X3D Graphics for Web Authors

Chapter 4

Viewing and Navigation

But the eyes, though they are no sailors, will never be satisfied with any model, however fashionable, which does not answer all the requisitions of art.

Henry David Thoreau, 1849

web|3D CONSORTIUM

Contents

Chapter Overview

Overview: Viewing and Navigation

Users explore X3D worlds by choosing predefined viewpoints and navigating through 3D space.

- Bindable nodes, so only one is active at a time
- Viewpoint lets authors identify key camera locations
- NavigationInfo provides options for moving around

Related nodes improve navigability, interaction

- Anchor makes geometric shapes linkable
- Billboard keeps child geometry facing the user
- Collision can allow or prevent a user's view from passing through geometry

Concepts

Viewing and navigation

It is helpful to think of X3D scenes as fixed at different locations in 3D space

- Viewpoints are like cameras, prepositioned in locations (and directions) of interest
- Users can move their current camera viewpoint further and change direction they are looking at
- This process is called *navigation*

Making navigation easy for users is important

- Authors provide viewpoints of interest with scenes
- Browsers enable camera rotation, pan, zoom, etc.

Goals of viewing and navigation

- Viewing a scene from different vantage points that reveal aspects of interest, document key locations, or help to tell a story
- Navigating changes in the user's view of a scene effectively, by moving from place to place in an intuitive manner
- Making geometric objects selectable so that users can transport to another viewpoint, launch into another scene, or receive other web content
- Taking advantage of viewpoint location for special interactive techniques, such as user-facing billboard rotations and terrain following

Bindable nodes

Bindable nodes have a special property:
only one can be active at a time

- Bindable nodes are Viewpoint, NavigationInfo, Background, TextureBackground, Fog
- Each implements X3DBindableNode type interface for consistency
- First nodes found in scene become active by default

Implemented using a stack

- Similar to spring-loaded tray of plates in cafeteria
- One (and only one) is active, on top
- One can be pulled off top, sent off to the side
- One can be pulled to top, pushing down others

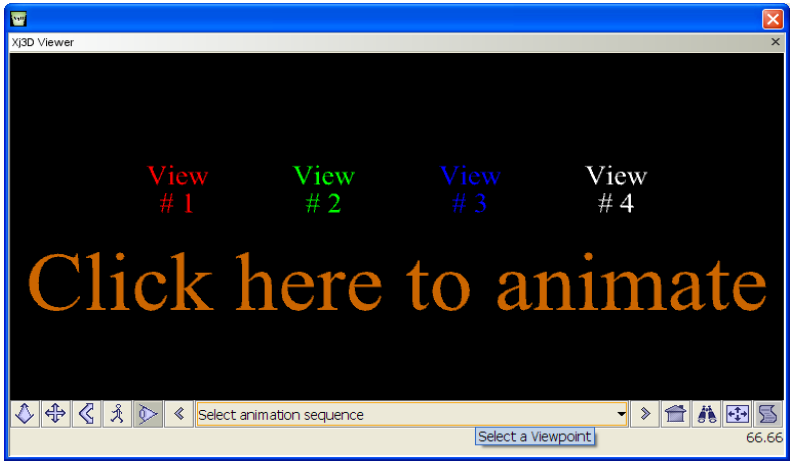
Binding example

Basic user operation is pretty simple:

- just select the desired Viewpoint

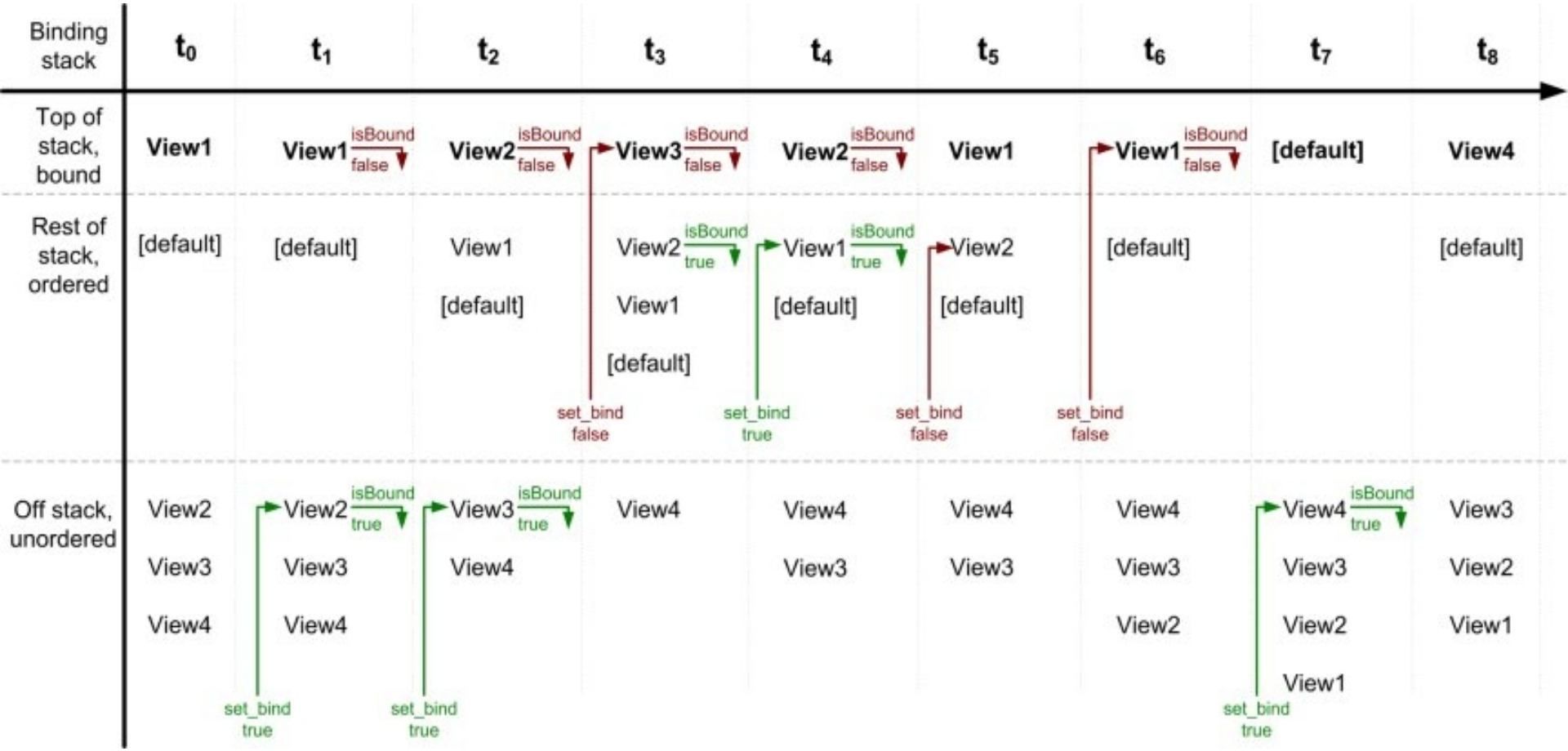
Complex example follows, stepping through binding stack operations

- Advanced details
- BindingOperations.x3d
- Animated with scripting
- Console results found in BindingOperations.console.txt



New users please skip ahead to Nodes and Examples

Binding node operations diagram



Viewpoints are activated (bound) upon selection, ordering is governed by stack operations

Binding node operations 1

- **Time t0**. The initial loading of the scene has first `<Viewpoint DEF='View1'/>` active and bound to the top of the binding stack. Other viewpoints are off the binding stack.
- If no viewpoints are provided in the scene, then the default `<Viewpoint position='0 0 10'/>` defined in the X3D Specification is used.

- **Time t1**. When the user selects View2 from the viewpoint list, it receives a *set_bind="true"* event and goes to the top of the binding stack. View2 also issues an *isBound="true"* event, and View1 issues an *isBound="false"* event as it moves down the stack.

Binding node operations 2

- **Time t2**. Similar to the previous transitions in step t1, View3 receives a *set_bind="true"* event and responds with an *isBound="true"* event, while View2 issues an *isBound="false"* event and pushes View1 further down the stack.

- **Time t3**. View3 receives a *set_bind="false"* event, triggering a corresponding *isBound="false"* event and dropping off the stack completely. Because View2 is the next node on the binding stack, it pops to the top to become the active Viewpoint node. View2 also issues an *isBound="true"* event.

Binding node operations 3

- **Time t4**. The user now selects View1 from the browser's viewpoint list, so View1 receives a *set_bind="true"* event and sends a corresponding *isBound="true"* event. View2 is no longer bound, and is pushed down the binding stack.

- **Time t5**. View2 receives a *set_bind="false"* event while on the binding stack but unbound, and as a result, it is taken completely off the binding stack.

- **Time t6**. View1 is now removed off the binding stack via a *set_bind="false"* event, leaving no other defined Viewpoint nodes on the stack.

Binding node operations 4

- **Time t7**. With no Viewpoint nodes remaining on the stack to bind, default viewpoint values are used: `<Viewpoint position='0 0 10'/>`. The user then selects the previously unbound View4 from the viewpoint list.

- **Time t8**. View4 remains as the bound viewpoint with no further viewpoints remaining on the stack.

