cassandra viewer                           #
# Normally do not need any modifications                    #
#############################################################
export CASSANDRAHOME=${SPIS_HOME}/ThirdPart/Cassandra-2.2-jdk1.4-vtk4.2
export CASSANDRACLASSPATH=${CASSANDRAHOME}:${CASSANDRAHOME}/Cassandra.jar:${CASSANDRAHOME}/
CassandraLauncher.jar:${CASSANDRAHOME}/ThirdPart/skinlf/skinlf.jar:${CASSANDRAHOME}/
thirdpart/DedaleGraph/DedaleGraph.jar:${CASSANDRAHOME}/thirdPart/Jyconsole/JyConsole.jar:$
{CASSANDRAHOME}/thirdpart/CassandraPipelineManager-1.1/ArtenumPipeLineManager-1.1.jar
export CLASSPATH=${CASSANDRACLASSPATH}:${CLASSPATH}

#############################################################
# Setting of the JSynoptic                                  #
# Normally do not need any modifications                    #
#############################################################
export CLASSPATH=${SPIS_HOME}/ThirdPart/JSynoptic/jsynoptic-1.0.jar:${SPIS_HOME}/ThirdPart/
JSynoptic/jsynoptic-parser-1.0.jar:${SPIS_HOME}/ThirdPart/JSynoptic/simtools-1.0.jar:$
{SPIS_HOME}/ThirdPart/JSynoptic/syn3d-1.0.jar:${CLASSPATH}

#############################################################
# Setting of the SPISNUM module (by default, should not be  #
# modified excepted in some specific cases)                 #
#############################################################
export SPISNUMHOME=${SPIS_HOME}/SpisNum/
export NETLIBHOME=${SPISNUMHOME}/lib/NetLib.jar
export CLASSPATH=$SPISNUMHOME/spis.jar:${NETLIBHOME}:$CLASSPATH

#############################################################
# Setting of the jModule (Normally do not need any         #
# modifications.                                            #
#############################################################
export JMODULEPATH=./jModule/jModuleUI.jar:./Lib/JFreeMesh/JFreeMesh.jar:./Lib/JFreeMesh/
JFreeMesh-VtkBuilder.jar
export CLASSPATH=${JMODULEPATH}:$CLASSPATH

#############################################################
# Setting of the GUI modules                                #
#############################################################
export GUIPATH=$HERE/GUI/SpisGui.jar:$HERE/GUI/lib/ArtTk.jar:$HERE/GUI/lib/JyConsole.jar
export CLASSPATH=${GUIPATH}:${CLASSPATH}
export CLASSPATH=./GUI/Icons:$CLASSPATH

#############################################################
# Setting of the postprocessing modules                     #
#############################################################
export POSTPROPATH=$HERE/Lib/FieldManagerUI/lib/fieldManagerPanelPkg.jar
export CLASSPATH=${POSTPROPATH}:${CLASSPATH}
export SPIS2DPLOTPATH=${SPIS_HOME}/SpisUI/Lib/Spis2DPlot/lib/spis2Dplot.jar
export CLASSPATH=${JFCCLASSPATH}:${SPIS2DPLOTPATH}:${CLASSPATH}
```

```
#############################################################
# Setting of the Documentation Viewer (by default, should   #
# not be modified excepted in some specific cases)          #
#############################################################
export CLASSPATH=${SPIS_HOME}/ThirdPart/Multivalent/Multivalent20040415.jar:${CLASSPATH}

#############################################################
# Setting of the jext editor                                #
#############################################################
export JEXTPATH=${SPIS_HOME}/ThirdPart/Jext/
export CLASSPATH=${JEXTPATH}/lib/dawn.jar:${JEXTPATH}/lib/jext.jar:${CLASSPATH}

export JYTHONARCH=/tmp/jythonArch-$USER/
mkdir $JYTHONARCH &>/dev/null

#############################################################
# This is the launching line (do not modify it).            #
#############################################################
exec $JYTHON_CMD -i -Dpython.cachedir=$JYTHONARCH -Dpython.path=${SPISNUMHOME}:$SPIS_HOME/
SpisUI/Modules/Adapter:$SPIS_HOME/SpisUI:$SPIS_HOME/SpisUI/Utils/spisUtil.jar:$SPIS_HOME/
SpisUI/PostProcessing/Lib/SpisViewer2.jar:${VTKJAVAWRAPPING} ${SPIS_HOME}/SpisUI/Bin/Tasks/
SpisTasksGraph.py $@
```

6 2. Windows

```
@echo off
REM ###########################################
REM #                                         #
REM #   Artenum http://www.artenum.com        #
REM #                                         #
REM #   Windows script, path must be          #
REM #   configurate for system                #
REM #                                         #
REM ###########################################

REM ###########################################
REM #   Start of the variable which be        #
REM #   configurate                           #
REM ###########################################

set SPISPATH=..
set SPISPATHR=..\..\..\
set JYTHONPATH=%SPISPATH%\ThirdPart\Jython\jython-2.1\
set JYTHONPATHR=%SPISPATHR%\ThirdPart\Jython\jython-2.1\
REM echo %JYTHONPATH%
set JYTHON_HOME=%JYTHONPATH%
set VTKPATH=..\..\..\ThirdPart\VTK\Windows\vtk42
set JAVAPATH=..\..\..\ThirdPart\JVM\windows\jre\

REM ###########################################
REM #   End of the variable which be          #
REM #   configurate                           #
REM ###########################################
more %SPISPATH%\SpisUI\Version
echo Please, wait...

set CLASSPATH=%JYTHONPATHR%\Lib;%JYTHONPATHR%\jython.jar;%CLASSPATH%
set PYTHONPATH=%JYTHONPATHR%\Lib;%PYTHONPATH%
set PATH=%PATH%;%JYTHONPATHR%
set PATH=%PATH%;%JAVAPATH%\bin;%JAVAPATH%\jre\bin;%VTKPATH%\bin\vtk.jar;%VTKPATH%\bin\;%
VTKPATH%
set LD_LIBRARY_PATH=%VTKPATH%\bin;%VTKPATH%\lib

set CLASSPATH=%VTKPATH%\bin\vtk.jar;.;%JYTHONPATHR%;%SPISPATHR%\SpisUI\vtk_local\src;%
SPISPATHR%\SpisUI\GUI\SpisGUI.jar;%SPISPATHR%\SpisUI\GUI\lib\ArtTk.jar;%SPISPATHR%\SpisUI
\GUI\lib\JyConsole.jar;%SPISPATHR%\SpisUI
set PYTHONPATH=%CLASSPATH%;%SPISPATHR%\SpisUI;%SPISPATHR%\SpisUI\Bin

REM ################################################################
REM # Setting of the SPISNUM module (by default should ne be       #
REM # modified)                                                    #
REM ################################################################
set CLASSPATH=..\..\..\SpisNum\spis.jar;%CLASSPATH%
set NETLIBHOME=..\..\..\SpisNum\lib\NetLib.jar
set CLASSPATH=%NETLIBHOME%;%CLASSPATH%

REM ################################################################
REM # Path for the multi-valent browser                            #
REM ################################################################
set CLASSPATH=..\..\Multivalent\Multivalent20040415.jar;%CLASSPATH%

