vtkESQui Developer's Guide

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Contents

1 Introduction

The aim of this document is to describe the *vtkESQui* project, in a detailed manner. This documentation is focused to developers who want to experiment with this platform.

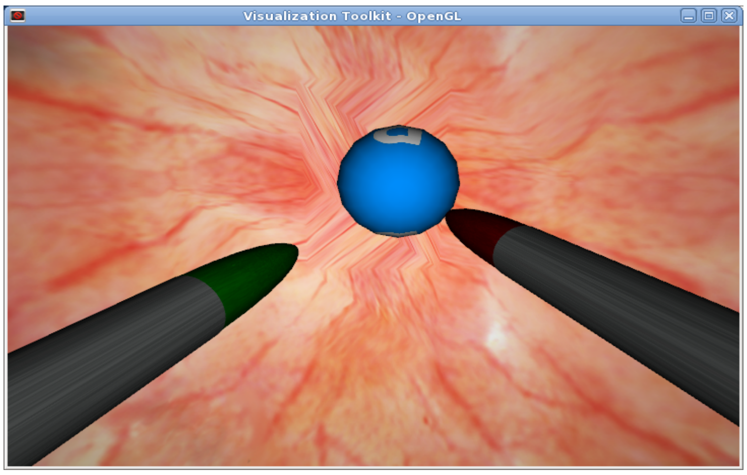
1.1 Background

vtkESQui is a surgical simulation software platform. The purpose of this project to provide a framework which allows, in an easy way, to build a virtual simulation of minimallly invasive surgical techniques.

These platform, is a vtk-based software project that has been implemented in C++. The distribution follows the standard structure for vtk's projects. There are a few access layers to ease the use of the platform, such as: Tcl and Python.

Compilation of the platform is done with *CMake*, what makes it a cross-platform project. It has been compiled and fully tested in Windows and Unix systems.

The goal is to provide the user a simple way to build a surgical scenario and easily interact with it. In a few words, a scenario (organs, tools, etc...) is generated and a simulation process is executed to manage the interaction between these scenario objects.



vtkESQui surgical scenario simulation

In vtkESQui platform, there are two ways of controlling the simulation objects, let's say simulation interactors:

- Keyboard + Mouse: Depending on the type of simulation, a mouse movement combined with akeyboard layout is used to control the objects (tools).
- Haptic Devices: In case an haptic device is available, it can be used to handle the simulation instruments. Interfaces has been implemented for the following haptic devices:

Xitact VSP	Endovascular techniques
Xitact IHP	Laparoscopic & Arthroscopic techniques
Immersion LSW	Laparoscopic technique: Laparoscopic techniques

Note

Haptic technology is a tactile feedback technology that estimulate the user sense of touch by applying forces and vibrations to the control device. It has been proved that haptic devices are extremely useful for training minimally invasive procedures, improving instrument control and making more realistic simulations.

Import of surgical scenarios into the *vtkESQui* framework is done from an SRML file, that contains all the information required to define a surgical simulation:

- Simulation: Simulation parameters such as: type, time rates, etc...
- Environment
  - Camera: position, orientation...
  - Lights: intensity, color...
- Objects: scenario objects such as: organs, tools, etc...
  - Elements
    - Models: visualization, collision and deformation models

1.2 Software License

2 Installation

This sectioncovers the whole process required to have your own copy of *vtkESQui* properly installed and fully working in your computer.

2.1 Requirements

In order to use this software the following packages must be installed:

- *VTK*. version > 5.6. http://www.vtk.org
- *Tcl/Tk*. version > 8.4. http://www.tcl.tk
- *CMake*. version > 2.5. http://www.cmake.org

This software has been compiled and tested in:

- Windows: (Visual Studio 2005 and Visual Studio 2008)
- Unix: (gcc > 4.4).

2.2 Download

There are multiple ways to get the software:

- Download the latest release at http://motivando.me/vtkESqui.html
- Insight Journal
- Access the git source-code repository:

```
$ git clone git://aecio/vtkESQui.git
```

2.3 Configuring

As a vtk-based project, *vtkESQui* configuration and compilation is done using *CMake* (http://cmake.org). *CMake* is a cross-platform, open-source build system that automatically generates makefiles and workspaces for later compilation.

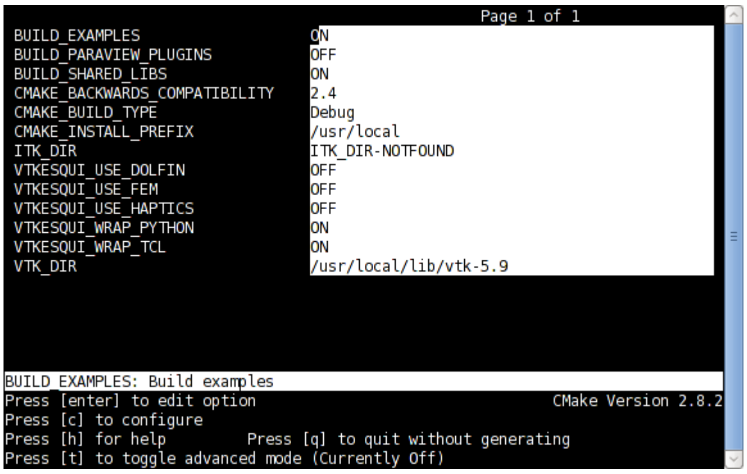
1. Once the source code has been downloaded and extracted/saved into a directory, let's name it VTKESQUI_DIR, a new binary directory has to be created.

   In Unix-like systems:

   ```
   $ mkdir vtkESQuiBin
   $ cd vtkESQuiBin
   $ ccmake ../VTKESQUI_DIR
   ```

   In Windows, the CMake GUI is used to define source and binary dir.