Same process for all X3D bindable node stacks:

- Viewpoint/OrthoViewpoint/GeoViewpoint, NavigationInfo/GeoViewpoint, Fog, Background/TextureBackground

X3D Nodes and Examples

Viewpoint node

It is helpful to think of X3D scenes as being fixed solidly in 3D space, positioned and oriented exactly where placed by the scene author

Viewing a scene is thus a matter of navigating the current user point of view through space

Viewpoint nodes let X3D scene authors predefine locations and orientations of particular interest

- Sometimes viewpoints are animated and moving
- Freedom of viewpoint is exciting and engaging, also a major advantage over fixed-viewpoint video

Viewpoint list

Viewpoint list is optional browser-provided feature that lists currently available viewpoints

- Provides description information for viewpoints
- Simplifies user selection of viewpoints
- Thus supports navigation within a scene

Viewpoints are listed in the order that they appear in the "extended scene graph"

- First includes order of definition in primary scene
- Then includes viewpoints provided by Inline and prototype instances, inserted in order within the list
- Authors need to order Viewpoints carefully so that user navigation, understanding is best supported

Viewpoint *description*

Each Viewpoint is given a *description* string to help users decide which view to select

- Clear, understandable descriptions can guide users
- Use an object's name first when many viewpoints follow, so they are more easily identified in a list
- Use whitespace instead of underscores for better readability

Viewpoints are primary user tool for navigation

- Browsers provide Viewpoint List to show and select descriptions
- So authors should always include *description*!

Viewpoint *position, orientation*

A Viewpoint node defines a specific *position* and *orientation* for looking at a 3D scene

- Similar to a "virtual camera" vantage point

Default Viewpoint *position* is (0 0 10)

- out 10 m on +Z axis, looking back towards origin

Any changes to Viewpoint *orientation* are made relative to that default direction (along -Z axis)

- Different initial direction than other orientations
- Visualize the situation and then use right-hand rule to figure out the correct *orientation* value

Viewpoint calculator

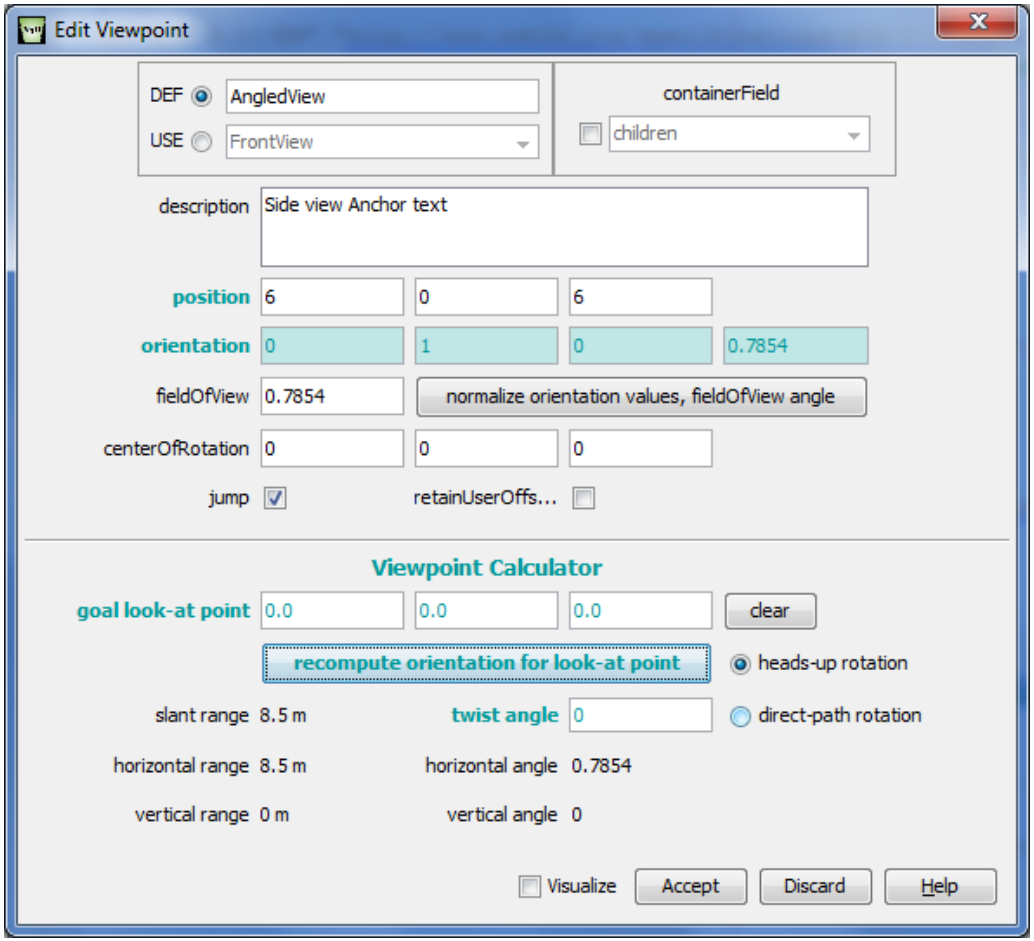
Viewpoint Calculator provided as an author-assist tool to compute Viewpoint orientation to a given point

Inputs:

position

goal look-at point

twist angle about viewing axis



Output:

orientation

Viewpoint *centerOfRotation, fieldOfView*

centerOfRotation is a local position

- User's current view rotates about this point if the bound NavigationInfo node is in EXAMINE mode
- Can be changed by a user's LOOKAT operation picking some other geometry as new center

fieldOfView is preferred minimum angular width

- Shorter side of horizontal width or vertical height
- Default is 45 degrees = pi/4 radians = 0.785
- Larger side determined by browser aspect ratio
- Author can set width, height if within HTML page

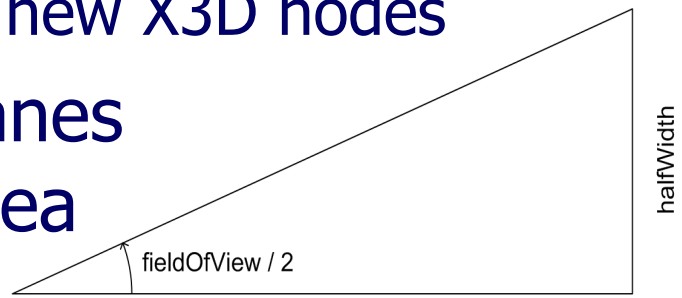
ViewFrustum prototype

ViewFrustum is a helpful visualization prototype

- Prototypes simplify creation of new X3D nodes

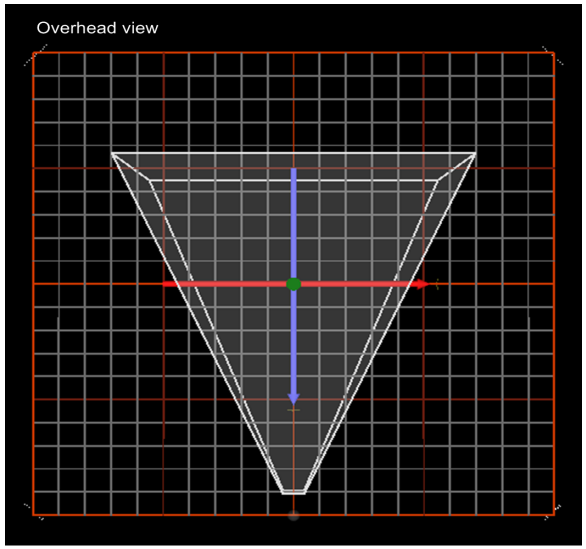
Shows near and far clipping planes that truncate the viewable area

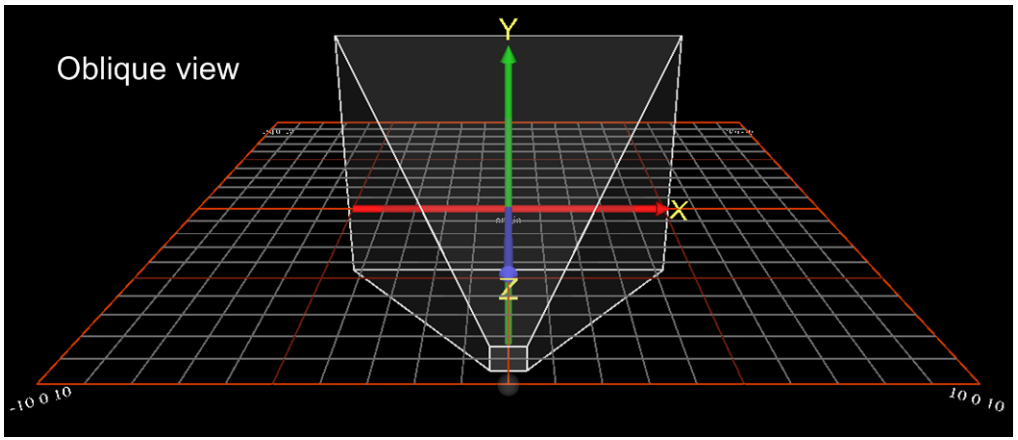
- Depends on Viewpoint and NavigationInfo parameters



Near clipping plane distance = *avatarSize[0]*
Far clipping plane distance = *visibilityLimit*

nearHalfWidth = tan(*fieldOfView* / 2) * *avatarSize[0]*;
farHalfWidth = tan(*fieldOfView* / 2) * *visibilityLimit*;





Viewpoint *jump*

jump can be a tricky field (but is not often used)

- *jump*='true' when a Viewpoint is selected means that the current view position and orientation is modified according to NavigationInfo *transitionType*
- *jump*='true' is usual default
- *jump*='false' is an advanced technique
  - User's view doesn't appear to change when new Viewpoint is selected
  - New Viewpoint is bound, but given offsets to match prior user position and orientation (hence no jumping)
  - Example use: changing bound viewpoint when moving from one floor into an elevator, then to another floor

Viewpoint hints and warnings

Use parent Transform node(s) for complex Viewpoint orientation and position values