REM #############################################################
REM # Setting of the Cassandra 2.1 viewer                       #
REM # Normally do not need any modifications                    #
REM #############################################################
set CASSANDRAHOME=%SPISPATHR%\ThirdPart\Cassandra-2.2-jdk1.4-vtk4.2
set CASSANDRACLASSPATH=%CASSANDRAHOME%;%CASSANDRAHOME%\Cassandra.jar;%CASSANDRAHOME%
\CassandraLauncher.jar;%CASSANDRAHOME%\ThirdPart\skinlf\skinlf.jar;%CASSANDRAHOME%\thirdPart
\Dedalegraph\DedaleGraph.jar;%CASSANDRAHOME%\thirdPart\artenum\Jyconsole\JyConsole.jar;%
CASSANDRAHOME%\thirdPart\CassandraPipelineManager-1.1\ArtenumPipeLineManager-1.1.jar
set CLASSPATH=%CASSANDRACLASSPATH%;%CLASSPATH%

REM #############################################################
REM # Setting of the GUI modules                                #
REM #############################################################
set GUIPATH=%SPISPATHR%\SpisUI\GUI\SpisGui.jar;%SPISPATHR%\SpisUI\GUI\lib\ArtTk.jar;%
SPISPATHR%\SpisUI\GUI\lib\JyConsole.jar;%SPISPATHR%\SpisUI\GUI\Icons
set CLASSPATH=%GUIPATH%;%CLASSPATH%
set CLASSPATH=%SPISPATHR%SpisUI\GUI\Icons;%CLASSPATH%

REM #############################################################
REM # Setting of the JSynoptic                                  #
REM # Normally do not need any modifications                    #
REM #############################################################
set JSYNOPTICPATH=%SPISPATHR%\ThirdPart\JSynoptic\lib\jsynoptic-1.0.jar;%SPISPATHR%
\ThirdPart\JSynoptic\lib\jsynoptic-parser-1.0.jar;%SPISPATHR%\ThirdPart\JSynoptic\lib
\simtools-1.0.jar;%SPISPATHR%\ThirdPart\JSynoptic\lib\syn3d-1.0.jar
set CLASSPATH=%JSYNOPTICPATH%;%CLASSPATH%

REM #############################################################
REM # Setting of the jModule (Normally do not need any         #
REM # modifications.                                            #
REM #############################################################
set JMODULEPATH=%SPISPATHR%\jModule\jModuleUI.jar;%SPISPATHR%\SpisUI\Lib\JFreeMesh
\JFreeMesh.jar;%SPISPATHR%\SpisUI\Lib\JFreeMesh\JFreeMesh-VtkBuilder.jar
set CLASSPATH=%JMODULEPATH%;%CLASSPATH%
```

7 Annexe 2: examples of SPIS-UI tablatures

7 1. Processing script

```
# Example of Spis Music Track (SMT) script or "How to use SPIS as
# simple Lib through a simple Jython script".
# This script can be directly launched as follow:
#     spis_task.sh -b thisScript.py
# or via the JyConsole.
#
# Author: M.Biais (Artenum), S.Jourdain (Artenum)
# (c) Artenum SARL, Paris, 2005

# to import the SPIS stuff in order to :
# - exchange
# - convert
# - edit
# easily all data and other stuffs
from Bin.GeomManager import GeomManager
from Bin.Tasks.TaskManager import TaskManager
from Bin.Tasks.shared import *
from Bin.Tasks.taskslist import TasksList
import spis

# Initialize Task Manager (if you want to use it))
tasksList = TasksList()
tasksList.initTasksList()
tasksList.setAllAlive()
task_manager = TaskManager(*[i[0] for i in tasksList.tasks])
task_manager.reset_done_nodes()

# To load the project (just by calling the LoadProj Task)
# The project should contain all needed Data. This can
# also be done by direct Python import (see documentation).
project_path = "../Data/ValidationTest/test3_sphere_low_resol/"
sharedFiles["project_directory"] = project_path
sharedFiles["projectLoadingFlag"] = 1 # to notify that the project is already defined

sharedTasks["context"] = []
sharedTasks["context"] = [ "projectInfo",
                           "geomFile",
                           "materials",
                           "elecNodes",
                           "plamas",
                           "groups",
                           "globals",
                           "geomLoading",
                           "meshLoading"]

# here the task manager will perform automatically all pre-processing tasks
# according the dependence tree
task_manager.set_done_task("LoadProj")
tasks_list = ["ProjectLoaderFormat2", "Mesher3D"] #"FieldManager"]
# Run tasks declared in the tasklist
for i in tasks_list:
    task_manager.run_tasks(i)
print "The Job is done ! Bye !"
```

7 2. Simulation demon

```
pathProjectIn = "."
pathProjectOut = "."

import spis
from Bin.Tasks.shared import *
import Bin.ProjectLoader2
from Bin.ProjectLoader2 import ProjectLoader2
import Bin.SpisNumInterface
from Bin.SpisNumInterface import *
import Bin.JyTop4
from Bin.JyTop4 import JyTop4
import Bin.ProjectWriter2
from Bin.ProjectWriter2 import ProjectWriter2
print "Begin"
# The project should contain all needed Data. This can
# also be done by direct Python import (see documentation).
sharedFiles["project_directory"] = pathProjectIn
sharedFiles["projectLoadingFlag"] = 1 # to notify that the project is already defined
# we load only the needed elements, i.e project s general info, global parameters
# preprocessing DataFields and MeshFiels, the mesh structure.
loadingList = [ "projectInfo", "globals", "preproDFLoading", "meshLoading"]
loader = ProjectLoader2()
loader.setLoadingList(loadingList)
loader.load()

print "Conversion UI to Num"
Interface = SpisNumInterface(sharedData["AllDataField"], sharedData["AllMeshField"])
Interface.BuildList(shared["Mesh"])
Interface.MapDFOnVolMesh()
Interface.MapDFOnSCMesh()
Interface.MapDFOnBdMesh()
Interface.buildCrossNumberingBetweenMesh()
sharedNum["SNMesh"] = Interface.GetSpisNumMesh()

print "Starting the simulation"
sharedSolver["jytop"] = JyTop4(sharedNum["SNMesh"])
sharedSolver["jytop"].BuildSim( sharedData["AllMeshField"], sharedData["AllDataField"])
sharedSolver["jytop"].Run()
sharedSolver["jytop"].ReadSim( sharedData["AllMeshField"], sharedData["AllDataField"])

print "Data recovering"
writer = ProjectWriter2()
writer.setOuputDirectory(pathProjectOut)
writer.createNewProject()
writer.write()

print "The Job is done ! Bye !"
```

8 Annexe 3: JyTop4.py script

```
import os, time
import java
from spis.Top.Simulation import *
from spis.Top.SC import *
from spis.Top.Plasma import *
from spis.Vol.VolMesh import *
from spis.Vol.VolField import *
from spis.Vol.VolDistrib import *
from spis.Vol.Geom import *
from spis.Surf.SurfMesh import *
from spis.Surf.SurfField import *
from spis.Util.Table import *
from spis.Util.Monitor import *
from spis.Top.Top import *
import spis.Top.Default.LocalParameter as LocalParameter
from Modules.Field.DataField            import DataField
from Modules.Field.DataFieldList        import DataFieldList
from Modules.Field.MeshField            import MeshField
from Modules.Field.MeshFieldList        import MeshFieldList
from math import sqrt
from config import GL_EXCHANGE, GL_DEFAULT_INPUT_PATH, GL_DATA_PATH
from Bin.Tasks.shared import sharedFiles
from Bin.Tasks.shared import sharedData
from Bin.Tasks.shared import sharedData

class JyTop4:
    '''
    Top simulation kernel wrapper. This Jython class wrap the
    java based SPIS-NUM simulation kernel. Its performs the data
    structure conversion from UI to NUM, the simulation model
    building, launches the execution of the simulation loop and
    recovers the output data.
    '''

    def __init__(self, spisNumMesh):
            tmpDate = time.gmtime()
            self.simulationId = `tmpDate[0]`+`tmpDate[1]`+`tmpDate[2]`+`tmpDate[3]`+`tmpDate[4]`
+`tmpDate[5]`
            print "Initialisation of simulation Nb:", self.simulationId

            self.logFile = os.path.join(GL_EXCHANGE, "spis_JyTop4.log")
            self.stream  = open(self.logFile,"w")

            self.logFile2 = os.path.join(GL_EXCHANGE, "spis_JyTop4-2.log")
            self.stream2 = open(self.logFile2,"w")
            self.spisNumMesh = spisNumMesh

