SOFA
Simulation Open Framework Architecture

Adaptative Beam Plugin

1 Installation

Uncomment the line

DEFINES += SOFA_HAVE_BEAMADAPTER

in *sofa-local.prf* (or *sofa-default.prf* if you have not created *sofa-local.prf*). Then, run qmake and make.

2 Sofa Datatypes

2.1 RigidType

2.2 SolidType

3 Beam Element

For the general introduction of beam theory and equations, see p.509 [5] .For detail of the construction local matrix, see the p.70 [2].

4 B-splines , Bézier Splines

B-splines in general and Bézier splines in particulary can see in [1] or more detail in [3]. A spline tool can see at [4]. Here assumed several general formula. In general, a Bézier curve order n is determined by $n+1$ control points (characteristic polygone) $P_{i,0\leqslant i\leqslant n}$. Its trajectory is :

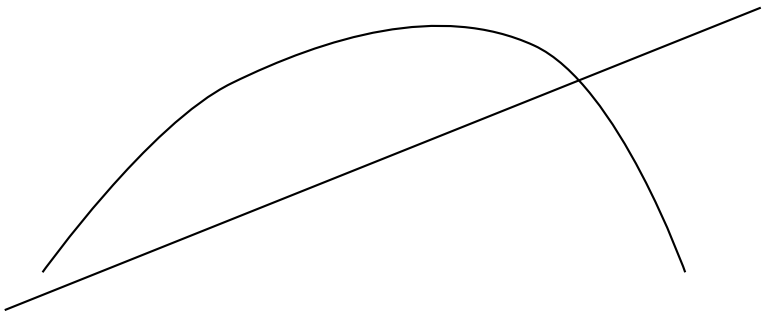
$$B(t) = \sum_{i=0}^{n} \hat{\mathbf{B}}_{i,n}(t).P_i$$

Where $\hat{\mathbf{B}}_{i,n}(t)$ are Bernstein polynomial given by

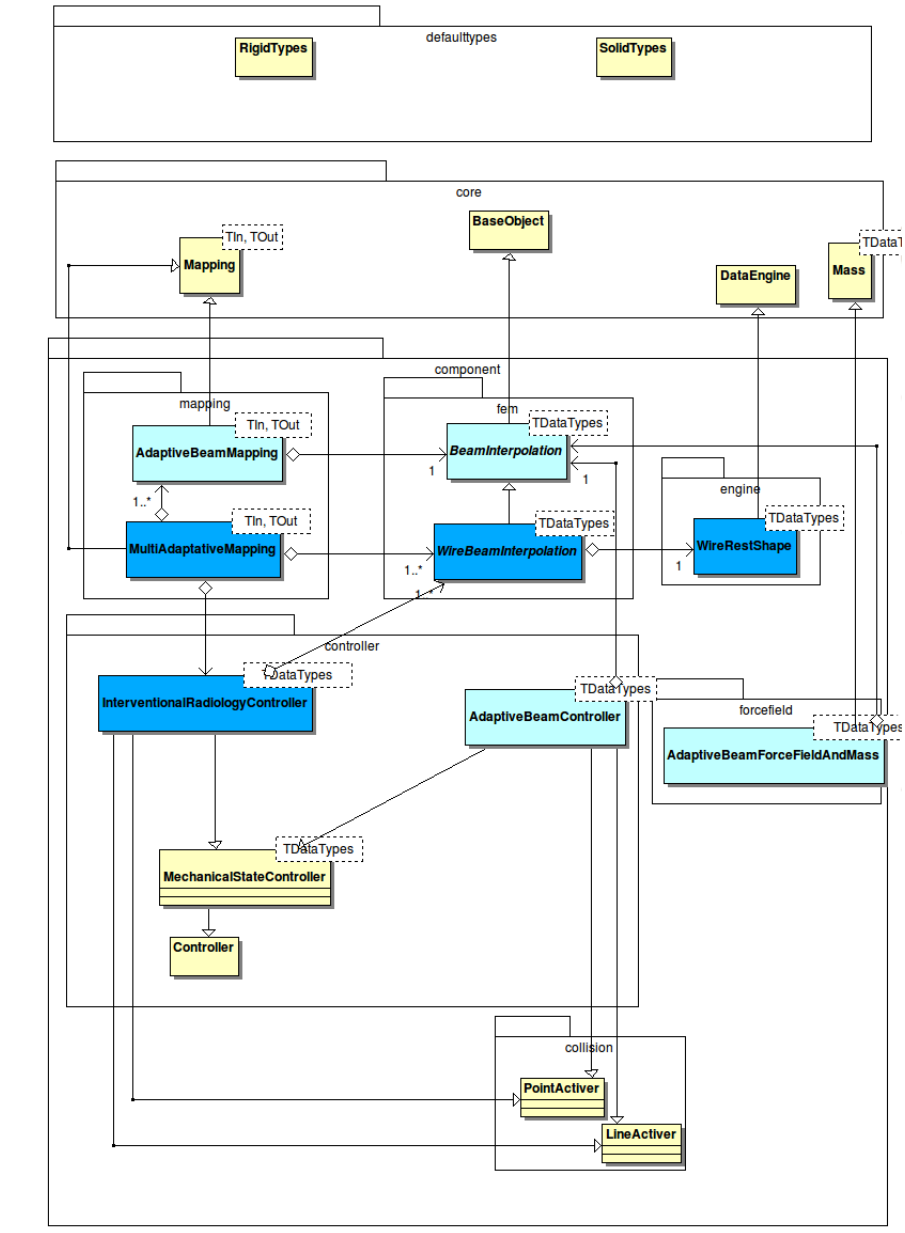
$$\hat{\mathbf{B}}_{i,n}(t) = \binom{n}{i}.t^i.(1-t)^{n-i}$$