- One axis of rotation at a time can work more clearly

Keyboard shortcuts are helpful

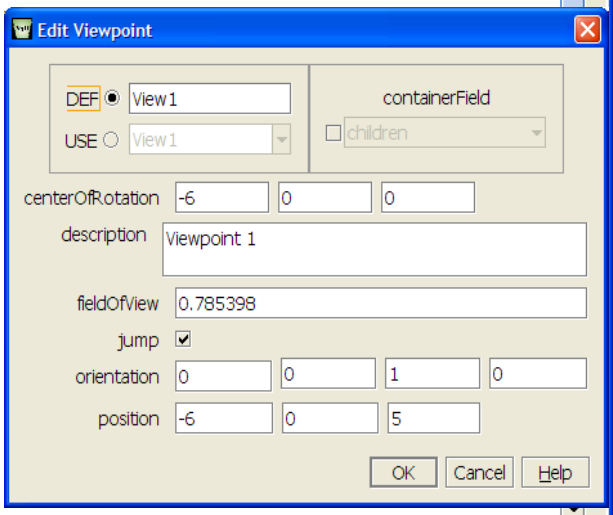
- PageUp PageDown Home End to select Viewpoint
- Arrow keys to examine (rotate), pan, zoom, etc. depending on current NavigationInfo mode
- Browser may allow Viewpoint reset after navigating

Distinguish between defined Viewpoint and current navigated user-view location, direction

BindingOperations.x3d - Editor

BindingOperations.x3d

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
    xsd:noNamespaceSchemaLocation='http://www.web3d.org/specifications/x3d-3.1.xsd'>
  <head>
    <meta content='BindingOperations.x3d' name='title'/>
    <meta content='Illustrate Viewpoint binding operations as described in Chapter 4 concepts.
                   Display the browser console to see an event' name='description'/>
    <meta content='Don Brutzman' name='creator'/>
    <meta content='5 January 2008' name='created'/>
    <meta content='5 January 2008' name='modified'/>
    <meta content='http://X3dGraphics.com' name='reference'/>
    <meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
    <meta content='Copyright Don Brutzman and Leonard Daly 2007' name='rights'/>
    <meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subject'/>
    <meta content='BindingOperations.console.txt' name='reference'/>
    <meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.x3d'
          name='identifier'/>
    <meta content='X3D-Edit, http://www.web3d.org/x3d/content/README.X3D-Edit.html' name='generator'/>
    <meta content='../../license.html' name='license'/>
  </head>
  <Scene>
    <Viewpoint DEF='View1' centerOfRotation='-6 0 0' description='Viewpoint 1' position='-6 0 5'/>
    <Viewpoint DEF='View2' centerOfRotation='-2 0 0' description='Viewpoint 2' position='-2 0 5'/>
    <Viewpoint DEF='View3' centerOfRotation='2 0 0'  description='Viewpoint 3' position='2 0 5'/>
    <Viewpoint DEF='View4' centerOfRotation='6 0 0'  description='Viewpoint 4' position='6 0 5'/>
    <Group>
      <Transform DEF='Text1' translation='-6 0 0'>
        <Shape>
          <Text string='"View" "# 1"'>
            <FontStyle DEF='CenterJustify'
          </Text>
          <Appearance>
        </Shape>
      </Transform>
      <Transform DEF='Text2' translation='
        <Shape>
      </Transform>
      <Transform DEF='Text3' translation='
        <Shape>
      </Transform>
      <Transform DEF='Text4' translation='
        <Shape>
      </Transform>
    </Group>
    <!-- The following advanced animation sequence uses nodes covered in Chapters 7, 8 and 9. -->
    <!-- It does not need to be studied in this chapter. -->
```



23:15 INS

X3D for Web Authors, Kelp Forest Exhibit: Kelp Forest Main

This is the main entry to the Kelp Forest that loads all of the other components as Inline scenes.

launch: X3D, X3DV, X3DB

links: VRML97, XHTML, C14N

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.0//EN"   "http://www.web3d.org/specifications/x3d-3.0.dtd">

<X3D profile='Immersive' version='3.0' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation=' http://www.web3d.org/specifications/x3d-3.0.xsd '>
   <head>
      <meta name='title' content='KelpForestMain.x3d'/>
      <meta name='description' content='This is the main entry to the Kelp Forest that loads all of the other components as Inline scenes.'/>
      <meta name='creator' content='Don Brutzman'/>
      <meta name='created' content='1 June 1998'/>
      <meta name='modified' content='13 June 2004'/>
      <meta name='reference' content=' http://web.nps.navy.mil/~brutzman/kelp '/>
      <meta name='reference' content=' http://web.nps.navy.mil/~brutzman/kelp/KelpForestDesignPaper.pdf '/>
      <meta name='subject' content='Kelp Forest 3D models'/>
      <meta name='accessRights' content='All content has permissions for free use. Please provide credit to the Naval Postgraduate School (NPS) Modeling Virtual Environments and Simulation
      (MOVES) Institute.'/>
      <meta name='identifier' content=' http://www.x3dbook.com/examples/X3dForWebAuthors/KelpForestExhibit/KelpForestMain.x3d '/>
      <meta name='generator' content='X3D-Edit, http://www.web3d.org/x3d/content/README.X3D-Edit.html'/>
      <meta name='license' content='../../license.html'/>
   </head>
   <!--
```

Index for ExternProtoDeclare definitions: ViewPositionOrientation, WaypointInterpolator

Index for DEF nodes: CENTER_WAVE, JEFFSCLOCK, K10_DEEP, K10_FLOOR, K10_LOCALE, K11_DEEP, K11_FLOOR, K11_LOCALE, K11_MIDWATER, K2_FLOOR, K2_LOCALE, K2_MIDWATER, K4_FLOOR, K4_LOCALE, K4_MIDWATER, K7_FLOOR, K7_LOCALE, K7_MIDWATER, KelpExamplesNoBase, LEFT_DEEP_WAVE, LEFT_SHALLOW_WAVE, MasterClock, Nancy, NancyInterpolator, NancyTransform, R2_DEEP, R2_LOCALE, R2_MIDWATER, R3_LOCALE, R3_MIDWATER, R5_LOCALE, R5_SHALLOW, RIGHT_DEEP_WAVE, RIGHT_SHALLOW_WAVE, Root, Viewpoints, WAVE_CLOCK

Index for Viewpoint images: Viewpoint_1, Viewpoint_2, Viewpoint_3, Viewpoint_4, Viewpoint_5, Viewpoint_6, Viewpoint_7

KelpForestMain.x3d (model/x3d+xml Object) - Mozilla Firefox

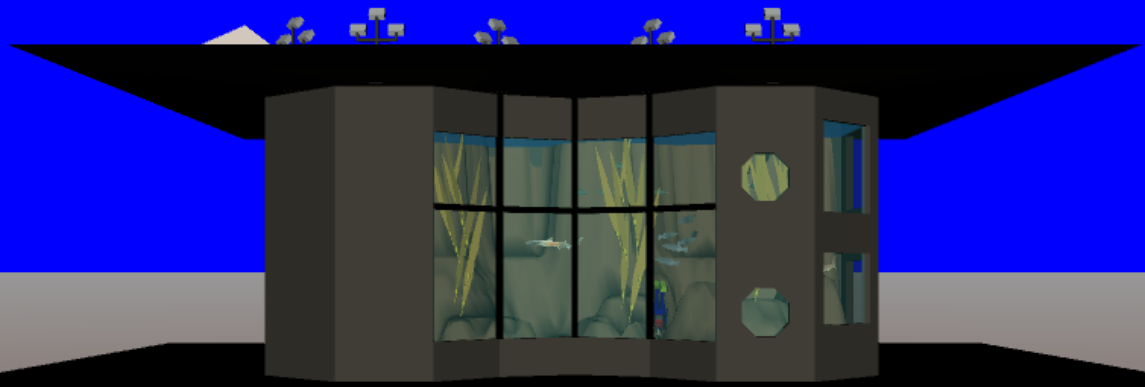
File Edit View History Bookmarks Tools GUtil! Help

http://www.x3dbook.com/examples/X3dForWebAuthors/KelpForestExhibit/KelpForestMain.x3d

john lennon acoustic

X3D Specification, ISO/IEC 1... | X3D for Web Authors, Kelp F... | Help: X3D Examples | X3D Scene Authoring Hints | KelpForestMain.x3d (mo...

Welcome to the NPS simulation of the Monterey Bay Aquarium Kelp Forest



Find sharks! See new viewpoints!
Press PageDown, wait and watch.