    #############################################
    #     Create and prepare the simulation     #
    #############################################
    def BuildSim(self, AllMeshField, AllDataField):
        '''
        Create and prepare the grids and the simulation model.
        '''
        print "SPIS/NUM main is under creation"

        # GEOMETRY INITIALISATION SECTION, MIMICKING (SEMI-)AUTOMATED
        #       DATA TRANSFER  FROM FRAMEWORK TO SPIS NUM


        # Creates meshes and some property fields from framework data.
        # (Of course these definitions and initialisations shall be
        # different in the framework, they are just written here for
        # testing).
        #
        # Data are:
        # - VolMesh (see ThreeDUnstructVolMesh for more on
        #            variable meaning and some classical
        #            constraints on numbering) :
        # cell (tetrahedra) number
        self.geom = ThreeDCartesianGeom()

        print >> self.stream, "creation of the ThreeDUnstructSurfMesh structure (for SC surface)"

        # -----------------------
        # - Init for spacecraft -
        # -----------------------
        self.scSurfMesh = \
          ThreeDUnstructSurfMesh(self.geom                                                 ,
                      None                                                                  ,
                      self.spisNumMesh.getSpacecraftMesh().getFaceNb()                      ,
                      self.spisNumMesh.getSpacecraftMesh().getEdgeNb()                      ,
                      self.spisNumMesh.getSpacecraftMesh().getNodeNb()                      ,
                      self.spisNumMesh.getSpacecraftMesh().getSurfEdge()                    ,
                      self.spisNumMesh.getSpacecraftMesh().getSurfNode()                    ,
                      self.spisNumMesh.getSpacecraftMesh().getEdgeNode()                    ,
                      self.spisNumMesh.getSpacecraftMesh().getData('SurfFlagS')             ,
                      self.spisNumMesh.getSpacecraftMesh().getSurfIndex()                   ,
                      []                                                                    ,
                      [0 for i in range(self.spisNumMesh.getSpacecraftMesh().getFaceNb())]  ,
                      self.spisNumMesh.getSpacecraftMesh().getData('EdgeFlagS')             ,
                      self.spisNumMesh.getSpacecraftMesh().getEdgeIndex()                   ,
                      []                                                                    ,
                      [0 for i in range(self.spisNumMesh.getSpacecraftMesh().getEdgeNb())]  ,
                      self.spisNumMesh.getSpacecraftMesh().getData('NodeFlagS')             ,
                      self.spisNumMesh.getSpacecraftMesh().getNodeIndex()                   ,
                      []                                                                    ,
                      self.spisNumMesh.getSpacecraftMesh().getXYZ()                         )


        # ---------------------
        # - Init for boundary -
        # ---------------------

        print >> self.stream, "creation of the ThreeDUnstructSurfMesh structure (for external
boudnary surface)"
        self.bdSurfMesh = \
                      ThreeDUnstructSurfMesh(self.geom,
                      None                                                                  ,
                      self.spisNumMesh.getBoundaryMesh().getFaceNb()                        ,
                      self.spisNumMesh.getBoundaryMesh().getEdgeNb()                        ,
                      self.spisNumMesh.getBoundaryMesh().getNodeNb()                        ,
                      self.spisNumMesh.getBoundaryMesh().getSurfEdge()                      ,
                      self.spisNumMesh.getBoundaryMesh().getSurfNode()                      ,
                      self.spisNumMesh.getBoundaryMesh().getEdgeNode()                      ,
                      self.spisNumMesh.getBoundaryMesh().getData('SurfFlagBd')              ,
                      self.spisNumMesh.getBoundaryMesh().getSurfIndex()                     ,
                      [-1 for i in range(self.spisNumMesh.getBoundaryMesh().getFaceNb())]   ,
                      [ 0 for i in range(self.spisNumMesh.getBoundaryMesh().getFaceNb())]   ,
                      self.spisNumMesh.getBoundaryMesh().getData('EdgeFlagBd')              ,
                      self.spisNumMesh.getBoundaryMesh().getEdgeIndex()                     ,
                      [-1 for i in range(self.spisNumMesh.getBoundaryMesh().getEdgeNb())]   ,
                      [ 0 for i in range(self.spisNumMesh.getBoundaryMesh().getEdgeNb())]   ,
                      self.spisNumMesh.getBoundaryMesh().getData('NodeFlagBd')              ,
                      self.spisNumMesh.getBoundaryMesh().getNodeIndex()                     ,
                      []                                                                    ,
                      self.spisNumMesh.getBoundaryMesh().getXYZ()                           )

        # -------------------
        # - Init for volume -
        # -------------------
        print >> self.stream, "creation of the ThreeDUnstructVolMesh structure (for Plasma Volume)"
        print "creation of the ThreeDUnstructVolMesh structure (for Plasma Volume)"

        self.volMesh = \
                       ThreeDUnstructVolMesh(self.geom                      ,
                       self.bdSurfMesh                                      ,
                       self.scSurfMesh                                      ,
                       self.spisNumMesh.getVolumeMesh().getCellNb()         ,
                       self.spisNumMesh.getVolumeMesh().getFaceNb()         ,
                       self.spisNumMesh.getVolumeMesh().getEdgeNb()         ,
                       self.spisNumMesh.getVolumeMesh().getNodeNb()         ,
                       self.spisNumMesh.getVolumeMesh().getCellSurf()       ,
                       self.spisNumMesh.getVolumeMesh().getCellEdge()       ,
                       self.spisNumMesh.getVolumeMesh().getCellNode()       ,
                       self.spisNumMesh.getVolumeMesh().getSurfEdge()       ,
                       self.spisNumMesh.getVolumeMesh().getSurfNode()       ,
                       self.spisNumMesh.getVolumeMesh().getEdgeNode()       ,
                       self.spisNumMesh.getVolumeMesh().getData('SurfFlag') ,
                       self.spisNumMesh.getVolumeMesh().getSurfIndexSC()    ,
                       []                                                   , # (surfIndexS2V)
                       self.spisNumMesh.getVolumeMesh().getSurfIndexB()     ,
                       self.spisNumMesh.getVolumeMesh().getData('EdgeFlag') ,
                       self.spisNumMesh.getVolumeMesh().getEdgeIndexSC()    ,
                       []                                                   , # (edgeIndexS2V)
                       self.spisNumMesh.getVolumeMesh().getEdgeIndexB()     ,
                       self.spisNumMesh.getVolumeMesh().getData('NodeFlag') ,
                       self.spisNumMesh.getVolumeMesh().getNodeIndexSC()    ,
                       []                                                   , # (nodeIndexS2V)
                       self.spisNumMesh.getVolumeMesh().getNodeIndexB()     ,
                       self.spisNumMesh.getVolumeMesh().getXYZ()            )