The most usually used is the cubic Bézier , where trajectory is given by

$$(1-t)^3.P_0 + 3.(1-t)^2t.P_1 + 3.t^2(1-t).P_3 + t^3.P_3$$



5 Implementation



5.1 WireRestShape

Define the rest shape of a wire.

The data *procedural* defines if the rest shape is generated procedurally, or loaded from a file with the data *filename*. It is possible to scale the rest shape loaded from a file with the parameter *nonProceduralScale*. The wire has a total length defined in *length*.

The procedural rest shape is composed of a straight segment with a spring-like shape on the tip. These shapes are defined with the following parameters:

- *straightLength* : length of the straight segment
- *spireDiameter* : spring diameter
- *spireHeight* : spring height

The component will implicitly get a **sofa::core::topology::TopologyContainer** to build the rest shape topology, with a **sofa::component::topology::EdgeSetGeometryAlgorithms** and a **sofa:: component:: topology::EdgeSetTopologyModifier**, generally in the same node in the scene graph.

5.2 BeamInterpolation

Describe the interpolation between the two frames of a beam. It is based on Bézier splines.

The component needs a **sofa::core::topology::BaseMeshTopology** to work on it.

5.3 AdaptiveBeamForceFieldAndMass

5.4 AdaptiveBeamController

5.5 AdaptiveBeamMapping

5.6 WireBeamInterpolation

5.7 InterventionalRadiologyController

5.8 MultiAdaptiveMapping

References

[1] F. Andersson, *Bézier and B-spline Technology*, PhD thesis, Juin 2003.

[2] J. Przemieniecki, *Theory of Matrix Structural Analysis*, 1968.

[3] T. W. Sederberg, *COMPUTER AIDED GEOMETRIC DESIGN*, 2011 ed.

[4] T-Spline, *http://www.tsplines.com/*.

[5] T.Belytschko, W. K. Liu, and B. Moran, *Nonlinear Finite Elements for continua and structures*, 2000.