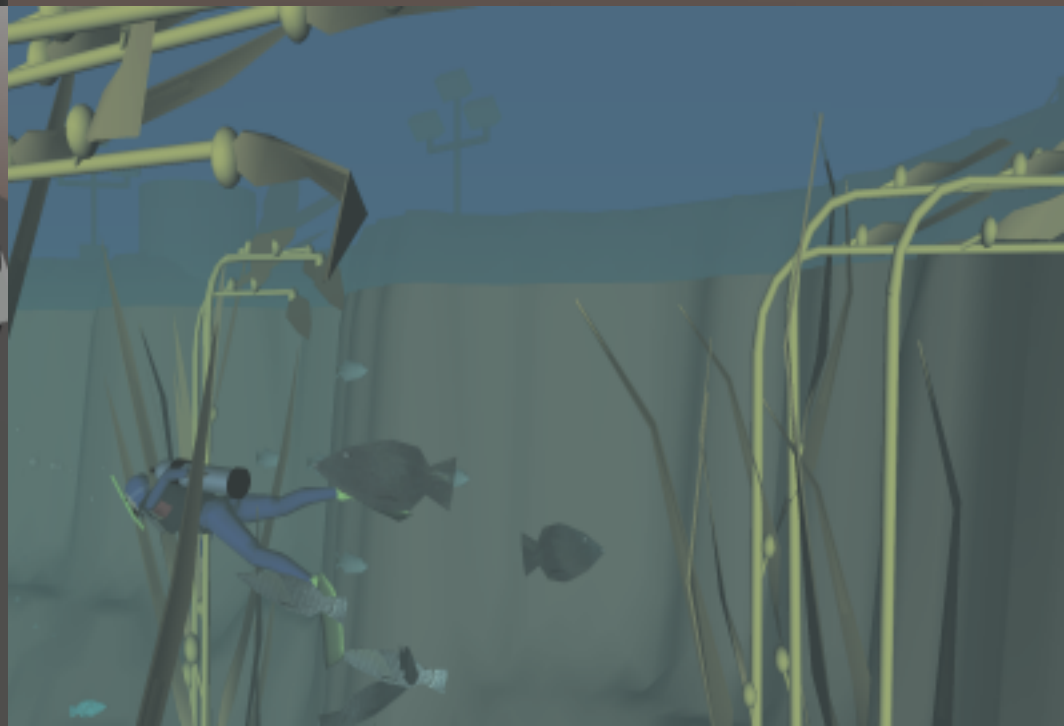
explore examine seek level back forward <- Kelp Forest Monter ->

Find: toolti Next Previous Highlight all Match case

Done 1.953s 72.52.156.96 70.134.87.160 0:906 Now: Rain, 51° F Sun: 55° F Mon: 54° F


NPS


Welcome to the NPS simulation of the
Monterey Bay Aquarium Kelp Forest
Find sharks! See new viewpoints!
Press PageDown, wait and watch.



Viewpoint	**Viewpoint provides a specific location and direction where the user may view the scene. Background, Fog, NavigationInfo, TextureBackground and Viewpoint are bindable nodes.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
description	**[description: accessType initializeOnly, type SFString CDATA #IMPLIED]** Text description or navigation hint to be displayed for this Viewpoint. **Hint:** use spaces, make descriptions clear and readable. **Warning:** without description, Viewpoint is unlikely to appear on browser Viewpoints menu. Hint: many XML tools substitute XML character references automatically if needed (like & for & or " for ").
position	**[position: accessType inputOutput, type SFVec3f CDATA "0 0 10"]** Position (x, y, z in meters) relative to local coordinate system.
orientation	**[orientation: accessType inputOutput, type SFRotation CDATA "0 0 1 0"]** Rotation (axis, angle in radians) of Viewpoint, relative to default -Z axis direction in local coordinate system. **Hint:** this is orientation _change_ from default direction (0 0 -1). **Hint:** complex rotations can be accomplished axis-by-axis using parent Transforms.
fieldOfView	**[fieldOfView: accessType inputOutput, type SFFloat CDATA "0.785398" (0..pi)]** Preferred minimum viewing angle from this viewpoint in radians. Small field of view roughly corresponds to a telephoto lens, large field of view roughly corresponds to a wide-angle lens. **Hint:** modifying Viewpoint distance to object may be better for zooming. **Warning:** fieldOfView may not be correct for different window sizes and aspect ratios.
jump	**[jump: accessType inputOutput, type SFBool (true|false) "true"]** Transition instantly by jumping, or smoothly animate to this Viewpoint. **Hint:** set jump=true for smooth camera motion when going to this viewpoint.
centerOfRotation	**[centerOfRotation: accessType inputOutput, type SFVec3f CDATA "0 0 0"]** centerOfRotation point relates to NavigationInfo EXAMINE mode.
set_bind	**[set_bind: accessType inputOnly, type SFBool (true|false) #FIXED ""]** Sending event set_bind=true makes this node active. Sending event set_bind=false makes this node inactive. Thus setting set_bind to true/false will pop/push (enable/disable) this Viewpoint.
bindTime	**[bindTime: accessType outputOnly, type SFTime CDATA #FIXED ""]** Event sent when node becomes active/inactive.
isBound	**[isBound: accessType outputOnly, type SFBool (true|false) #FIXED ""]** Event true sent when node becomes active, event false sent when unbound by another node.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

OrthoViewpoint

OrthoViewpoint provides an orthographic perspective-free view of a scene from a specific location and direction

- *fieldOfView* minX, maxX, minY, maxY values (default -1 -1, 1 1) define minimum and maximum extents of view, provided in units of local coordinate system
- For a rectangular display:

  width/height = (maxX-minX)/(maxY-minY)
- <component name='Navigation' level='3'/>
- Caution: often disorienting, special uses only

Navigation model 1

Users can select predefined Viewpoints

- Defines both position and direction of view

Users can further navigate around scene

- Using pointing device or hot keys
- Chosen viewpoint remains bound

Key	Emulated Action	WALK mode	FLY mode	EXAMINE mode
Up arrow	Pointer up	forward	forward	orbit up
Down arrow	Pointer down	backward	backward	orbit down
Left arrow	Pointer left	left	left	orbit left
Right arrow	Pointer right	right	right	orbit right

These are the default navigation key responses

Navigation model 2

User's current view can itself be animated

- ROUTE new position/direction event values to the Viewpoint itself, or to parent Transform nodes
- User navigation offsets to that view remain in effect
- Thus "over the shoulder" viewpoints can follow a moving object around, while still allowing user to look around while in that moving viewpoint

Lefty and Lucy shark in the Kelp Forest Main scene use this technique as virtual tour guides

NavigationInfo node

NavigationInfo indicates how a browser might best support user navigation in the scene

Multiple NavigationInfo nodes may exist in scene

- Or in multiple Inline scenes loaded together

NavigationInfo is an X3DBindableNode

- So only one NavigationInfo can be active at a time
- Follows the same binding rules as Viewpoint, but note that they are easily selectable by end users
- Can be linked to a given Viewpoint by ROUTE that connects *isBound* of one node to *set_bind* of other

NavigationInfo *type*

Primary field is *type* which indicates which of the various modes of navigation are relevant

- "EXAMINE" best for rotating solitary objects
- "FLY" allows zooming in, out and around
- "WALK" also allows exploration, but on the ground
- "LOOKAT" use pointer to select geometry of interest
- "ANY" lets user select any mode
- "NONE" gives user zero control of navigation

MFString array default *type*=' "EXAMINE" "ANY" '

- which gives users plenty of flexibility

NavigationInfo *type* details 1

- "**EXAMINE**" Used to view individual objects. Scene navigation consists of rotating the user viewpoint about the center of the observed object. The *centerOfRotation* field of the currently bound Viewpoint node values determines which local point centers the view rotation.

- "**WALK**" Used when exploring a virtual world on the ground. The user's eye level stays above the ground geometry and collision detection prevents the user from falling if underlying geometry is present.

NavigationInfo *type* details 2

- "**FLY**" Similar to "WALK", but terrain following and collision detection is ignored. This type of navigation has the fewest constraints. Shifts the current view and related *centerOfRotation* values to track or zoom toward objects of interest to user.
- "**ANY**" Browser is allowed to provide whichever navigation type seems appropriate for the task at hand, modifying the user interface if necessary.
- "**NONE**" All navigation disabled and hidden. Navigation remains possible via animation of viewpoint fields or by binding other viewpoints (using viewpoint-list selection or Anchor node).

NavigationInfo speed, headlight

speed determines how fast navigation occurs

- Default value 1 meter/second is usually pretty slow
- Might need to vary widely from ground to space
- Might need multiple NavigationInfo nodes matching different viewpoints (high *speed* for flying, low *speed* for walking around or examining objects)

headlight is whether a light is shining ahead from user's point of view

- Otherwise one or more Light nodes is needed (covered in Chapter 11), or else world goes black

NavigationInfo transitions

transitionType determines type of path followed when transitioning between viewpoints

- "ANIMATE" browser chooses smoothing algorithm
- "LINEAR" interpolation of position, orientation
- "TELEPORT" immediate repositioning to destination