        # -----------------------------------------
        # - Linking surface meshes to volume mesh -
        # -----------------------------------------
        print >> self.stream, "Linking surface meshes to volume mesh"
        print "Linking surface meshes to volume mesh"

        print "STEP 0"
        self.bdSurfMesh.setVm(self.volMesh)

        print "STEP 1"
        self.scSurfMesh.setVm(self.volMesh)

        # ----------------
        # - Global Param -
        # ----------------
        print >> self.stream, "creating Global Parameter data"
        print "creating Global Parameter data"
        from spis.Top.Simulation import *
        from spis.Top.Default import *
        from Bin.Tasks.shared import sharedGlobals
        self.globalParameterArray = []
        for key in sharedGlobals.keys():
            p = sharedGlobals[key]
            param = GlobalParameter(key,p[2],p[4],p[3],p[1])
            self.globalParameterArray.append(param)

        # ---------------
        # - Local Param -
        # ---------------
        self.localParameterArray = []

        # --------------------------
        # - Local Param for Volume -
        # --------------------------
        print "############   Mapping of Data in Volume  #########"
        paramNameList = [ ['VolInteracFlag', 3] ,\
                          ['BackGroundDens', 3] ]
```

```
        spisMesh      = self.spisNumMesh.getVolumeMesh()
        spisNumMesh   = self.volMesh
        self.buildLocalParamFromList(paramNameList, spisMesh, spisNumMesh)

        # ------------------------------
        # - Local Param for Spacecraft -
        # ------------------------------
        print "#############   Mapping of Data on S/C surface  #########"
        paramNameList = [ ['MatModelId'      , 2] ,\
                          ['MatTypeId'       , 2] ,\
                          ['MatThickness'    , 2] ,\
                          ['PhotoEmis'       , 2] ,\
                          ['ElecSecEmis'     , 2] ,\
                          ['ProtSecEmis'     , 2] ,\
                          ['VolConduct'      , 2] ,\
                          ['IndConduct'      , 2] ,\
                          ['SurfConduct'     , 2] ,\
                          ['Temperature'     , 2] ,\
                          ['SunFlux'         , 2] ,\
                          ['ElecNodeId'      , 2] ,\
                          ['EdgeElecNodeId'  , 1] ,\
                          ['SCDiriFlag'      , 0] ,\
                          ['SCDiriPot'       , 0] ,\
                          ['SCDiriPotEdge'   , 1] ,\
                          ['SCDiriPotSurf'   , 2] ,\
                          ['SCFourFlag'      , 2] ,\
                          ['SCFourAlpha'     , 2] ,\
                          ['SCFourValue'     , 0] ,\
                          ['SourceId'        , 2] ,\
                          ['SourceCurrent'   , 2] ,\
                          ['SourceTemp'      , 2] ,\
                          ['SourceMach'      , 2] ]
        spisMesh      = self.spisNumMesh.getSpacecraftMesh()
        spisNumMesh   = self.scSurfMesh
        self.buildLocalParamFromList(paramNameList, spisMesh, spisNumMesh)

        # ----------------------------
        # - Local Param for Boundary -
        # ----------------------------
        print "#############   Mapping of Data on External BD  #########"
        paramNameList = [ ['BdDiriFlag'  , 0] ,\
                          ['BdDiriPot'   , 0] ,\
                          ['BdFourFlag'  , 2] ,\
                          ['BdFourAlpha' , 2] ,\
                          ['BdFourValue' , 0] ,\
                          ['IncomPart'   , 2] ,\
                          ['OutgoPart'   , 2] ]
        spisMesh      = self.spisNumMesh.getBoundaryMesh()
        spisNumMesh   = self.bdSurfMesh
        self.buildLocalParamFromList(paramNameList, spisMesh, spisNumMesh)

        self.runId = -1
        print "Now, everything should be ready for the simulation"


        ###############################################################
        #                     CALLING SPIS-NUM:                       #
        #    Major place where modifications can be done by users     #
        ###############################################################
        print "GL_DATA_PATH:", GL_DATA_PATH
        print "GL_DEFAULT_INPUT_PATH: ", GL_DEFAULT_INPUT_PATH
        import os
        os.listdir(GL_DEFAULT_INPUT_PATH)

        print "Building of the simulation model"
        print >> self.stream, "creating GEO simulation java objet in SPIS/NUM"
        self.simu = SimulationFromUIParams( self.volMesh,
                                            self.bdSurfMesh,
                                            self.scSurfMesh,
                                            self.globalParameterArray,
                                            self.localParameterArray,
                                            GL_DATA_PATH,
                                            GL_DEFAULT_INPUT_PATH)

    def buildLocalParamFromList(self, list, spisMesh, spisNumMesh):
        for param in list:
           self.buildLocalParam(self.localParameterArray, param[0], param[1], spisMesh, spisNumMesh)

    def buildLocalParam(self, paramArray, localName, localisation, spisMesh, spisNumMesh):

        paramArray.append(LocalParameter( localName,
                                          spisMesh.convertDataToFloatArray(localName),
                                          localisation, spisNumMesh,
                                          sharedData["AllDataField"].Dic[localName].Unit,
                                          'no comment'))
   def Run(self):
        print "SPIS/NUM main is starting"
        self.runId = self.runId + 1
        print "Run Nb:", self.runId
        print >> self.stream, "Integration in SPIS/NUM"
        self.simu.integrate()
        self.simu.close()
        print >> self.stream, "Back from SPIS/NUM"

        #####          Examples of possible modifications:        #####
        # GEO simulation: change the above 5 lines into the following #
        # (uncommented them! and comment the above ones):            #

        #print >> self.stream, "creating GEO simulation java objet in SPIS/NUM"
        #self.simu = GeoExample2(self.volMesh, self.bdSurfMesh,
        #self.scSurfMesh,self.globalParameterArray)
        #print >> self.stream, "Integration in SPIS/NUM"
        #self.simu.integrate()
        #print >> self.stream, "Back from SPIS/NUM"

        # LEO simulation: change the above 5 lines into the following #
        # (uncommented them! and comment the above ones):            #

        #print >> self.stream, "creating LEO simulation java objet in SPIS/NUM"
        #self.simu = LeoExample(self.volMesh, self.bdSurfMesh, self.scSurfMesh)
        #print >> self.stream, "Integration in SPIS/NUM"
        #self.simu.integrate(0.001)
        #print >> self.stream, "Back from SPIS/NUM"

        # GEO simulation with photo-emission turned on after a while: #
        #print >> self.stream, "creating GEO simulation java objet in SPIS/NUM (with photo-
        #emission)"
        #self.simu = GeoExample2(self.volMesh, self.bdSurfMesh, self.scSurfMesh)
        #print >> self.stream, "Integration in SPIS/NUM"
        #self.simu.integrate(1.0)
        #print >> self.stream, "Back from SPIS/NUM"

        # To dump meshes, and be able to run SPIS-NUM as a standalone #
        # code (within Eclipse), and reload these meshes through the  #
        # import command in the SPIS-NUM menu used when standalone:   #

    def ReadSim(self, AllMeshField, AllDataField):
        print "SPIS/NUM: Reading of the results"

        ###############################################################
        #   Section of return of output data from nun to ui           #
        ###############################################################
        print >> self.stream, " "
        print >> self.stream, "Getting of output data "
```