2. Follow the *ccmake* configuration. Don't forget to set the VTK_DIR path (the folder where you have compiled vtk and you have your VTKConfig.cmake file), and the Tcl/Tk libraries path. If you would like to use the software with haptic devices (LWS-Immersion Corp, IHP,etc), please set the *CMake* variable VTKESQUI_USE_HAPTICS to ON. The wrapping and other configuration are done by default (they are included in the CMakelist.txt file).



```
                                                 Page 1 of 1
 BUILD_EXAMPLES                  ON
 BUILD_PARAVIEW_PLUGINS          OFF
 BUILD_SHARED_LIBS               ON
 CMAKE_BACKWARDS_COMPATIBILITY   2.4
 CMAKE_BUILD_TYPE                Debug
 CMAKE_INSTALL_PREFIX            /usr/local
 ITK_DIR                         ITK_DIR-NOTFOUND
 VTKESQUI_USE_DOLFIN             OFF
 VTKESQUI_USE_FEM                OFF
 VTKESQUI_USE_HAPTICS            OFF
 VTKESQUI_WRAP_PYTHON            ON
 VTKESQUI_WRAP_TCL               ON
 VTK_DIR                         /usr/local/lib/vtk-5.9



BUILD_EXAMPLES: Build examples
Press [enter] to edit option                           CMake Version 2.8.2
Press [c] to configure
Press [h] for help           Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

CMake configuration options

3. Finally, after configuring the *CMake* options:

   In Unix-like systems:

   Press 'c' to configurate project and then 'g' to generate the makefiles

   In Windows:

   Press Configure button and then Generate button.

2.4 Building

Once you have succesfully configured the project, the building process is started by:

In Unix:

```
$ make
```

If anything went wrong, you may have vtkESQui platform compiled. If you want to install vtkESQui in your operating system you must type:

```
$ make install
```

In Windows you must import the project in Visual Studio, and compile it as usual.

2.5 Setting up the environment

Set the environment variables: LD_LIBRARY_PATH and TCLLIBPATH to the path where are the (.so/dlls) vtk/wrapping libraries. If you have other Tcl/Tk versions, you should declare the TK_LIBRARY and TCL_LIBRARY variables.

i.e. (under linux):