transitionTime

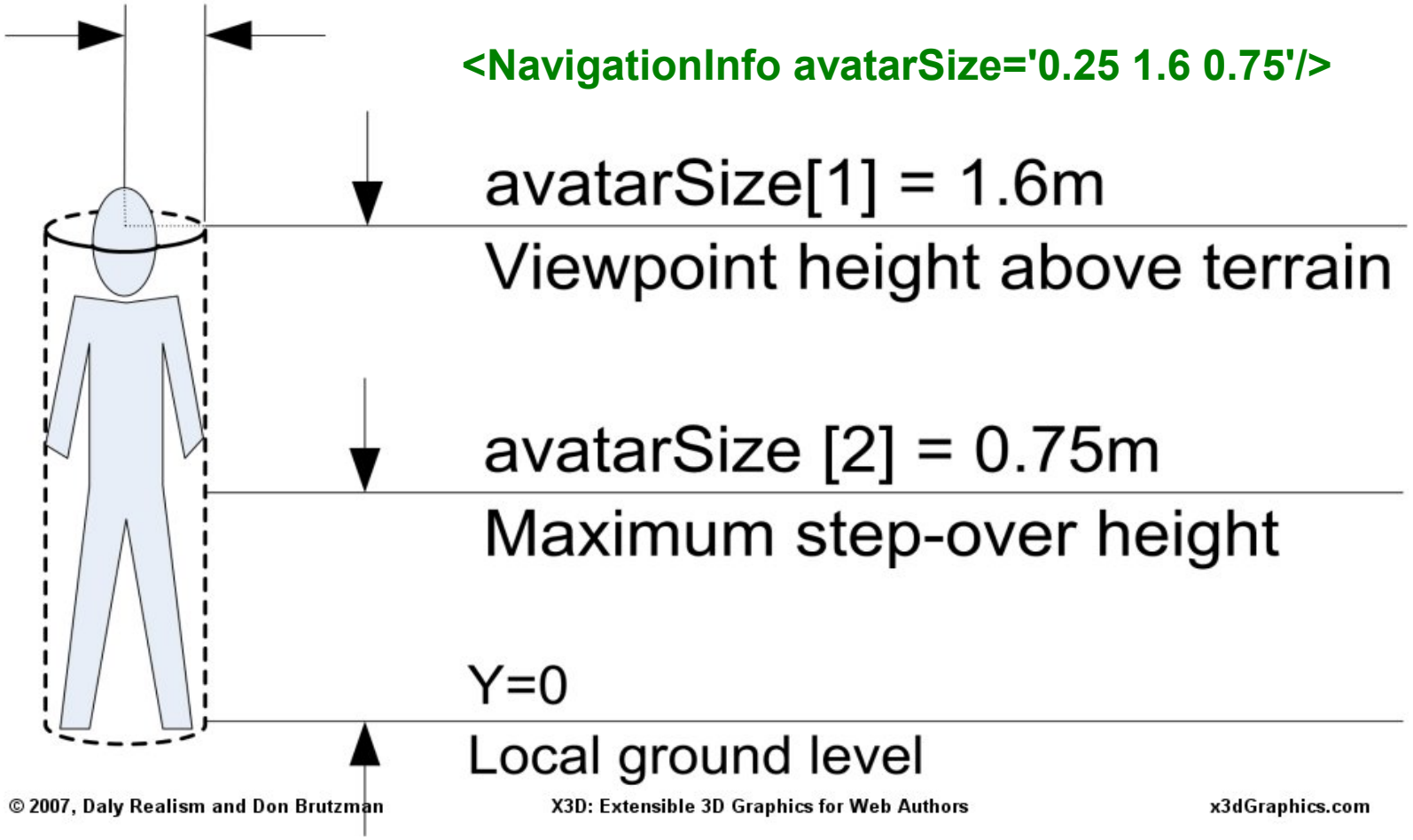
- initial array value used for linear, otherwise multiple values can be used by browser-specific "ANIMATE"

transitionComplete lets author know when done

- SFBool boolean event sent when move is finished

avatarSize SFVec3f array

avatarSize[0] = 0.25m
Allowed collision distance



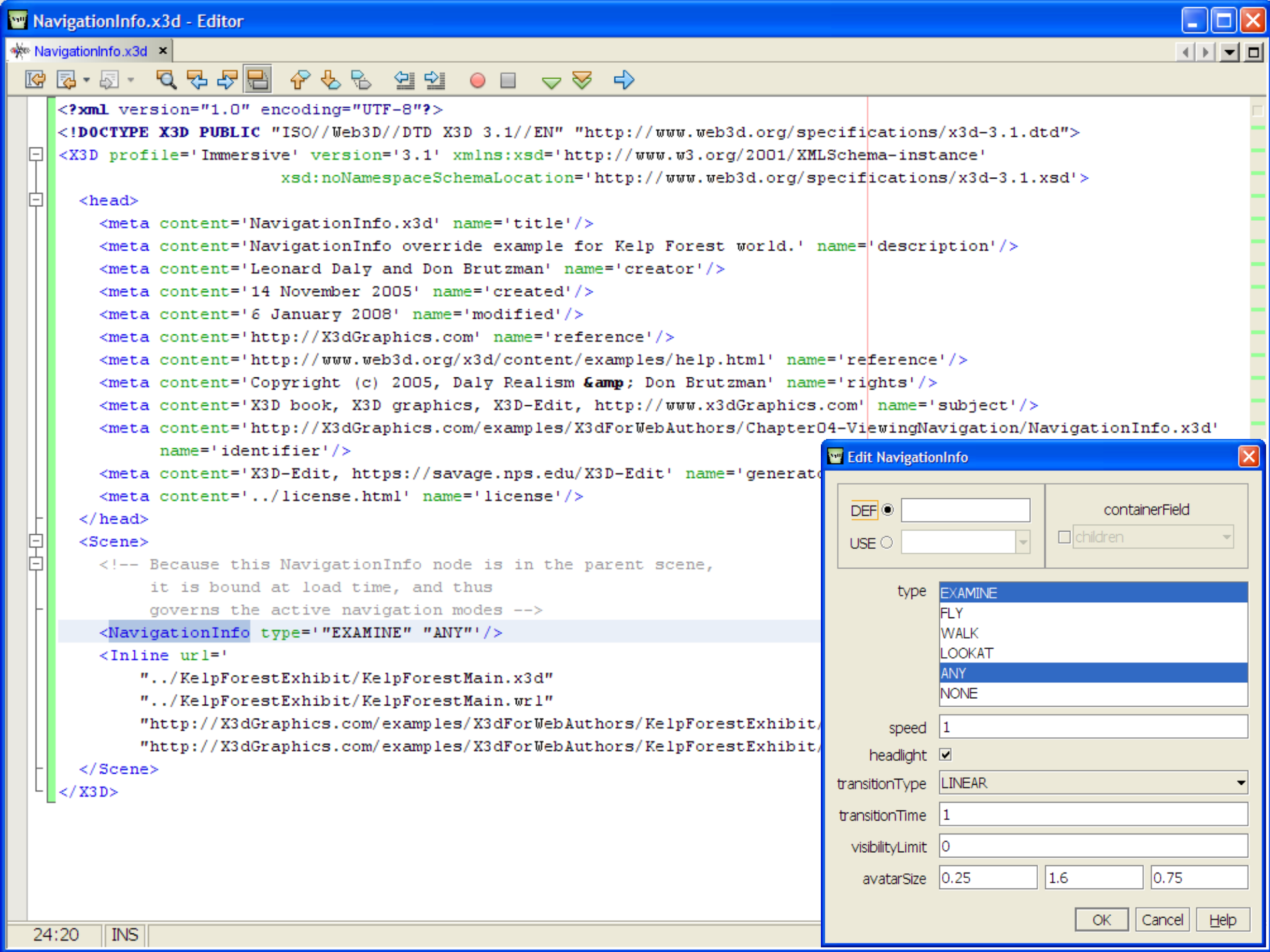
NavigationInfo *visibilityLimit*

visibilityLimit defines the maximum range that may be rendered by the browser

- Measured from the user's point of view
- Geometry beyond that distance are not drawn
- *visibilityLimit*='0.0' means no limits are imposed

Quality thumbrule: meet following relationship

- *avatarSize.collisionDistance* / *visibilityLimit* < 10,000
- Avoids floating-point roundoff error on graphics card and almost-coplanar polygon tearing/aliasing
- Exactly coplanar polygons still suffer from aliasing


NavigationInfo.x3d - Editor
NavigationInfo.x3d
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
xsd:noNamespaceSchemaLocation='http://www.web3d.org/specifications/x3d-3.1.xsd'>
<head>
<meta content='NavigationInfo.x3d' name='title'/>
<meta content='NavigationInfo override example for Kelp Forest world.' name='description'/>
<meta content='Leonard Daly and Don Brutzman' name='creator'/>
<meta content='14 November 2005' name='created'/>
<meta content='6 January 2008' name='modified'/>
<meta content='http://X3dGraphics.com' name='reference'/>
<meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
<meta content='Copyright (c) 2005, Daly Realism & Don Brutzman' name='rights'/>
<meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subject'/>
<meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/NavigationInfo.x3d'
name='identifier'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generat
<meta content='../license.html' name='license'/>
</head>
<Scene>
<!-- Because this NavigationInfo node is in the parent scene,
it is bound at load time, and thus
governs the active navigation modes -->
<NavigationInfo type='"EXAMINE" "ANY"'/>
<Inline url='
"../KelpForestExhibit/KelpForestMain.x3d"
"../KelpForestExhibit/KelpForestMain.wrl"
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForestExhibit/
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForestExhibit/
</Scene>
</X3D>
Edit NavigationInfo
DEF
USE
containerField
children
type
EXAMINE
FLY
WALK
LOOKAT
ANY
NONE
speed
1
headlight
transitionType
LINEAR
transitionTime
1
visibilityLimit
0
avatarSize
0.25
1.6
0.75
OK
Cancel
Help
24:20
INS