```
        ##########################################
        # S/C data                               #
        ##########################################
        print "Getting now the spacecraft surface data for postprocessing"
        print "\n"
        self.scSurfResults = self.simu.getScSurfResults()
        # self.scSurfResults should now contain a SurfField[]
        print >> self.stream, \
        'back from NUM: SC surface fields = ',self.scSurfResults

        self.dataIndex = max(AllDataField.IdList)
        print "Data Index start Value ", self.dataIndex
        for i in range(len(self.scSurfResults)):
            if self.scSurfResults[i] != None:         #we check if the object exist
                #print self.scSurfResults[i].getName()
                self.dataIndex = self.dataIndex + 1
                surfData = DataField()
                surfData.Id = self.dataIndex
                surfData.Name = self.scSurfResults[i].getName()
                surfData.Type = 'Float (TBC)'
                surfData.Unit = self.scSurfResults[i].getUnit().getLongName()
                surfData.Local = self.scSurfResults[i].getCentring().getAbsDim()
                surfData.LockedValue = 0
                tmpValueList = self.scSurfResults[i].getTable().getValues()
                surfData.ValueList = []
                for elm in tmpValueList:
                    surfData.ValueList.append(elm)
                surfData.Category = "outputSim"+self.simulationId+"Run"+`self.runId`+"DataOnSC"

                if surfData.Local == 0:
                    surfData.MeshFieldId = AllMeshField.Dic['NodeFlagS_MF'].Id
                    if len(AllMeshField.Dic['NodeFlagS_MF'].MeshElementIdList) != len
(surfData.ValueList):
                       print "ERROR datafield vs meshfield, SC ", i, \
                       len(AllMeshField.Dic['NodeFlagS_MF'].MeshElementIdList),\
                       len(surfData.ValueList), surfData.Local
                if surfData.Local == 1:
                    surfData.MeshFieldId = AllMeshField.Dic['EdgeFlagS_MF'].Id
                    if len(AllMeshField.Dic['EdgeFlagS_MF'].MeshElementIdList) != len
(surfData.ValueList):
                       print "ERROR datafield vs meshfield, SC ", i, \
                             len(AllMeshField.Dic['EdgeFlagS_MF'].MeshElementIdList),\
                             len(surfData.ValueList), surfData.Local
                if surfData.Local == 2:
                    surfData.MeshFieldId = AllMeshField.Dic['SurfFlagS_MF'].Id
                    if len(AllMeshField.Dic['SurfFlagS_MF'].MeshElementIdList) != len
(surfData.ValueList):
                       print "ERROR datafield vs meshfield, SC ", i, \
                             len(AllMeshField.Dic['SurfFlagS_MF'].MeshElementIdList),\
                             len(surfData.ValueList), surfData.Local
                AllDataField.Add_DataField(surfData)
                print surfData.Name
                print >> self.stream, surfData.Name
                print >> self.stream, surfData.ValueList
                print >> self.stream, "\n"

        ##########################################
        # Boundary surface data                  #
        ##########################################
        print "\n"
        print "Getting now the boundary surface data for posprocessing"
        print "\n"
        self.bdSurfResults = self.simu.getBdSurfResults()
        # self.bdSurfResults should now contain a SurfField[]
        print >> self.stream, \
        'back from NUM: boundary surface fields = ',self.bdSurfResults
        for i in range(len(self.bdSurfResults)):
            if self.bdSurfResults[i] != None:         #we check if the object exist
                #print self.bdSurfResults[i].getName()
                bdsurfData = DataField()
                self.dataIndex = self.dataIndex + 1
                bdsurfData.Id = self.dataIndex
                bdsurfData.Name = self.bdSurfResults[i].getName()
                bdsurfData.Type = 'Float (TBC)'
                bdsurfData.Unit = self.bdSurfResults[i].getUnit().getLongName()
                bdsurfData.Local = self.bdSurfResults[i].getCentring().getAbsDim()
                bdsurfData.LockedValue = 0                                      #TBC
                #bdsurfData.ValueList = self.bdSurfResults[i].getTable().getValues()
                tmpValueList = self.bdSurfResults[i].getTable().getValues()
                bdsurfData.ValueList = []
                for elm in tmpValueList:
                    bdsurfData.ValueList.append(elm)
                bdsurfData.Category = "outputSimu"+self.simulationId+"Run"+`self.runId`+"DataOnBd"
                bdsurfData.MeshFieldId = AllMeshField.Dic['NodeFlagBd_MF'].Id
                if bdsurfData.Local == 0:
                    bdsurfData.MeshFieldId = AllMeshField.Dic['NodeFlagBd_MF'].Id
                    if len(AllMeshField.Dic['NodeFlagBd_MF'].MeshElementIdList) != len
(bdsurfData.ValueList):
                        print "ERROR datafield vs meshfield, Bd ", i, \
                        len(AllMeshField.Dic['NodeFlagBd_MF'].MeshElementIdList),\
                        len(bdsurfData.ValueList), bdsurfData.Local
                if bdsurfData.Local == 1:
                    bdsurfData.MeshFieldId = AllMeshField.Dic['EdgeFlagBd_MF'].Id
                    if len(AllMeshField.Dic['EdgeFlagBd_MF'].MeshElementIdList) != len
(bdsurfData.ValueList):
                        print "ERROR datafield vs meshfield, Bd ", i, \
                        len(AllMeshField.Dic['EdgeFlagBd_MF'].MeshElementIdList),\
                        len(bdsurfData.ValueList), bdsurfData.Local
                if bdsurfData.Local == 2:
                    bdsurfData.MeshFieldId = AllMeshField.Dic['SurfFlagBd_MF'].Id
                    if len(AllMeshField.Dic['SurfFlagBd_MF'].MeshElementIdList) != len
(bdsurfData.ValueList):
                        print "ERROR datafield vs meshfield, Bd  ", i, \
                        len(AllMeshField.Dic['SurfFlagBd_MF'].MeshElementIdList),\
                        len(bdsurfData.ValueList), bdsurfData.Local
                # XXX see SC section for extension to properties living on edge and surf XXX
                AllDataField.Add_DataField(bdsurfData)
               print bdsurfData.Name
                print >> self.stream, bdsurfData.Name
                print >> self.stream, bdsurfData.ValueList
                print >> self.stream,"\n"

        ##########################################
        # Volumic data                           #
        ##########################################
        print "\n"
        print "Getting now the volume data for posprocessing"
        print "\n"
        self.volResults = self.simu.getVolResults()
        # self.volResults should now contain a VolField[]
        # use .buildExternIndexedTable().getValues() on each of the volField
        print >> self.stream, \
        'plasma potential back from NUM',self.volResults

        for i in range(len(self.volResults)):
            if self.volResults[i] != None:         #we check if the object exist
                #print self.volResults[i].getName()
                self.volDat = DataField()
                self.dataIndex = self.dataIndex + 1
                self.volDat.Id = self.dataIndex
                self.volDat.Name = self.volResults[i].getName()
                self.volDat.Type = 'Float TBC'
                self.volDat.Unit = self.volResults[i].getUnit().getLongName()
                self.volDat.Local = 0
                self.volDat.LockedValue = 0
                #self.volDat.ValueList = self.volResults[i].buildExternIndexedTable().getValues()
                tmpValueList = self.volResults[i].buildExternIndexedTable().getValues()
                self.volDat.ValueList = []
                for elm in tmpValueList:
                    self.volDat.ValueList.append(elm)
                self.volDat.Category = "outputSimu"+self.simulationId+"Run"+`self.runId`
+"DataInvolume"
                self.volDat.MeshFieldId = AllMeshField.Dic['NodeFlag_MF'].Id
                # XXX see SC section for extension to properties living on edge and surf XXX
                if len(AllMeshField.Dic['NodeFlag_MF'].MeshElementIdList) != len
(self.volDat.ValueList):
                    print "ERROR datafield vs meshfield, Vol",i\
                          ,len(AllMeshField.Dic['NodeFlag_MF'].MeshElementIdList),
                           len(self.volDat.ValueList)
                AllDataField.Add_DataField(self.volDat)
                print self.volDat.Name
                print >> self.stream, self.volDat.Name
                print >> self.stream, self.volDat.ValueList
                print >> self.stream, "\n"