```
export LD_LIBRARY_PATH=/usr/local/lib/vtk-5.9:/home/user/software/ESQUI/EsquiBin/bin/
export TCLLIBPATH=/home/user/software/ESQUI/ESQUI/Wrapping/Tcl
```

3 Design

This section contains a detailed description of the *vtkEQSui* framework design layout.

3.1 Structure

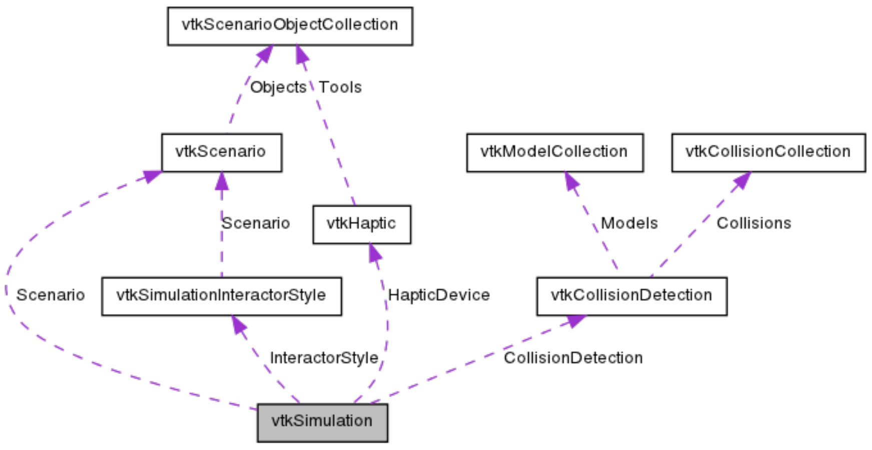
As vtk-based project, *vtkESQui* follows the *VTK* folder structure. The framework has been implemented in a modular way, trying to make, if possible, every module independent from the rest. In this release the following folders are included:

Module	Description
BioMechanics	Biomechanical (deformation) models and interfaces
CollisionDetection	Collision detection models and interfaces
Common	Project wide needed by the project
Documentation	Documentation of the platform: Doxygen, user & developer guides
Examples	List of examples implemented in C++ and Tcl
Haptics	Classes that wrap the haptic device's API
Scenario	Management of the rendered objects
Simulation	Simulation process execution
Utilities	Scripts and C++ classes to share/export/import models
Wrapping	Code for wrapping under Tcl

Each module of the platform is stored in one folder, containing all the *C++* classes and testing scripts.

3.2 Framework

The following diagram shows in a glimpse the architecture of the platform:



vtkSimulation class executes a cyclic process at time rate previously defined. The whole simulation is updated on every step and the render window is refreshed to display any change the scenario objects could have suffered.

In a standard simulation process there are three main modules involved:

- Collision: Handle collision between scenario object models
- Rendering: Refresh object display properties

- Interaction: User-machine interface for simulation object control

Attending to the *vtkESQui* structure, in the following section all the project classes are described.

4 Modules

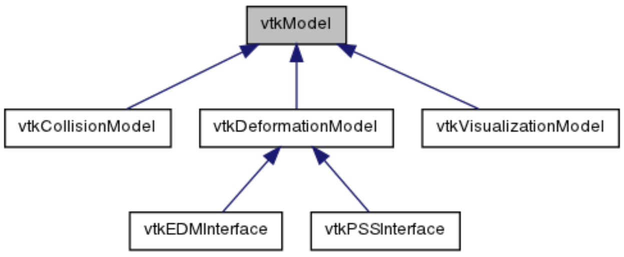
In this section we explain the usage and the functionalities of the modules developed using the *vtkESQui* framework.

4.1 Common

The Common module contains all the core classes that serve as base class for the rest of the project classes.

4.1.1 *vtkModel*

This class represents an abstract model on a scenario element. It acts as a base class for visualization, collision and deformation models.



vtkModel class has two inputs. By default the input data will be read from a vtp file specified in *FileName* attribute. There is a second optional parameter, the source. The output displays the transformed mesh according to transfromation matrix values.

4.1.2 *vtkModelCollection*

vtkModelCollection is an object for creating and manipulating lists of scenario element models. The lists are unsorted and allow duplicate entries.

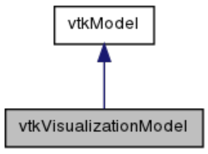
4.2 Scenario

Scenario module contains all classes that manage the scenario objects display. A revision to all these classes, from bottom to top in its hierarchy level, is made in this section of the document.

4.2.1 *vtkVisualizationModel*

vtkVisualizationModel object defines a visualization mesh (vtkPolyData)

This class inherits from vtkModel base class. As it is specified in vtkModel, at least an input mesh should be defined. Optionally a source mesh for synchronization purposes may be defined.

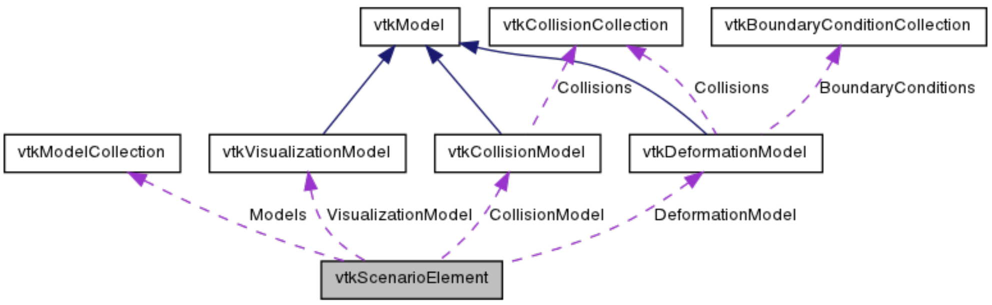


To enhance visualization user experience a mesh texture can be specified through the *TextureFileName* attribute.

4.2.2 *vtkScenarioElement*

vtkScenarioElement class implements the use of a surgical scenario element

This class contains all the required attributes to define a scenario element, providing an easy use of element models collections.



Every element has at least a visualization model (vtkVisualizationModel), and optionally a collision model (vtkCollisionModel) and a deformation model (vtkDeformationModel).

Please refer to Examples section if you want to know more about this class.

4.2.3 *vtkScenarioElementCollection*

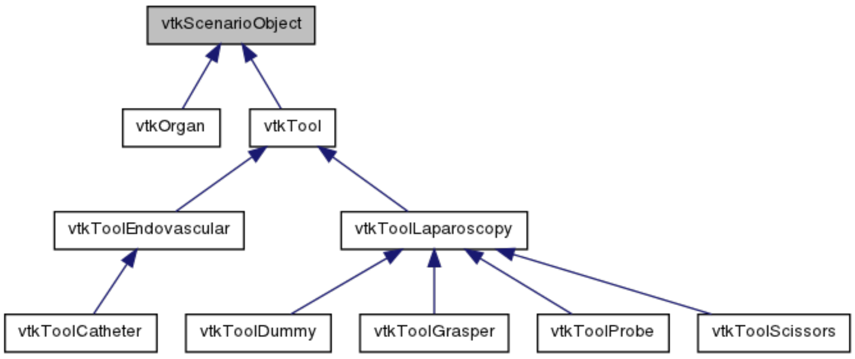
vtkScenarioElementCollection is an object for creating and manipulating lists of scenario element models (vtkScenarioElement). The lists are unsorted and allow duplicate entries.

4.2.4 *vtkScenarioObject*

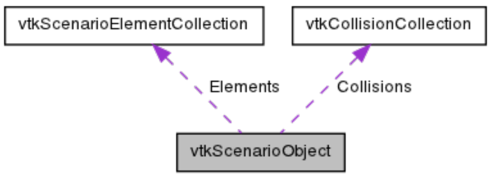
vtkScenarioObject class implements the use of a surgical scenario object.

This class contains all the required attributes to define a scenario object, providing an easy use of surgical objects such as: tools, organs, etc...

The following graph shows the inheritance hierarchy of this class:



Every scenario object is formed a collection of scenario elements, *Elements*, implemented in the vtkScenarioElement class. At least one scenario element per scenario object must be defined.



