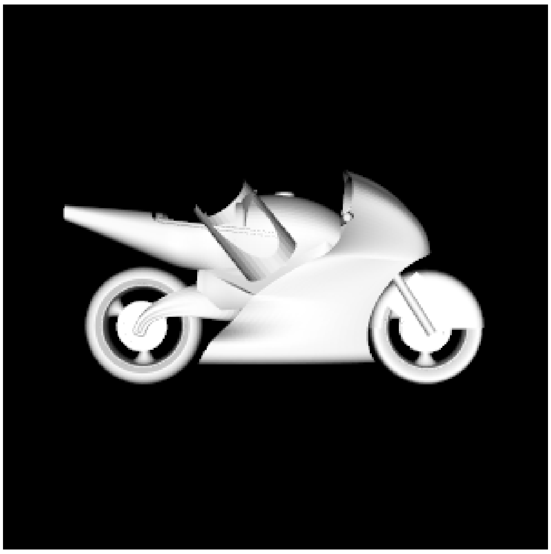
Summary of GSoC2015/VTK

During this GSoC, my work mainly focus on adding some new classes in to VTK to support spline visualization. The finished work (not all in the proposal which I should ashamed of :-() are a new set of vtkFiltersBezier class including

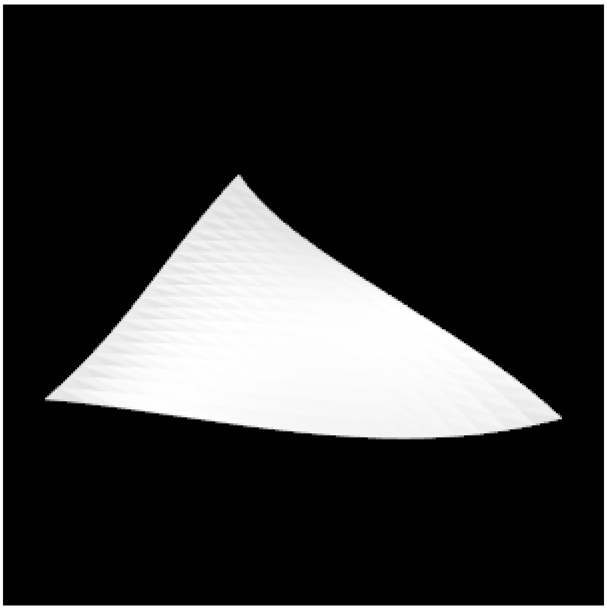
1. vtkPatchInterpolation
    a. two methods to compute point interpolation for rectangular/simplicial 1-d, 2-d and 3-d bezier patch.
    b. several methods to generate control points for conic curves (ellipse and hyperbola)
    c. a method to triangulate the bezier patch and return vtkUnstructuredGrid for visualization
2. vtkNURBSPatchAdaptor (1-d, 2-d and 3-d are supported)
    a. a knot insertion algorithm
    b. a method to convert NURBS patch to bezier patch and fetch its triangulated shape for visualization
    c. a method to evaluate point coordinates
    d. methods to evalute first order and second order derivatives of 1-d to 3-d patch
    e. a point inversion/projection algorithm based on Newton method
    f. a vtkControlPointArray for in-situ iterpretation of control points. This is because vtkPoints only allow 3-component vtkDataArray while the control points for rational spline are always 4-component. This class allow vtkPoints to hold a virtual copy of the control points and the control polygon to be visualized easily
3. vtkBREPReader (not all kind of shape can be parsed currently)
    a. a vtkAlgorithm subclass to read .brep file and return triangulated shape of those NURBS and Bezier patch in it.

Some of the rendered pictures are show below

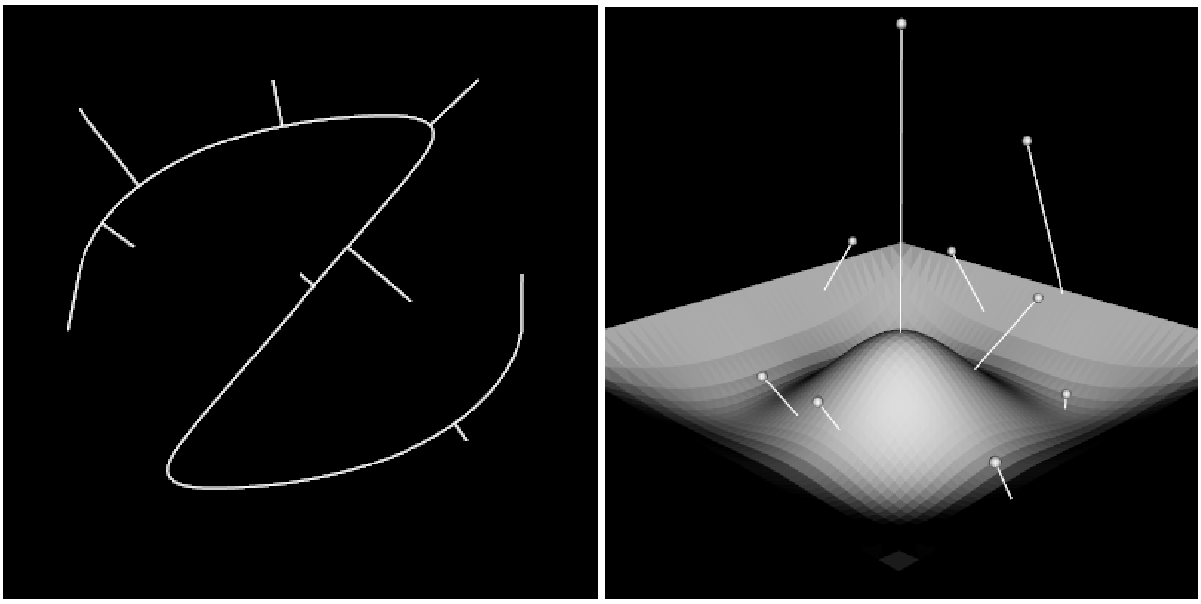
1. A motorcycle model for test of vtkBREPReader



2. Test interpolation of simplicial bezier patch



3. Test inversion/projection algorithm for curve and surface



End of summary.

Timeline (Finished, Ongoing, Not yet)

- **Coding Period**
  - Week 1 to Week 2
    - Start with implementing the evaluation and inversion functions for Bézier patches.
  - Week 3
    - Verify implementation, submit patches and review code.
  - Week 4 – Week 6
    - Implement VTK dataset class for Bézier patches.
    - Implement adaptor for different spline formulations.
  - Week 7
    - Verify implementation, submit patches and review code.
  - Week 8 to Week 10
    - Implement operation algorithms including boundary extraction, clipping, isovolume/isocontour to handle and manipulate Bézier patches.
  - Week 11
    - Verify implementation, submit patches and review code.
  - Week 12
    - Utilise for anything that remains

7/7/2015 Lin

Todo:

- load external file (currently .BRep file)

7/1/2015 Lin

So far, I have added quite a few new funtionalities to the vtkFiltersBezier module, including

- evaluation for 1-d, 2-d and 3-d bezier patch
- generate line segments and triangle meshes to visualize bezier curves and surfaces
- an adaptor to convert NURBS to bezier patch

So in summary, we have implemented the functionalities to visualize NURBS patch in VTK lib.

Some pictures of curve and surfaces of bezier patch and NURBS patch