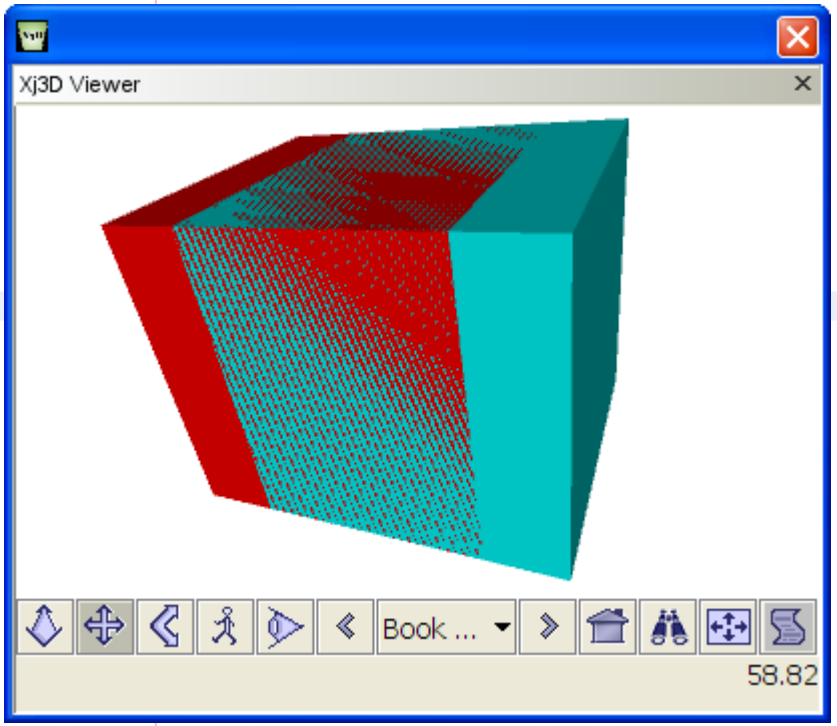
NavigationInfo	**NavigationInfo describes the viewing model and physical characteristics of the viewer's avatar.** **Hint: for inspection of simple objects, usability often improves with type="EXAMINE" "ANY"** **Hint: NavigationInfo types '"WALK" "FLY"' support camera-to-object collision detection. Background, Fog, NavigationInfo, TextureBackground and Viewpoint are bindable nodes.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
type	**[type: accessType inputOutput, type MFString CDATA "EXAMINE" "ANY"]** Enter one or more quoted Strings: "EXAMINE" "WALK" "FLY" "LOOKAT" "ANY" "NONE". Hint: for inspection of simple objects, usability often improves with type="EXAMINE" "ANY". Hint: types WALK and FLY force strict camera-to-object collision detection. Hint: see Collision node for further details on camera-to-object collision detection. Hint: Strings can have multiple values, so separate each string by quote marks ["http://www.url1.org" "http://www.url2.org" "etc."] Interchange profile hint: this field may be ignored.
speed	**[speed: accessType inputOutput, type SFFloat CDATA "1.0"]** [0..+infinity) Default rate at which viewer travels through scene, meters/second. Warning: default 1 m/s usually seems slow for ordinary navigation. Interchange profile hint: this field may be ignored.
headlight	**[headlight: accessType inputOutput, type SFBool (true|false) "true"]** Enable/disable directional light that always points in the direction the user is looking.
avatarSize	**[avatarSize: accessType inputOutput, type MFFloat CDATA "0.25 1.6 0.75"]** avatarSize triplet values are: (a) collision distance between user and geometry (near culling plane of the view frustrum) (b) viewer height above terrain (c) tallest height viewer can WALK over. Hint: keep (visibilityLimit / avatarSize.CollisionDistance) < 10,000 to avoid aliasing artifacts (i.e. polygon "tearing"). Interchange profile hint: this field may be ignored.
visibilityLimit	**[visibilityLimit: accessType inputOutput, type SFFloat CDATA "0.0"]** Geometry beyond the visibilityLimit may not be rendered (far culling plane of the view frustrum). visibilityLimit=0.0 indicates an infinite visibility limit. Hint: keep visibilityLimit >= zero. Hint: keep (visibilityLimit / avatarSize.CollisionDistance) < 10,000 to avoid aliasing artifacts (i.e. polygon "tearing"). Interchange profile hint: this field may be ignored.
transitionType	**[transitionType: accessType inputOutput, type MFString CDATA "ANIMATE"]** Enter one or more quoted Strings: "ANIMATE" "LINEAR" "TELEPORT". Interchange profile hint: this field may be ignored.
transitionTime	**[transitionTime: accessType inputOutput, type MFFloat CDATA "1.0"]** Duration of viewpoint transition. Hint: If transitionType is "ANIMATE", transitionTime provides browser-dependent animation parameters. Interchange profile hint: this field may be ignored.
transitionComplete	**[transitionComplete: accessType outputOnly, type MFFloat CDATA #FIXED ""]** Event signaling viewpoint transition complete. Interchange profile hint: this field may be ignored.
set_bind	**[set_bind: accessType inputOnly, type SFBool (true|false) #FIXED ""]** Setting set_bind true makes this node active setting set_bind false makes this node inactive. Thus setting set_bind true/false will pop/push (enable/disable) this node.
bindTime	**[bindTime: accessType outputOnly, type SFTime CDATA #FIXED ""]** Event sent when node becomes active/inactive.
isBound	**[isBound: accessType outputOnly, type SFBool (true|false) #FIXED ""]** Event true sent when node becomes active, event false sent when unbound by another node.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.

Aliasing (tearing) of polygons

AliasingExample.x3d - Editor

AliasingExample.x3d

```
<?xml version="1.0" encoding="UTF
<!DOCTYPE X3D PUBLIC "ISO//Web3D/
<X3D profile='Interchange' versi
                    xsd:noNamesp
  <head>
    <meta content='AliasingExample.x3d' name='title'/>
    <meta content='Illustrates the effect of aliasing (tearing) by the coplanar overlap of two cubes with different colors.'
          name='description'/>
    <meta content='Leonard Daly and Don Brutzman' name='creator'/>
    <meta content='19 June 2006' name='created'/>
    <meta content='7 January 2008' name='modified'/>
    <meta content='http://X3dGraphics.com' name='reference'/>
    <meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
    <meta content='Copyright (c) 2006, Daly Realism and Don Brutzman' name='rights'/>
    <meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subject'/>
    <meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/AliasingExample.x3d' name='identifier'/>
    <meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
    <meta content='../license.html' name='license'/>
  </head>
  <Scene>
    <Background skyColor='1 1 1'/>
    <NavigationInfo headlight='true' type='"EXAMINE" "ANY"'/>
    <Viewpoint description='Book View'/>
    <Transform translation='-.25 0 0'>
      <Shape>
        <Appearance>
          <Material diffuseColor='1 0 0'/>
        </Appearance>
        <Box/>
      </Shape>
    </Transform>
    <Transform translation='.25 0 0'>
      <Shape>
        <Appearance>
          <Material diffuseColor='0 1 1'/>
        </Appearance>
        <Box/>
      </Shape>
    </Transform>
  </Scene>
</X3D>
```



29:13 INS

Anchor node

Anchor is another grouping node that can contain other nodes

Geometry rendered by contained nodes is active and can be selected by user

- User clicking on Anchor geometry launches url link (.html .x3d mailto: etc.)
  - thus similar to HTML anchor tag `<a href="url">link</a>`
- Alternatively can select a viewpoint in the scene (similar to HTML bookmark)

Selected link can replace current X3D scene, or else launch into another browser window

Anchor *description*

The *description* field provides the user with a single-string summary of what is selected when the Anchor geometry is selected, e.g.

- *description*='click door, open portal to new world'
- *description*='jump to next viewpoint...'

X3D browsers usually pop up the text description when the pointing device is over the selection geometry

url Uniform Resource Locator

The *url* field provides either

- Address to new X3D scene, HTML page, or another Web resource, or else
- Viewpoint bookmark within the scene

MFString array provides alternate url addresses

- url addresses can be either local or online
- Point to alternate versions of same resource
- X3D browser goes sequentially through ordered list, one at a time, until one retrieval succeeds

Anchor *parameter*

parameter provides additional information to browser regarding redirection of loaded result

- *parameter*='target=_blank' sends to new frame
- *parameter*='target=frame4' sends to named frame
- May be ignored if browser is solely X3D capable, rather than (for instance) a Web-browser plugin

Once again, designed to match functionality found in HTML anchor tag

Anchor hints and warnings

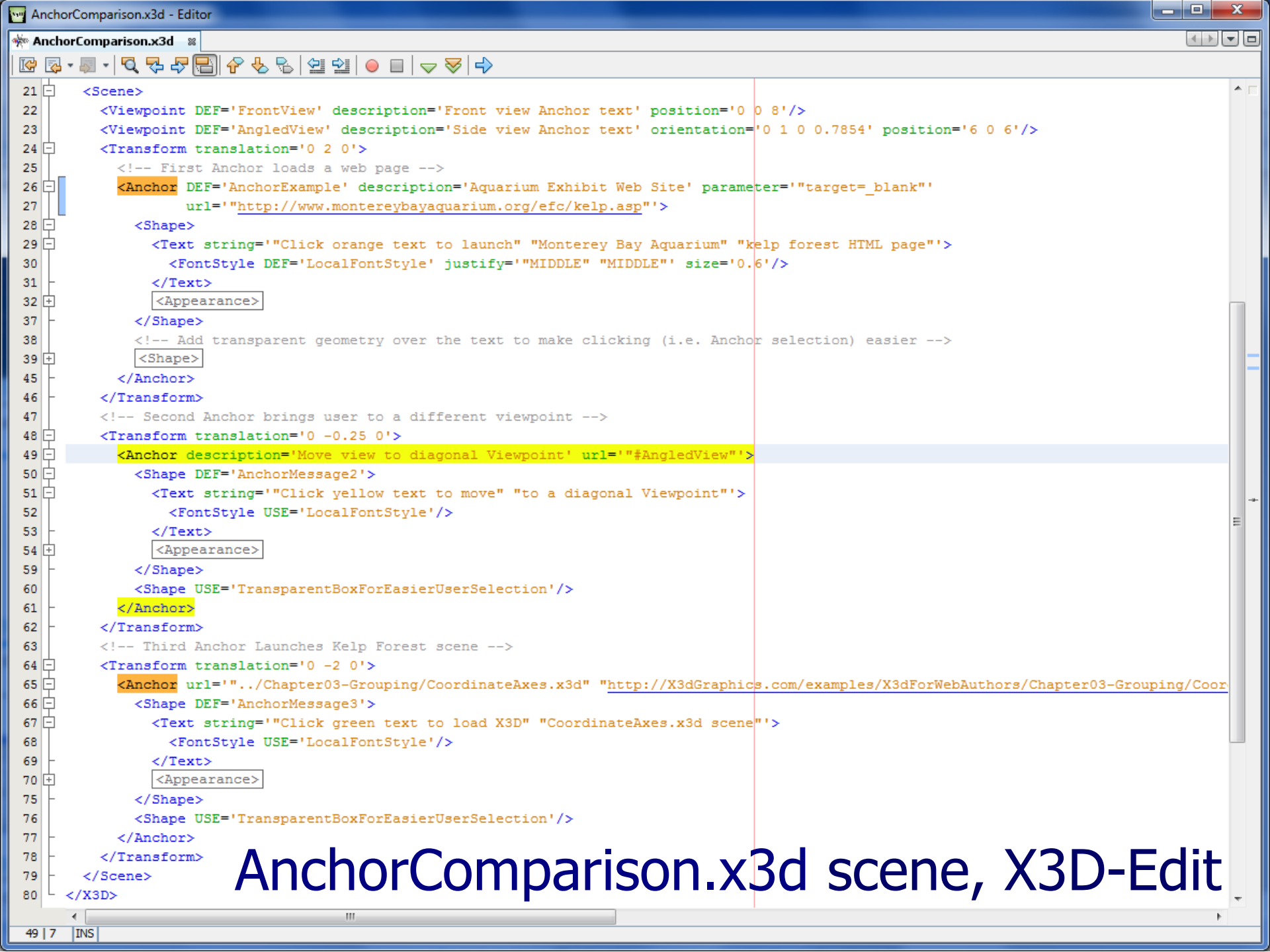
Strictly match capitalization of directories and file names