In order to manage scenario objects interaction a collection of collisions (see vtkCollisionCollection), *Collisions*, has been included in this this class.

Please refer to Examples section if you want to know more about this class.

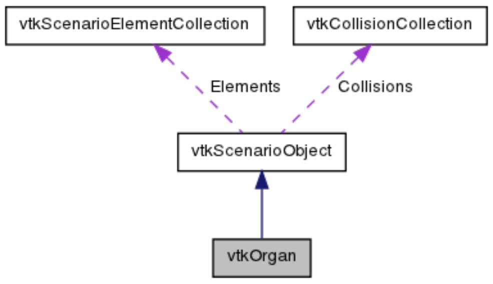
4.2.5 vtkScenarioObjectCollection

vtkScenarioObjectCollection is an object for creating and manipulating lists of scenario object models (vtkScenarioObject). The lists are unsorted and allow duplicate entries.

4.2.6 vtkOrgan

Implementation class for scenario organ definition.

In vtkESQui an organ is considered an scenario object, so vtkScenarioObject serves as its base class.



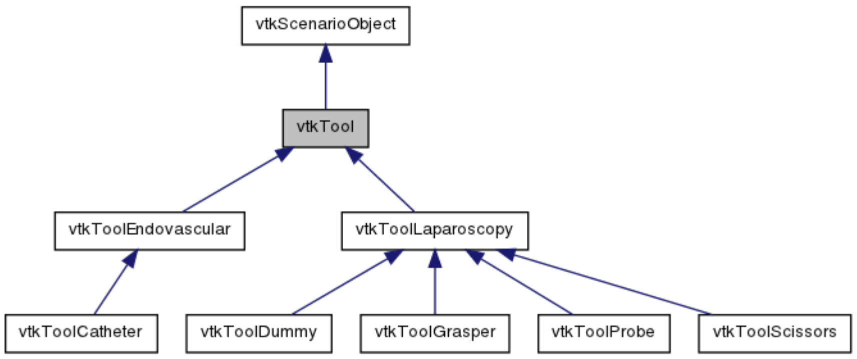
As a vtkModel based class, at least a visualization model has to be defined. If the organ is deformable, a deformation and a collision model must be also defined.

Please refer to Examples section if you want to know more about this class.

4.2.7 vtkTool

Implementation class for scenario tool definition.

In vtkESQui a tool is considered an scenario object, so vtkScenarioObject serves as its base class. This class is inherited by specific surgical technique tool implementations: vtkToolLaparoscopy, vtkToolEndovascular, etc...

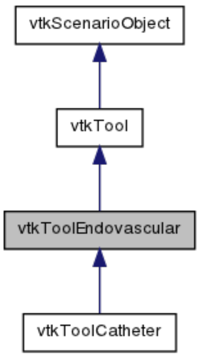


As a vtkModel based class, at least a visualization model has to be defined. If the tool is deformable, a deformation and a collision model must also be defined.

4.2.8 vtkToolEndovascular

vtkToolEndovascular class implements a surgical endovascular tool.

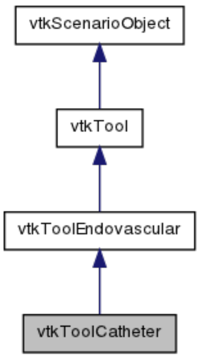
This class inherits from vtkTool, and serves as base class for specific endovascular techniques tools: vtkToolCatheter, etc...



A few specific movements (rotation, insertion, etc...) has been defined to control the tool.

4.2.9 *vtkToolCatheter*

Implementation class of an endovascular catheter tool.



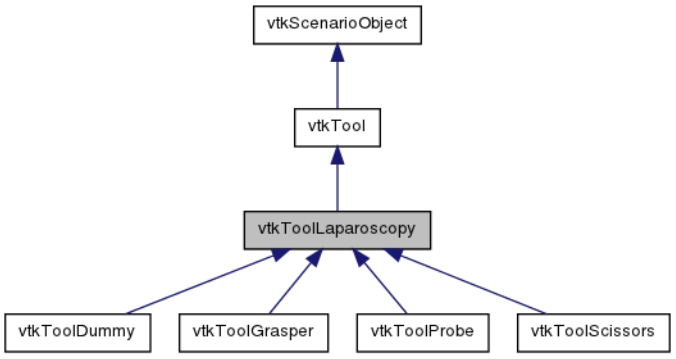
This class inherits from vtkToolEndovascular. Contains methods for position/orientation control of the tool in the scene and collision detection.

Please refer to Examples section if you want to know more about this class.

4.2.10 *vtkToolLaparoscopy*

vtkToolLaparoscopy class implements a surgical laparoscopic tool.

This class inherits from vtkTool, and serves as base class for specific laparoscopic techniques tools: vtkToolProbe, vtkToolGrasper, etc...

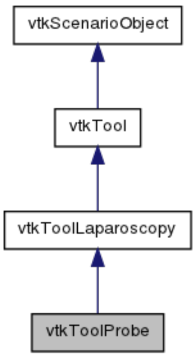


A few laparoscopic specific movements (rotation, insertion, opening etc...) has been defined to control the tool.

4.2.11 *vtkToolProbe*

Implementation class of a surgical laparoscopic probe.

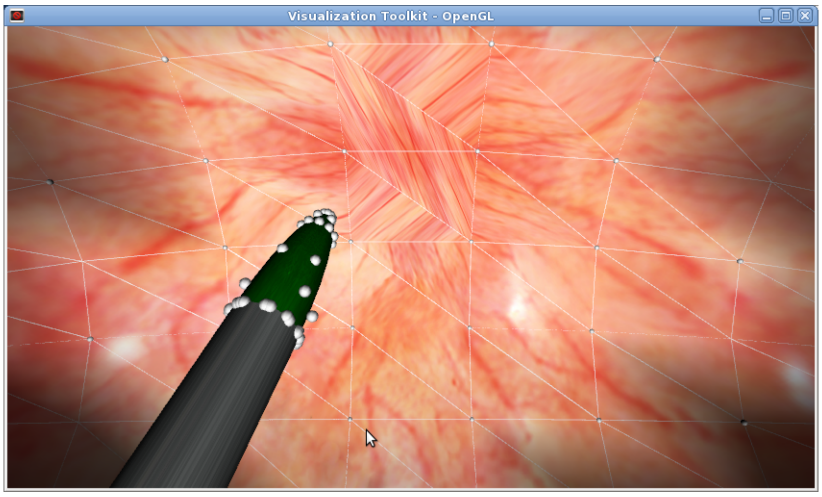
This class, that inherits from vtkToolLaparoscopy, defines a surgical laparoscopic probe, inside the scenario.



A laparoscopic probe is composed of 2 elements:

- *Stick*
- *Tip*

Contains methods for position control of the tool in the scene and collision detection.



vtkESQui simulation screenshot displaying a laparoscopic probe.

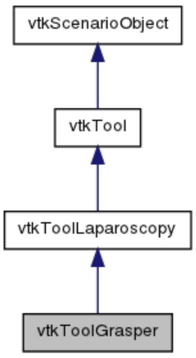
Note: The white dots represent the collision model and the white grid deformation model.

Please refer to Examples section if you want to know more about this class.

4.2.12 *vtkToolGrasper*

Implementation class of a surgical laparoscopic grasper.

This class, that inherits from vtkToolLaparoscopy, defines a surgical laparoscopic grasper, inside the scenario.

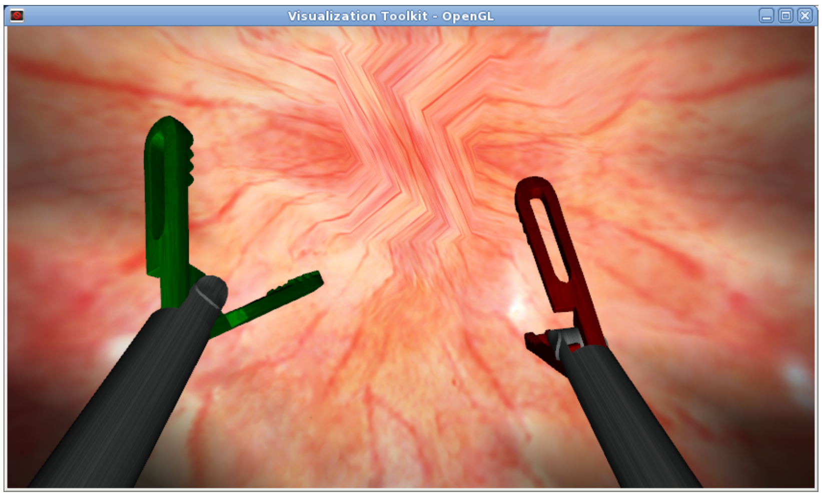


A laparoscopic probe is composed of 3 elements:

- *Stick*
- 2 *Levers*

Contains methods for position/orientation control of the tool in the scene and collision detection.

Please refer to Examples section if you want to know more about this class.



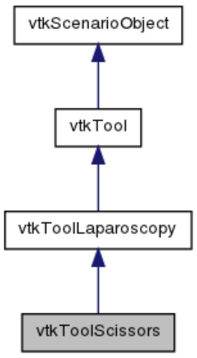
vtkESQui simulation screenshot displaying two laparoscopic graspers.

Note: The white dots represent the collision model and the white grid deformation model.

4.2.13 vtkToolScissors

Implementation class of surgical laparoscopic scissors.

This class, that inherits from vtkToolLaparoscopy, defines surgical laparoscopic scissors, inside the scenario.



Laparoscopic scissors are composed of 3 elements:

- *Stick*
- 2 *Blades*

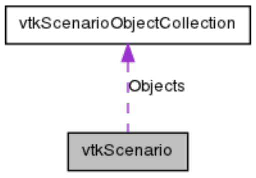
Contains methods for position/orientation control of the tool in the scene and collision detection.

Please refer to Examples section if you want to know more about this class.

4.2.14 vtkScenario

In *vtkESQui* framework a surgical scenario is implemented with this class.

All the elements in the scenario (objects, tools...) are stored in a collection, *Objects*. Any scenario object should be previously defined (all of its required parameters set) before being inserted/added to the scenario.



Apart from scenario objects, a *vtkRenderWindow* object must be assigned before object initialization for displaying purposes. The following code excerpt shows initialization process of the simulation scenario:

```
void vtkScenario::Init()
{
        if(!this->Initialized && this->RenderWindow)
        {
                this->Objects->InitTraversal();
                int i = 0;
                while(vtkScenarioObject * o = this->Objects->GetNextObject())
                {
                        o->SetRenderWindow(this->RenderWindow);
                        o->SetRenderer(this->Renderer);
                        o->SetId(i);

                        if(!o->IsInitialized()) o->Init();

                        //Add all actors to the render window
                        for(int id = 0; id<o->GetNumberOfElements(); id++)
                        {
                                vtkScenarioElement * e = o->GetElement(id);

                                //Display every visible model. Hiding model is done by vtkModel:Hide()
                                vtkModelCollection * models = e->GetModels();
                                models->InitTraversal();
```

```
                                        while(vtkModel * m = models->GetNextModel()){
                                                if(m->GetVisibility()) this->Renderer->AddActor(m->GetActor());
                                        }

                                }
                                i++;
                        }
                        this->Initialized = 1;
                }
        }
```

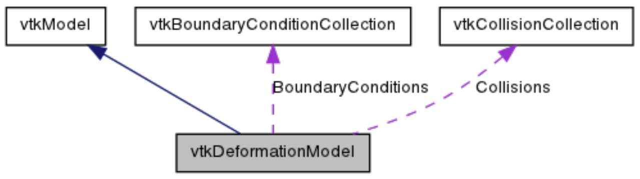
Please refer to Examples section if you want to know more about this class.

4.3 BioMechanics

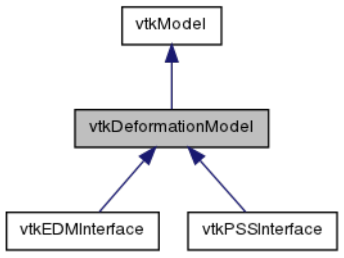
The BioMechanics module is filled with all the classes involved in deformation process of scenario objects. Every deformable scenario object, must have a deformation model defined. vtkDeformationModel class is the base class for the interfaces to several deformation systems.

4.3.1 *vtkDeformationModel*

vtkDeformationModel object defines a deformation model based on a mesh (vtkPolyData).



This class inherits from vtkModel base class. As it is specified in vtkModel, at least an input mesh should be defined. Optionally a source mesh for synchronization purposes may be defined.



An interface based on this class must be implemented to access available deformation models:

- vtkParticleSpringSystem: vtkPSSInterface
- vtkExplicitDeformableModel: vtkEDMInterface

4.3.2 *vtkBoundaryCondition*

This class contains the required information to define a boundary condition.

vtkBoundaryCondition acts as data container storing all the useful information of a boundary condition:

- *Type*
- *Value*
- *Point Identifier*
- *Point Position*

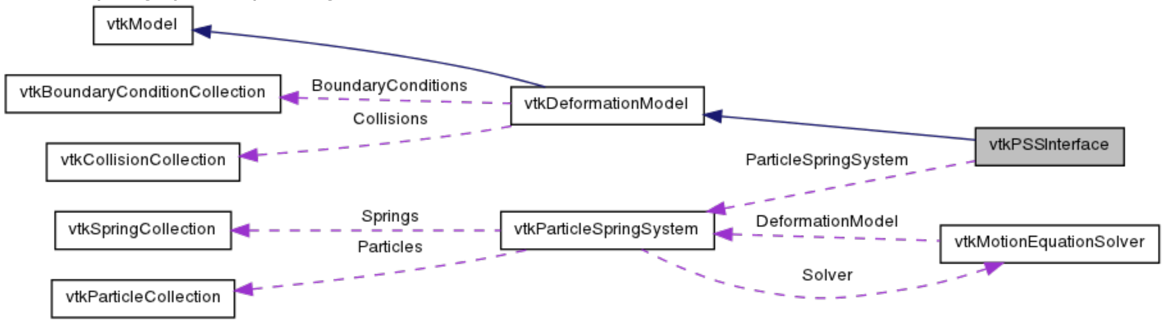
4.3.3 vtkBoundaryConditionCollection

vtkBoundaryConditionCollection is an object for creating and manipulating lists of boundary conditions (vtkBoundaryCondition). The lists are unsorted and allow duplicate entries.

4.3.4 vtkPSSInterface

Interface class for a particle-spring deformation system.

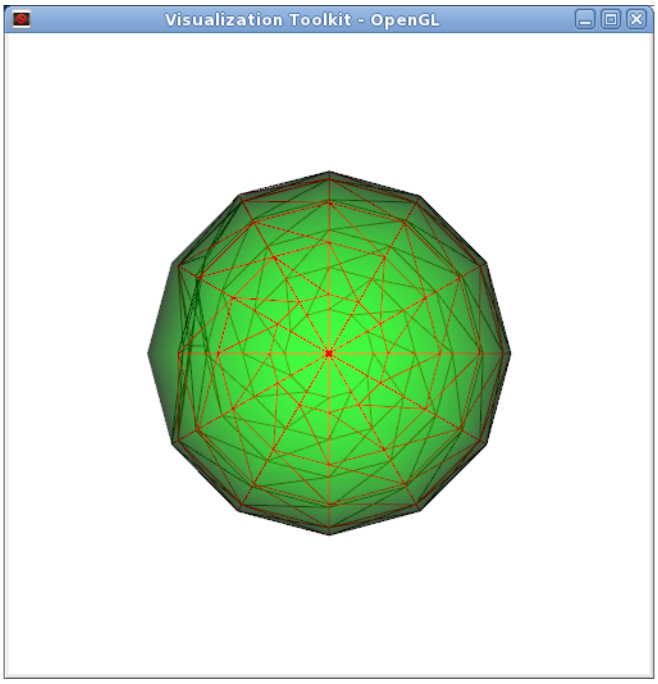
This class, based in vtkDeformationModel class, adapts the access to the external vtkParticleSpringSystem package.



The interface has to be initialized in order to be updated. Some parameters must be previously defined:

- Input: vtkPolyData object
- DistanceCoefficient: Maximum distance between points
- DampingCoefficient: (d) oscillation coefficient
- SpringCoefficient: (K) spring coefficient
- Mass: unit mass of each particle
- RigidityFactor: n-neighborhood connectivity
- DeltaT: time step of deformation process
- SolverType: motion equation solver type

The following screenshot displays the input mesh in translucid green and the deformed output as a grid.



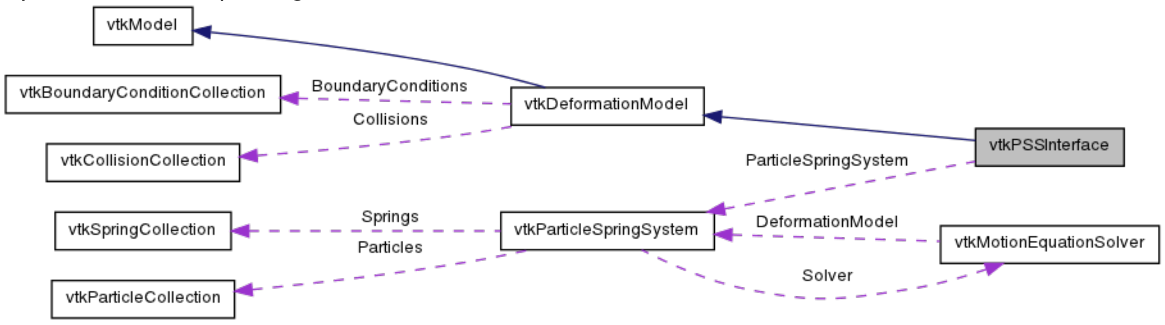
vtkESQui screenshot displaying an particle-spring deformation process

Please check Testing source folder if you want to know more about this class.

4.3.5 vtkEDMInterface

Interface class for a explicit deformation system. This deformatiom model uses a level set technique adapting the input mesh to a *vtkImageData* input.

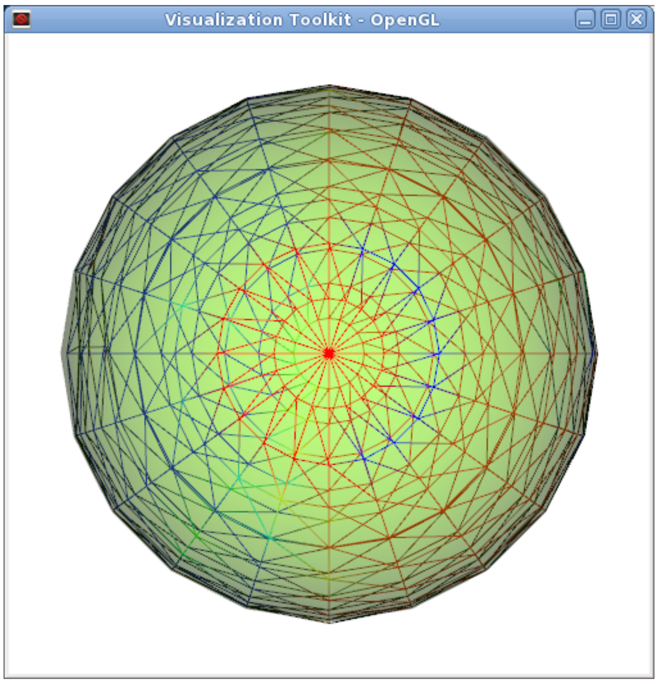
vtkEDMInterface class, based in vtkDeformationModel class, adapts the access to the external vtkExplicitDeformable package.



The interface has to be initialized in order to be updated. Some parameters must be previously defined:

- *Input*: vtkPolyData object
- *NumberOfIterations*: Maximum number of iterations
- *WarpScaleFactor*: Deformation scale factor

The following screenshot displays the input mesh in translucid green and the deformed output as a grid.



vtkESQui screenshot displaying an explicit deformation process

Please Testing source folder if you want to know more about this class.

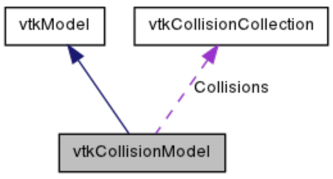
4.4 CollisionDetection

In the CollisionDetection model are stored all the classes involved in the collision detection process. This process is run over the scenario obejct collision models (vtkCollisionModel) and the obtained results are saved as vtkCollision objects.

4.4.1 vtkCollisionModel

vtkCollisionModel object defines a collision model based on a mesh (vtkPolyData).