        ##########################################
        # Time dependent data                    #
        ##########################################
        print >> self.stream, \
        "Getting now the x(t) data"
        print "Getting now the x(t) data"
        fieldIndex = max(AllMeshField.IdList)
        fieldIndex = fieldIndex + 1
        print "New MeshFields start at:", fieldIndex

        self.scalTimePlots = self.simu.getScalTimePlots()
        # self.scalTimePlots should now contain a XyData[]
        print >> self.stream, \
        'back from NUM: x(t) data  = ',self.scalTimePlots
        sharedData["scalTimePlots"] = self.scalTimePlots

        for i in range(len(self.scalTimePlots)):
            if self.scalTimePlots[i] != None:         #we check if the object exist
                nbValideData = self.scalTimePlots[i].getDataNb()
                #first, we build the MesField corresponding to the time.
                #for now, time is expressed in number of time step only.
                # for the moement, we build a MeshField for each time-plot and we store directly the
                # the time. But this should be chenged into a "time-mesh" in the future
                #self.indexedTime = [i for i in range(len(self.scalTimePlots[0].YArray))]
                self.timeMeshField = MeshField()
                self.timeMeshField.Id = fieldIndex
                self.timeMeshField.Name = 'Time'
                self.timeMeshField.Local = 4
                self.timeMeshField.Description = "time in steps"

                tmpArray = range(nbValideData)
                for j in xrange(nbValideData):
                    tmpArray[j] = self.scalTimePlots[i].XArray[j]

                self.timeMeshField.MeshElementList =  tmpArray
                self.timeMeshField.MeshElementIdList =  tmpArray    #this is not clean but...

                AllMeshField.Add_MeshField(self.timeMeshField)

                self.timeDat = DataField()
                tmpArray = range(nbValideData)
                tmpIdArray = range(nbValideData)
                for j in xrange(nbValideData):
                    tmpArray[j] = self.scalTimePlots[i].YArray[j]
                    tmpIdArray[j] = j

                self.dataIndex = self.dataIndex + 1
                self.timeDat.Id = self.dataIndex
                self.timeDat.Name = self.scalTimePlots[i].getName()
                self.timeDat.Type = "FLOAT" #tmpArray[1]
                self.timeDat.Unit = self.scalTimePlots[i].getYTable().getUnit().getLongName()
                self.timeDat.Local = 4                      #time is a curviline absciss
                self.timeDat.LockedValue = 0
                self.timeDat.ValueList = tmpArray
                self.timeDat.MeshElementIdList = tmpIdArray
                self.timeDat.MeshFieldId = fieldIndex
                self.timeDat.Category = "outputSimu"+self.simulationId+"Run"+`self.runId`
+"TimeDependentData"
                AllDataField.Add_DataField(self.timeDat)
                print self.timeDat.Name
                print >> self.stream, self.timeDat.Name
                print >> self.stream, self.timeDat.ValueList
                print >> self.stream, "\n"
                fieldIndex = fieldIndex + 1

        print >> self.stream, \
        "Getting now the (x(y))(t) data"

        self.curveTimePlots = self.simu.getCurveTimePlots()
        # self.curveTimePlots should now contain a XyzData[]
        print >> self.stream, \
        'back from NUM: (x(y))(t) data  = ',self.curveTimePlots

        ##########################################
        # Particle trajectories                  #
        ##########################################
        print >> self.stream, \
        "Getting now the trajectory data"
        print "Getting now the trajectory data"

        self.trajectories = self.simu.getTrajectories()
        # self.trajectories should now contain a Trajectory[]
        fieldIndex = max(AllMeshField.IdList)
        fieldIndex = fieldIndex + 1
        print "New MeshFields start at:", fieldIndex

        sharedData["particleTrajectories"] = self.trajectories

        for i in range(len(self.trajectories)):
            if self.trajectories[i] != None:         #we check if the object exist

                nbPoints = self.trajectories[i].getPointNb()
                #first, we build the MesField corresponding to the traj.
                #self.indexedTime = [i for i in range(len(self.scalTimePlots[0].YArray))]
                self.trajMeshField = MeshField()
                self.trajMeshField.Id = fieldIndex
                self.trajMeshField.Name = 'trajectory'
                self.trajMeshField.Local = 5
                self.trajMeshField.Description = "coordinates"

                #tmpArray = self.scalTimePlots[i].XArray
                tmpArray = range(nbPoints)
                for j in xrange(nbPoints):
                    tmpArray[j] = (self.trajectories[i].getPosArray()[j][0], self.trajectories
[i].getPosArray()[j][1], self.trajectories[i].getPosArray()[j][2])

                self.trajMeshField.MeshElementList =  tmpArray  #self.indexedTime
                AllMeshField.Add_MeshField(self.trajMeshField)

                self.velocity = DataField()
                #tmpArray = self.scalTimePlots[i].YArray
                tmpArray = range(nbPoints)
                tmpIdArray = range(nbPoints)
                for j in xrange(nbPoints):
                    tmpArray[j] = (self.trajectories[i].getPosArray()[j][0], self.trajectories
[i].getPosArray()[j][1], self.trajectories[i].getPosArray()[j][2])
                    tmpIdArray[j] = j
                self.dataIndex = self.dataIndex + 1
                self.velocity.Id = self.dataIndex
                self.velocity.Name = self.trajectories[i].getName()
                self.velocity.Type = "FLOAT" #tmpArray[1]
                self.velocity.Unit = 'see name'
                self.velocity.Local = 5
                self.velocity.LockedValue = 0
                self.velocity.ValueList = tmpArray
                self.velocity.MeshElementIdList = tmpIdArray
                self.velocity.MeshFieldId = fieldIndex
                self.velocity.Category = "outputSimu"+self.simulationId+"Run"+`self.runId`
+"ParticleTrajectory"
                # XXX see SC section for extension to properties living on edge and surf XXX
                #if len(AllMeshField.Dic['NodeFlag_MF'].MeshElementIdList) != len
(self.volDat.ValueList):
                #    print "ERROR datafield vs meshfield, Vol",i\
                #    ,len(AllMeshField.Dic['NodeFlag_MF'].MeshElementIdList),len
(self.volDat.ValueList)
                AllDataField.Add_DataField(self.velocity)
                print self.velocity.Name
                print >> self.stream, self.velocity.Name
                print >> self.stream, self.velocity.ValueList
                print >> self.stream, "\n"
                fieldIndex = fieldIndex + 1

        print >> self.stream, \
        'back from NUM: trajectory data  = ',self.trajectories

        ####### END OF THE DATA EXTRACTION ########

        # more generally for a field f (a SurfField or VolField, as
        # self.top.getScPotential() here):
        # - f.getTable().getValues() returns the values (float[]
        #   or float[][] for a VectxxxField)
        # - for node-centred volume fields, which have a different
        # internal indexing, one must use
        #   f.buildExternIndexedTable().getValues() (f.getTable().getValues() returns values
        # - the centring of the field can be tested through
        #   self.top.getScPotential().getCentring().getAbsDim(),
        #   which returns 0 for nodes, 2 for surfaces...
        # - the mesh this field lives on is obtained by
        #   - f.getSm() for a SurfField (must be either
        #   self.bdSurfMesh or self.scSurfMesh)
        #   - f.getVm() for a VolField (must be self.volMesh)
        #   NB: a generic method f.getMesh() might be written in java,
        #   if good for jython
        #   NB2: the meshes are nor duplicated in java, hence testing
        #   whether f.getSm() is self.bdSurfMesh or self.scSurfMesh,
        #   can in principle be done by comparing references
```

9 Annexe 4: Task dependence tree, tasklist.py script.