- Unix and http are case sensitive and fail otherwise
- Windows is forgiving but actually this hides errors

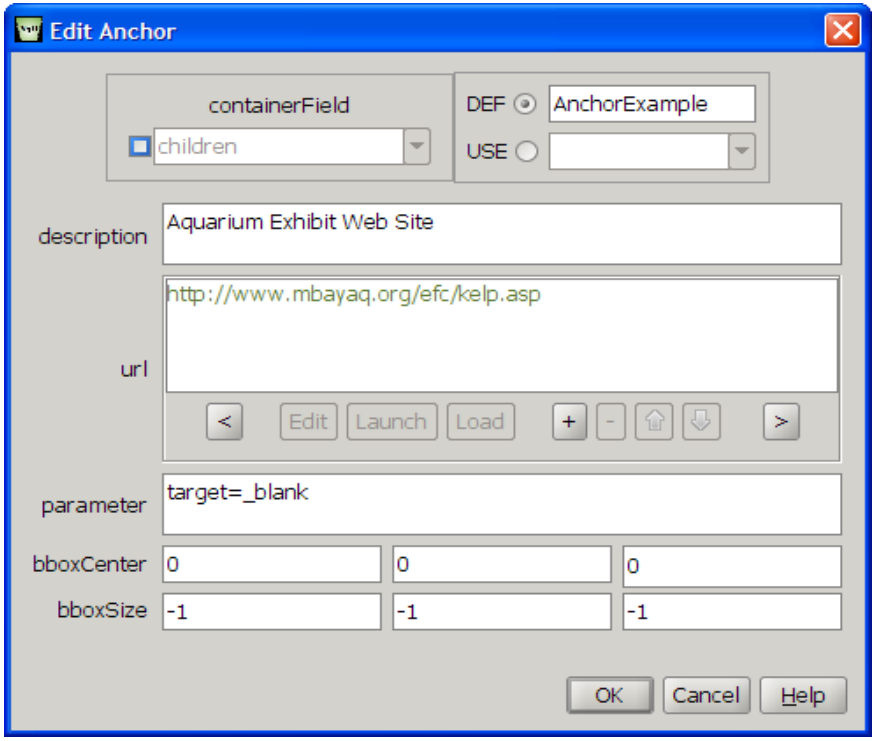
XML escape characters

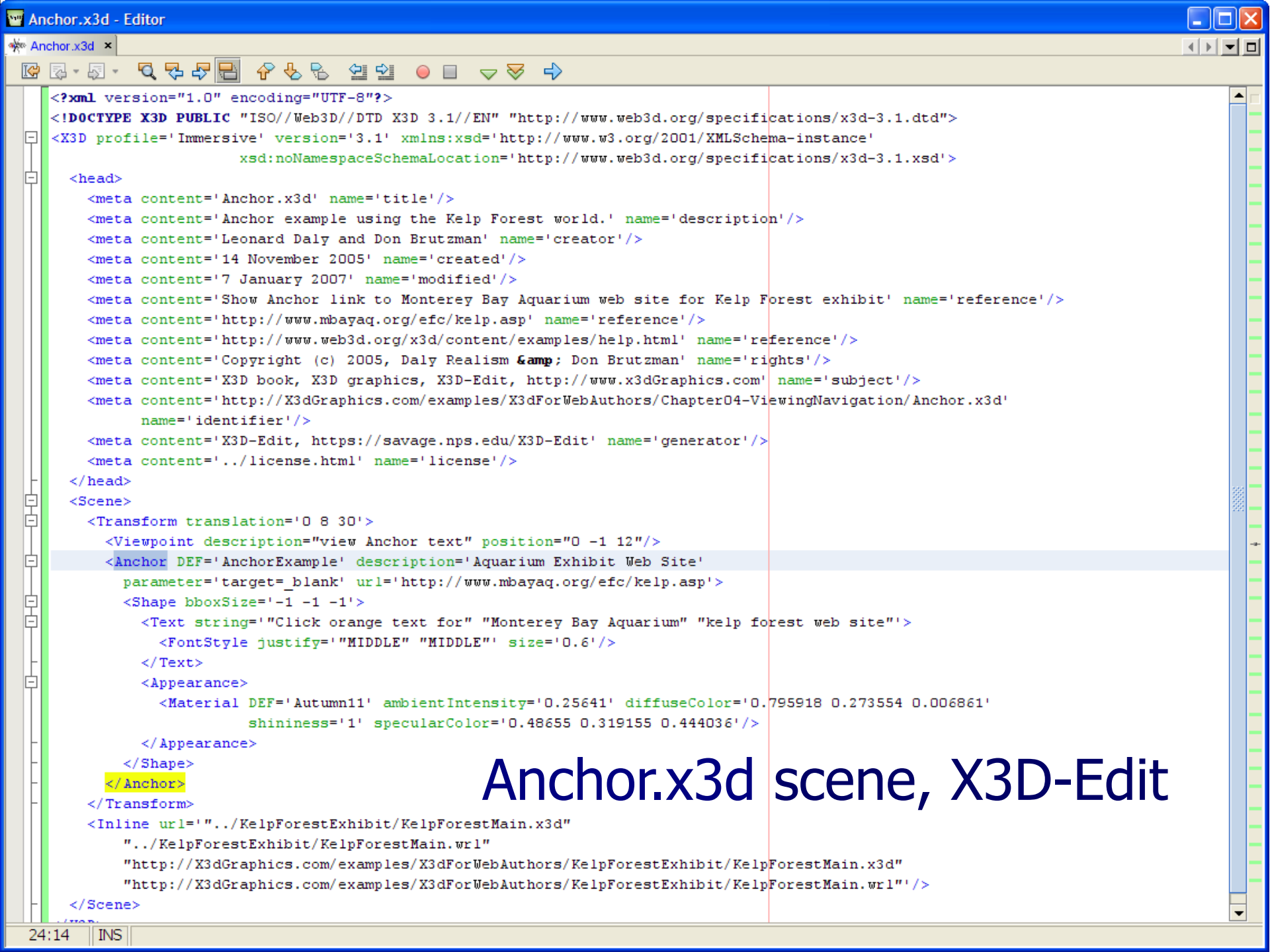
- & (ampersand) &
- ' (apostrophe) '
- " (double quote) "

AnchorComparison.x3d scene


AnchorComparison.x3d - Editor
AnchorComparison.x3d
<Scene>
<Viewpoint DEF='FrontView' description='Front view Anchor text' position='0 0 8'/>
<Viewpoint DEF='AngledView' description='Side view Anchor text' orientation='0 1 0 0.7854' position='6 0 6'/>
<Transform translation='0 2 0'>
<!-- First Anchor loads a web page -->
<Anchor DEF='AnchorExample' description='Aquarium Exhibit Web Site' parameter='"target=_blank"'
url='"http://www.montereybayaquarium.org/efc/kelp.asp"'>
<Shape>
<Text string='"Click orange text to launch" "Monterey Bay Aquarium" "kelp forest HTML page"'>
<FontStyle DEF='LocalFontStyle' justify='"MIDDLE" "MIDDLE"' size='0.6'/>
</Text>
<Appearance>
</Shape>
<!-- Add transparent geometry over the text to make clicking (i.e. Anchor selection) easier -->
<Shape>
</Anchor>
</Transform>
<!-- Second Anchor brings user to a different viewpoint -->
<Transform translation='0 -0.25 0'>
<Anchor description='Move view to diagonal Viewpoint' url='"#AngledView"'>
<Shape DEF='AnchorMessage2'>
<Text string='"Click yellow text to move" "to a diagonal Viewpoint"'>
<FontStyle USE='LocalFontStyle'/>
</Text>
<Appearance>
</Shape>
<Shape USE='TransparentBoxForEasierUserSelection'/>
</Anchor>
</Transform>
<!-- Third Anchor Launches Kelp Forest scene -->
<Transform translation='0 -2 0'>
<Anchor url='"../Chapter03-Grouping/CoordinateAxes.x3d" "http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter03-Grouping/Coor
<Shape DEF='AnchorMessage3'>
<Text string='"Click green text to load X3D" "CoordinateAxes.x3d scene"'>
<FontStyle USE='LocalFontStyle'/>
</Text>
<Appearance>
</Shape>
<Shape USE='TransparentBoxForEasierUserSelection'/>
</Anchor>
</Transform>
</Scene>
</X3D>
AnchorComparison.x3d scene, X3D-Edit
49 | 7
INS