This class inherits from vtkModel base class. As it is specified in vtkModel, at least an input mesh should be defined. Optionally a source mesh for synchronization purposes may be defined.



4.4.2 vtkCollision

This class contains the required information to define a collision.

vtkCollision acts as data container storing all the useful information of a scenario collision:

- *Type*
- *ObjectId*
- *ElementId*
- *Point Id*

- *Point Position*
- *Cell Id*
- *Distance* between collided points
- *Displacement* vector obtained from objects inertia

All the information is stored in pair, one for each scenario object collided.

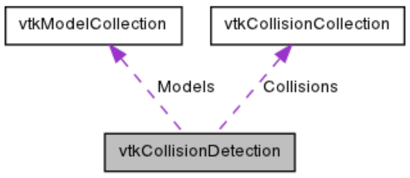
4.4.3 vtkCollisionCollection

vtkCollisionCollection is an object for creating and manipulating lists of scenario object collisions (vtkCollision). The lists are unsorted and allow duplicate entries.

4.4.4 vtkCollisionDetection

Generic base class for collision detection library interfaces

This class serves as a base class for the collision detection libraries. Scenario object models, vtkCollisionModel must be assigned before process execution. The result of the procedure is collection of collisions, vtkCollisionCollection, between scenario objects.



vtkBioEngInterface, an interface based on this class, has been implemented to access the available deformation model, vtkbioeng.

4.4.5 vtkBioEngInterface

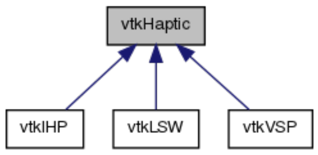
This interface enables tehe access to the vtkbioeng collision detection library. In a few words, the object collision models are translated to its defined position, and then evaluated to check if they intersect between each other.

For more info on this collision library refer to http://sourceforge.net/projects/vtkbioeng/

4.5 Haptics

4.5.1 vtkHaptic

Generic haptic class for haptic device interface implementation.

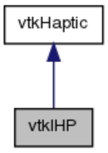


This generic class serves as base for haptic devices interfaces. The following interfaces has been implemented:

- vtkIHP: Xitact IHP. Laparoscopic and arthroscopic techniques.
- vtkVSP: Xitact VSP. Endovascular techniques.
- vtkLSW: Immersion LSW. Laparoscopic techniques.

4.5.2 vtkIHP

vtkIHP class wraps the access to the IHP haptic device. This interface enables the interaction with the Xitact IHP haptic device.

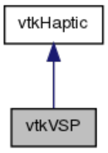


In a cyclic process the haptic is synchronously checked for changes. Device physical attributes are saved and then sent to the simulation process.

An access method to device initialization has also been implemented.

4.5.3 vtkVSP

vtkVSP class wraps the access to the VSP haptic device. This interface enables the interaction with the Xitact VSP haptic device.

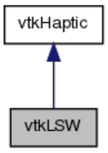


In a cyclic process the haptic is synchronously checked for changes. Device physical attributes are saved and then sent to the simulation process.

An access method to device initialization has also been implemented.

4.5.4 vtkLSW

vtkLSW class wraps the access to the LSW haptic device. This interface enables the interaction with the Immersion LSW haptic device.



In a cyclic process the haptic is synchronously checked for changes. Device physical attributes are saved and then sent to the simulation process.

Access method to device initialization has also been implemented.

4.5.5 vtkLSWTool

Immersion LSW tool interface class. This interface has been implemented to access each of the Immersion haptic device tools independently.

The haptic device could not be used unless a SetData command is sent to it. Once the tool has been initialized it could be accessed from a vtkESQui simulation process.

4.6 Simulation

This module purpose is to manage the surgical simulation process, including the following classes:

Class	Description

vtkSimulation	Simulation process management
vtkSimulationInteractorStyle	Default keyboard & mouse interactor

4.6.1 *vtkSimulation*

Implementation of the *vtkESQui* simulation process.

Simulation process is executed with timer callback function that handles three timed threaded loops at different rates:

- **Scenario**: This module purpose is to display/update all the scenario objects. Acts as an observer, listening to any possible change that may affect any of the scenario objects.
- **Collision**: A collision detection process that handles interaction between scenario object collision models. If any collision is detected, the scenario module is notified to apply changes to the objectes (deformation, displacements, etc..)
- **Interaction**: User-machine interface module. A haptic device, if present, send its internal values to the simulation process and the scenario objects are updated according to these values. If no haptic devices is present, then an auxiliary control system (Keyboard+Mouse) is available.

The following code excerpt shows implementation of the simulation process:

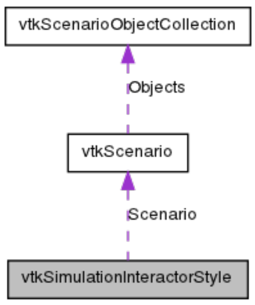
```
void func ( vtkObject* caller, long unsigned int eventId, void* clientData, void* callData )
{
        vtkSimulation * sim = static_cast<vtkSimulation*>(clientData);