```
import sys

print "Please wait..."
sys.stdout.write("Tasks loading")
from Bin.Tasks.TaskCADImporter            import TaskCADImporter; sys.stdout.write(".")
from Bin.Tasks.TaskMesher                 import TaskMesher; sys.stdout.write(".")
from Bin.Tasks.TaskMaterial               import TaskMaterial; sys.stdout.write(".")
from Bin.Tasks.TaskGroupManager           import TaskGroupManager; sys.stdout.write(".")
from Bin.Tasks.TaskFieldManager           import TaskFieldManager; sys.stdout.write(".")
from Bin.Tasks.TaskSpisNumInterface       import TaskSpisNumInterface; sys.stdout.write(".")
from Bin.Tasks.TaskViewPipeline1          import TaskViewPipeline1; sys.stdout.write(".")
from Bin.Tasks.TaskViewPipeline2          import TaskViewPipeline2; sys.stdout.write(".")
from Bin.Tasks.TaskToolCaller             import TaskToolCaller; sys.stdout.write(".")
from Bin.Tasks.TaskEditIni                import TaskEditIni; sys.stdout.write(".")
from Bin.Tasks.TaskPrompt                 import TaskPrompt; sys.stdout.write(".")
from Bin.Tasks.TaskFileChooser            import TaskFileChooser; sys.stdout.write(".")
from Bin.Tasks.TaskJyTop                  import TaskJyTop; sys.stdout.write(".")
from Bin.Tasks.TaskMesher2D               import TaskMesher2D; sys.stdout.write(".")
from Bin.Tasks.TaskMesher3D               import TaskMesher3D; sys.stdout.write(".")
from Bin.Tasks.TaskBuildDataFieldChooser  import TaskBuildDataFieldChooser; sys.stdout.write(".")
from Bin.Tasks.TaskBuildPlot2D            import TaskBuildPlot2D; sys.stdout.write(".")
from Bin.Tasks.TaskEditNumSettings        import TaskEditNumSettings; sys.stdout.write(".")
from Bin.Tasks.TaskGroupEditor            import TaskGroupEditor; sys.stdout.write(".")
from Bin.Tasks.TaskReloadSolver           import TaskReloadSolver; sys.stdout.write(".")
from Bin.Tasks.TaskSaveProj               import TaskSaveProj; sys.stdout.write(".")
from Bin.Tasks.TaskSaveProjAs             import TaskSaveProjAs; sys.stdout.write(".")
from Bin.Tasks.TaskLoadProj               import TaskLoadProj; sys.stdout.write(".")
from Bin.Tasks.TaskMaterialEditor         import TaskMaterialEditor; sys.stdout.write(".")
from Bin.Tasks.TaskElecNodeEditor         import TaskElecNodeEditor; sys.stdout.write(".")
from Bin.Tasks.TaskPlasmaEditor           import TaskPlasmaEditor; sys.stdout.write(".")
from Bin.Tasks.TaskDataEditor             import TaskDataEditor; sys.stdout.write(".")
from Bin.Tasks.TaskReload                 import TaskReload; sys.stdout.write(".")
from Bin.Tasks.TaskInitGroup              import TaskInitGroup; sys.stdout.write(".")
from Bin.Tasks.TaskConvertGroup           import TaskConvertGroup; sys.stdout.write(".")
from Bin.Tasks.TaskSaveCAD                import TaskSaveCAD; sys.stdout.write(".")
from Bin.Tasks.TaskLoadCAD                import TaskLoadCAD; sys.stdout.write(".")
from Bin.Tasks.TaskSaveProperties         import TaskSaveProperties; sys.stdout.write(".")
from Bin.Tasks.TaskLoadProperties         import TaskLoadProperties; sys.stdout.write(".")
from Bin.Tasks.TaskNewProject             import TaskNewProject; sys.stdout.write(".")
from Bin.Tasks.TaskSolverInit             import TaskSolverInit; sys.stdout.write(".")
from Bin.Tasks.TaskSolverBuildSim         import TaskSolverBuildSim; sys.stdout.write(".")
from Bin.Tasks.TaskSolverRun              import TaskSolverRun; sys.stdout.write(".")
from Bin.Tasks.TaskSolverReadSim          import TaskSolverReadSim; sys.stdout.write(".")
from Bin.Tasks.TaskParaview               import TaskParaview; sys.stdout.write(".")
from Bin.Tasks.TaskParamsEditor           import TaskParamsEditor; sys.stdout.write(".")
from Bin.Tasks.TaskSaveGroups             import TaskSaveGroups; sys.stdout.write(".")
from Bin.Tasks.TaskLoadGroups             import TaskLoadGroups; sys.stdout.write(".")
from Bin.Tasks.TaskDocCaller              import TaskDocCaller; sys.stdout.write(".")
from Bin.Tasks.TaskCallCassandra          import TaskCallCassandra; sys.stdout.write(".")
from Bin.Tasks.TaskCallJyConsole          import TaskCallJyConsole; sys.stdout.write(".")
from Bin.Tasks.TaskCallMemoryMonitor      import TaskCallMemoryMonitor; sys.stdout.write(".")
from Bin.Tasks.TaskCallJSynoptic          import TaskCallJSynoptic; sys.stdout.write(".")
from Bin.Tasks.TaskMeshSplitter           import TaskMeshSplitter; sys.stdout.write(".")
from Bin.Tasks.TaskInitFields             import TaskInitFields; sys.stdout.write(".")
from Bin.Tasks.TaskExit                   import TaskExit; sys.stdout.write(".")
from Bin.Tasks.TaskExportToGmshMesh       import TaskExportToGmshMesh; sys.stdout.write(".")
from Bin.Tasks.TaskMeshImporter           import TaskMeshImporter; sys.stdout.write(".")
from Bin.Tasks.TaskDataBusCleaner         import TaskDataBusCleaner; sys.stdout.write(".")
from Bin.Tasks.TaskCallNumParamEditor     import TaskCallNumParamEditor; sys.stdout.write(".")
from Bin.Tasks.TaskEditCharScales         import TaskEditCharScales; sys.stdout.write(".")
from Bin.Tasks.TaskPicUpParamsEditor      import TaskPicUpParamsEditor; sys.stdout.write(".")
from Bin.Tasks.TaskExportToPicUp          import TaskExportToPicUp; sys.stdout.write(".")
from Bin.Tasks.TaskCallPicUp3D            import TaskCallPicUp3D; sys.stdout.write(".")
from Bin.Tasks.TaskCallPicUp3DReload      import TaskCallPicUp3DReload; sys.stdout.write(".")
from Bin.Tasks.TaskProjectControler       import TaskProjectControler; sys.stdout.write(".")
from Bin.Tasks.TaskProjectLoaderFormat2   import TaskProjectLoaderFormat2; sys.stdout.write(".")
from Bin.Tasks.TaskGeomManager            import TaskGeomManager; sys.stdout.write(".")
from Bin.Tasks.TaskExecuteCmdAsDemaon     import TaskExecuteCmdAsDemaon; sys.stdout.write(".")
from Bin.Tasks.TaskAbout                  import TaskAbout; sys.stdout.write(".")
print ""
class TasksList:
    '''
    Define the dependence tree of all Tasks defined in the SPIS-UI framework.
    If you whish add de new Tasks, you must:

    1) Add it import in this module, as follow:

       from Bin.Tasks.TaskMyTask                 import TaskMyTask; sys.stdout.write(".")

