Evaluation of NURBS Surface Capabilities of X3D Browsers

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Summary:

Eight X3D browsers were evaluated for their ability to render surfaces from the X3D NURBS component. Models from the Web3D NURBS Examples set were used for the tests. Seven of the browsers were publically available in October 2012, one (Octaga Player v2) is an older version that is no longer distributed by its developers. The tests covered rendering of the NurbsPatchSurface node and NurbsTrimmedSurface nodes, and included the ability of the browsers to correctly handle texture coordinates and the "solid" attribute. In brief, the results are:

- A branch of the Xj3D browser passed all tests for NURBS patch and NURBS trimmed surface.
- The Instant Player nearly passed all tests; it appears to have a correctable bug in how it maps parametric coordinates onto the surface.
- The Octaga Player v 2 nearly passed all tests; it failed some tests because it does not supply default values for X3D node fields.
- The Octaga Player v 4, SwirlX3D, view3dscene, and BS Contact passed or nearly passed the tests for NURBS patch surfaces but did not support NURBS trimmed surfaces.
- The FreeWRL browser does not support NURBS surfaces.

Browsers Tested

Octaga Player v2: Version 2.3.0.3 of the Octaga Player (for Mac OS X) was downloaded and registered in Jan 2009 from the now inactive site www.octaga.com This version of the Octaga Player is no longer publically distributed.

Octaga Player v4: Version 4.0.2 of the Octaga Player (for 32-bit Windows) was downloaded from http://www.octagavs.com in October 2012.

BS Contact: Version 8.000 of the Contact browser, on Windows XP, was dowloaded from http://www.bitmanagement.com

view3dscene: Version 3.11.0, for WIndows, was downloaded from the Sourceforge project page at http://castle-engine.sourceforge.net/view3dscene.php . This browser only loads scenes from local files, not from URLs.

Instant Player: Version 2.2.0 , for Mac OS X, was downloaded from http://www.instantreality.org

SwirlX3D: version 3.1.1, on WIndows, was downloaded from http://www.pinecoast.com . This browser only loads X3D scenes from local files.

FreeWRL: version 1.22.12, for Windows, was downloaded from the Sourceforge project page at http://sourceforge.net/projects/freewrl (Windows Installer). Console output for this browser states that NurbsPatchSurface and NurbsTrimmedSurface nodes are not supported.

Xj3D: Tested was a branch of the Xj3D browser in which parts of the NURBS Components has been implemented with the help of the jgeom library. Java source code for this branch is available as a Subversion checkout or export from https://kshell.sourcerepo.com/kshell/kshell/xj3d_code/tags/rel_1_1 at revision 3113 . For this testing the Java application was compiled and run on Mac OS 10.6.8

Test X3D Scenes

The following files constituted the tests for the X3Dbrowsers. The browser passed the test if the rendering was comparable to the test image referenced in each file. No attempt is made to rate the quality of the tesselation or shading performed for each browser.

1. Nurbs Patch Surface
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/NurbsPatch.x3d

2. Nurbs Patch Solid
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/NurbsPatchSolid.x3d

3. Nurbs Patch Image Texture
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/NurbsPatchImageTexture.x3d

4. Nurbs Trimmed Surface
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/NurbsTrimmedSurface.x3d

5. Hole Centered
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/HoleCentered.x3d

6. Hole Small Offset
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/HoleSmallOffset.x3d

7. Hole Large Offset
X3D file: http://www.web3d.org/x3d/content/examples/Basic/NURBS/HoleLargeOffset.x3d

Tabulated Test Results

X3D Browser	1	2	3	4	5	6	7
Octaga Player v 2	✔	✔	✔	[1]	[1]	[1]	[1]
Octaga Player v 4	✔	✔	✔				
BS Contact	✔	✔	✔				
view3dscene	✔	✔	✔				
Instant Player	✔	[2]	[2]	[2]	✔	✔	✔
SwirlX3D	[3]	✔	✔				
FreeWRL							
Xj3D	✔	✔	✔	✔	✔	✔	✔

Notes:

[1]: The Octaga Player v 2 failed these tests only because it does not supply the default value (as defined in the X3D DTD) for the value of the attribute containerField for the Contour2D nodes. When this attribute is explicitly included in the test X3D model then the Octaga v2 browser passes these tests.

[2]: The Instant Player browser transposes the u-v coordinate axes on the NURBS patch, leading to a common failure for these tests. Tests 5,6.7 are symmetric in the u-v axes, so the browser passes these tests.

[3]: The SwirlX3D fails this test only because the surface is invisible from the inner side.

Summary of Results:

These tests were meant to ascertain the capabilities of the browsers in rendering the surface nodes of the X3D NURBS component. Those nodes are the NurbsPatchSurface and NurbsTrimmedSurface . The geometric computations required to prepare a mesh for rendering are more complex for the trimmed surface than for the patch surface, so it is not surprising that the browsers fall into three groups of increasing level of NURBS surface support.

No Support : The FreeWRL does not offer any support for these surface nodes in the NURBS Component.

NurbsPatchSurface Support: Support for the NurbsPatchSurface is tested in Tests 1-3. All of the browsers, with the exception of the FreeWRL, pass or nearly pass these tests. The Instant Player browser fails those aspects of the NurbsPatchSurface tests which depend on the way that the internal u-v coordinates of the Nurbs surface are

mapped onto the geometric patch. The SwirlX3D browser fails to correctly implement the **solid** field in the context of a Nurbs surface.

NurbsPatchSurface + NurbsTrimmedSurface Support: The Instant Player, Octaga Player v 2, and the branch of Xj3D browser, support the NurbsTrimmedSurface by passing or nearly passing Tests 4-7. This support for the trimmed surface was dropped in the later version 4 of the Octaga Player. The Instant Player browser fails the test of the trimmed surface that relies on the u-v mapping on the surface geometry; as it did for the tests 2-3 of the patch surface node. The Octaga Player v2 did require that the containerField field of the nodes be explicitly defined in the model, and for this reason did not pass the tests with the canonicalized X3D files. The Xj3D branch, which can supply the default values for the containerField attribute from the X3D DTD, passes tests 4-7.