        if (vtkCommand::TimerEvent == eventId)
        {
                int tid = * static_cast<int *>(callData);
                if (tid == sim->GetHapticTimerId())
                {
                        //cout << "Haptic\n";
                        sim->UpdateHaptic();
                }
                if (tid == sim->GetSimulationTimerId())
                {
                        //cout << "Simulation\n";
                        sim->UpdateScenario();
                }
                else if (tid == sim->GetRenderTimerId())
                {
                        //cout << "Render\n";
                        vtkRenderWindowInteractor * Interactor = sim->GetInteractor();
                        if (Interactor &&
                                        Interactor->GetRenderWindow() &&
                                        Interactor->GetRenderWindow()->GetRenderers())
                        {
                                Interactor->Render();
                        }
                }
        }
```

Please refer to Examples section if you want to know more about this class.

4.6.2 *vtkSimulationInteractorStyle*

Implementation of the simulation interactor style. Defines a standard keyboard layout for simulation control in laparoscopic techniques.



Mouse and keyboard events are handled and further actions, such as rotations or translations, implemented.

Please refer to Examples section if you want to know more about this class.

4.7 Utilities

The utilities module has been designed to act as an I/O interface of the *vtkESQui* framework. A few tools has been implemented to import data into the application.

4.7.1 vtkSRMLImporter

Import an SRML scenario file into vtkESQui framework.

The following parameters should be defined before import process:

- *FileName*: SRML file name (with full path)
- *DataPath*: Base path for SRML referenced data files.

The SRML file format is the standard *vtkESQui* input file. Basically, a SRML file is an XML file that contains all the information required for a simulation execution. A DTD has been defined to standarize the creation of these files:

```
<!ELEMENT Simulation (Scenario, Haptic*)>
<!ELEMENT Haptic (#PCDATA)>
<!ELEMENT Scenario (Environment, Objects*)>
<!ELEMENT Environment (Cameras, Lights)>
<!ELEMENT Cameras (Camera+)>
<!ELEMENT Camera (#PCDATA)>
<!ELEMENT Lights (Light+)>
<!ELEMENT Light (#PCDATA)>
<!ELEMENT Objects (Object+)>
<!ELEMENT Object (Elements)>
<!ELEMENT Elements (Element+)>
<!ELEMENT Element (Models)>
<!ELEMENT Models (Model+)>
<!ELEMENT Model (Interface?)>
<!ELEMENT Interface (#PCDATA)>

<!ATTLIST Simulation Name #IMPLIED>
<!ATTLIST Simulation Type #IMPLIED>
<!ATTLIST Simulation UseHaptic #REQUIRED>
<!ATTLIST Simulation RenderRate #REQUIRED>
<!ATTLIST Simulation HapticRate #REQUIRED>
<!ATTLIST Simulation SimulationRate #REQUIRED>
```

4.7.2 vtk2Blender

Tex_vtkBlender.py has been designed to import models designed in Blender (http://www.blender3d.org), a 3D modelling, animation and rendering software, into any vtk-based project.

For further information read Tex_Blender.py.pdf.

5 Examples