    2) Add it in the tasklist self.tasks, as follow:

        (TaskMesher("iMyTask", 0, "Other")                                  , "MyTask")

        The 0 flag means that this task must be run in forground mode.

        "Other" is the name of the Task on whish one your task is dependent on.

        The last field "MyTask" is the string corresponding the celling message used
        by the TaskManager to perform the task. Typically, this string is returned by the
        main SPIs-UI GUI.

    Please see the SPIS-UI Developper Guide for further informations.
    '''

    def __init__(self):
        #print "Tasks list intantiation"
        self.isDeamon = 1
        self.tasks = []

    def initTasksList(self):
        '''
        initialises the depedence tree (tasklist).
        '''
        # dependency tree between tasks.
        print "Building of the dependence tree..."
        #print "isDeamon", self.isDeamon
        self.tasks = [(TaskFileChooser("FileChooser")                        , "FileChooser"),
                    (TaskCADImporter("CADImporter", 0)                       , "CADImporter"),
                    (TaskMesher("Mesher", 0, "CADImporter")                  , "Mesher"),
                    (TaskViewPipeline1("ViewPipeline1", 0, "ConvertGroup")   , "ViewPipeline1"),
                    (TaskMaterial("Material")                                , "Material"),
                    (TaskGroupManager("GroupManager", 0, "Material")         , "GroupManager"),
                    (TaskFieldManager("FieldManager", 0, "ConvertGroup", \
                    "InitFields")                 , "FieldManager"),
                    (TaskSpisNumInterface("SpisNumInterface", 0, \
                                                               "FieldManager", \
                                                               "ParamsEditor"), "SpisNumInterface"),
                    (TaskViewPipeline2("ViewPipeline2", self.isDeamon)        , "ViewPipeline2"),
                    (TaskJyTop("JyTop", self.isDeamon)                        , "JyTop"),
                    (TaskToolCaller("ToolCaller", self.isDeamon)              , "ToolCaller"),
                    (TaskEditIni("EditIni", self.isDeamon)                    , "EditIni"),
                    (TaskPrompt("Prompt", self.isDeamon)                      , "Prompt"),
                    (TaskMesher2D("Mesher2D", 0, "CADImporter")               , "Mesher2D"),
                    (TaskMesher3D("Mesher3D", 0, "CADImporter")               , "Mesher3D"),
                    (TaskBuildDataFieldChooser("BuildDataFieldChooser", self.isDeamon) ,
"BuildDataFieldChooser"),
                    (TaskBuildPlot2D("BuildPlot2D",self.isDeamon)             , "BuildPlot2D"),
                    (TaskGroupEditor("GroupEditor", 0)                        , "GroupEditor"),
                    (TaskReloadSolver("ReloadSolver")                         , "ReloadSolver"),
                    (TaskSaveProj("SaveProj", self.isDeamon)                  , "SaveProj"),
                    (TaskSaveProjAs("SaveProjAs",self.isDeamon)               , "SaveProjAs"),
                    (TaskLoadProj("LoadProj")                                 , "LoadProj"),
                    (TaskMaterialEditor("MaterialEditor", self.isDeamon)      , "MaterialEditor"),
                    (TaskElecNodeEditor("ElecNodeEditor", self.isDeamon)      , "ElecNodeEditor"),
                    (TaskPlasmaEditor("PlasmaEditor", self.isDeamon)          , "PlasmaEditor"),
                    (TaskDataEditor("DataEditor", self.isDeamon)              , "DataEditor"),
                    (TaskReload("Reload")                                     , "Reload"),
                    (TaskInitGroup("InitGroup")                               , "InitGroup"),
                    (TaskConvertGroup("ConvertGroup", 0, "Mesher3D")          , "ConvertGroup"),
                    (TaskSaveCAD("SaveCAD", self.isDeamon)                    , "SaveCAD"),
                    (TaskLoadCAD("LoadCAD")                                   , "LoadCAD"),
                    (TaskSaveProperties("SaveProperties", self.isDeamon)      , "SaveProperties"),
                    (TaskLoadProperties("LoadProperties")                     , "LoadProperties"),
                    (TaskNewProject("NewProject")                             , "NewProject"),
                    (TaskSolverInit("SolverInit", 0)                          , "SolverInit"),
                    (TaskSolverBuildSim("SolverBuildSim")                     , "SolverBuildSim"),
                    (TaskSolverRun("SolverRun", self.isDeamon)                , "SolverRun"),
                    (TaskSolverReadSim("SolverReadSim")                       , "SolverReadSim"),
                    (TaskParaview("Paraview", self.isDeamon)                  , "Paraview"),
                    (TaskParamsEditor("ParamsEditor", 0)                      , "ParamsEditor"),
                    (TaskSaveGroups("SaveGroups")                             , "SaveGroups"),
                    (TaskLoadGroups("LoadGroups")                             , "LoadGroups"),
                    (TaskDocCaller("DocCaller", self.isDeamon)                , "DocCaller"),
                    (TaskCallCassandra("CallCassandra", self.isDeamon)        , "CallCassandra"),
                    (TaskCallJyConsole("CallJyConsole", self.isDeamon)        , "CallJyConsole"),
                    (TaskCallMemoryMonitor("CallMemoryMonitor", self.isDeamon),
"CallMemoryMonitor"),
                    (TaskCallJSynoptic("CallJSynoptic", self.isDeamon)        , "CallJSynoptic"),
                    (TaskMeshSplitter("MeshSplitter", 0, "InitFields")        , "MeshSplitter"),
                    (TaskInitFields("InitFields",0, "ConvertGroup")           , "InitFields"),
                    (TaskExit("Exit")                                         , "Exit"),
                    (TaskExportToGmshMesh("ExportToGmshMesh", self.isDeamon)  , "ExportToGmshMesh"),
                    (TaskMeshImporter("MeshImporter")                         , "MeshImporter"),
                    (TaskCallNumParamEditor("CallNumParamEditor")             ,
"CallNumParamEditor"),
                    (TaskDataBusCleaner("DataBusCleaner")                     , "DataBusCleaner"),
                    (TaskEditCharScales("EditCharScales")                     , "EditCharScales"),
                    (TaskPicUpParamsEditor("PicUpParamsEditor")             , "PicUpParamsEditor"),
                    (TaskExportToPicUp("ExportToPicUp" 0,"EditCharScales","PicUpParamsEditor"),
"ExportToPicUp"),
                    (TaskCallPicUp3D("CallPicUp3D",0,"PicUpParamsEditor","ExportToPicUp"),
"CallPicUp3D"),
                    (TaskCallPicUp3DReload("CallPicUp3DReload"), "CallPicUp3DReload"),
                    (TaskProjectControler("ProjectControler"), "ProjectControler"),
                    (TaskProjectLoaderFormat2("ProjectLoaderFormat2",self.isDeamon),
"ProjectLoaderFormat2"),
                    (TaskGeomManager("GeomManager", self.isDeamon), "GeomManager"),
                    (TaskExecuteCmdAsDemaon("ExecuteCmdAsDemaon", self.isDeamon),
"ExecuteCmdAsDemaon"),
                    (TaskAbout("About",  self.isDeamon), "About")
                    ]

    def setAllAlive(self):
        '''
        Forces all tasks to be in forground mode. Usefull in script or batch mode.
        '''
        self.isDeamon = 0
```