Anchor example scene, editor




Anchor.x3d - Editor
Anchor.x3d
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
xsd:noNamespaceSchemaLocation='http://www.web3d.org/specifications/x3d-3.1.xsd'>
<head>
<meta content='Anchor.x3d' name='title'/>
<meta content='Anchor example using the Kelp Forest world.' name='description'/>
<meta content='Leonard Daly and Don Brutzman' name='creator'/>
<meta content='14 November 2005' name='created'/>
<meta content='7 January 2007' name='modified'/>
<meta content='Show Anchor link to Monterey Bay Aquarium web site for Kelp Forest exhibit' name='reference'/>
<meta content='http://www.mbayaq.org/efc/kelp.asp' name='reference'/>
<meta content='http://www.web3d.org/x3d/content/examples/help.html' name='reference'/>
<meta content='Copyright (c) 2005, Daly Realism & Don Brutzman' name='rights'/>
<meta content='X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com' name='subject'/>
<meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/Anchor.x3d'
name='identifier'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
</head>
<Scene>
<Transform translation='0 8 30'>
<Viewpoint description="view Anchor text" position="0 -1 12"/>
<Anchor DEF='AnchorExample' description='Aquarium Exhibit Web Site'
parameter='target=_blank' url='http://www.mbayaq.org/efc/kelp.asp'>
<Shape bboxSize='-1 -1 -1'>
<Text string='"Click orange text for" "Monterey Bay Aquarium" "kelp forest web site"'>
<FontStyle justify='"MIDDLE" "MIDDLE"' size='0.6'/>
</Text>
<Appearance>
<Material DEF='Autumn11' ambientIntensity='0.25641' diffuseColor='0.795918 0.273554 0.006861'
shininess='1' specularColor='0.48655 0.319155 0.444036'/>
</Appearance>
</Shape>
</Anchor>
</Transform>
<Inline url='"../KelpForestExhibit/KelpForestMain.x3d"
"../KelpForestExhibit/KelpForestMain.wrl"
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForestExhibit/KelpForestMain.x3d"
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForestExhibit/KelpForestMain.wrl"'/>
</Scene>
Anchor.x3d scene, X3D-Edit
24:14
INS

⚓ Anchor	**Anchor is a Grouping node that can contain most nodes. Clicking Anchored geometry loads content specified by the url field. Loaded content completely replaces current content, if parameter is same window.** Hint: **insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
description	**[description: accessType inputOutput, type SFString CDATA #IMPLIED]** Text description to be displayed for action of this node. Hint: many XML tools substitute XML character references automatically if needed (like & for & or " for "). Interchange profile hint: this field may be ignored.
url	**[url: accessType inputOutput, type MFString CDATA #IMPLIED]** Address of replacement world, activated by clicking Anchor geometry. Hint: jump to a world's internal viewpoint by appending viewpoint name (e.g. #ViewpointName, someOtherCoolWorld.wrl#GrandTour). Hint: jump to a local viewpoint by only using viewpoint name (e.g. #GrandTour). Hint: Strings can have multiple values, so separate each string by quote marks ["http://www.url1.org" "http://www.url2.org" "etc."]. Hint: XML encoding for " is " (a character entity). Warning: strictly match directory and filename capitalization for http links! Hint: can replace embedded blank(s) in url queries with %20 for each blank character. Hint: pop up a new window with url value as follows: "JavaScript:window.open('popup.html','popup','width=240,height=240');location.href='HelloWorld.wrl'"
parameter	**[parameter: accessType inputOutput, type MFString CDATA #IMPLIED]** Passed parameter that signals web browser how to redirect url loading. Hint: set parameter to target=_blank to load target url into a blank frame. Hint: set parameter to target=frame_name to load target url into another frame. Hint: Strings can have multiple values, so separate each string by quote marks. ["http://www.url1.org" "http://www.url2.org" "etc."]. Interchange profile hint: this field may be ignored.
bboxCenter	**[bboxCenter: accessType initializeOnly, type SFVec3f CDATA "0 0 0"]** Bounding box center: position offset from origin of local coordinate system.
bboxSize	**[bboxSize: accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]** Bounding box size: automatically calculated, can be specified as an optimization or constraint.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

Billboard node

Billboard is another X3DGroupingNode

Child-content geometry faces user

- Special effect that improves readability or visibility

axisOfRotation determines Billboard pivot point

- Relative to local coordinate system
- Default is *axisOfRotation*='0 1 0' which swivels about vertical (Y axis)
- Rotations unpredictable when view above (on axis)
- Define *axisOfRotation*='0 0 0' for circular rotation in any direction, always fully facing the user

Billboard hints and warnings

DEF, USE allowed for multiple Billboards nodes

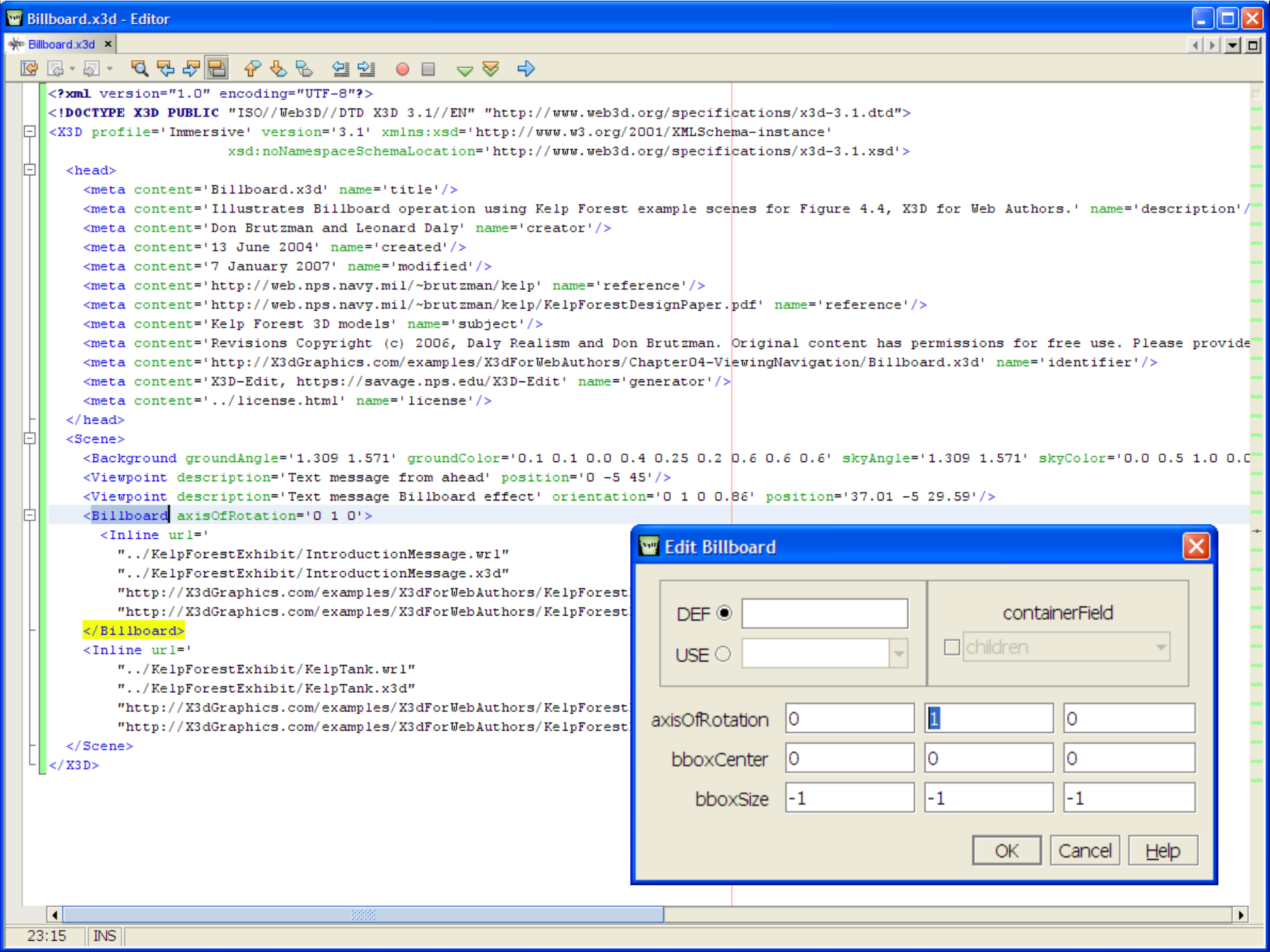
- Each copy should independently face user

Put Billboard as close to moving geometry as possible, nested inside a positioning Transform

- Usually bad idea to put Transform inside Billboard

Do not put a Viewpoint under a Billboard

- Creates a feedback loop
- Unpredictable behavior likely to result


Billboard.x3d - Editor
Billboard.x3d
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance'
xsd:noNamespaceSchemaLocation='http://www.web3d.org/specifications/x3d-3.1.xsd'>
<head>
<meta content='Billboard.x3d' name='title'/>
<meta content='Illustrates Billboard operation using Kelp Forest example scenes for Figure 4.4, X3D for Web Authors.' name='description'/
<meta content='Don Brutzman and Leonard Daly' name='creator'/>
<meta content='13 June 2004' name='created'/>
<meta content='7 January 2007' name='modified'/>
<meta content='http://web.nps.navy.mil/~brutzman/kelp' name='reference'/>
<meta content='http://web.nps.navy.mil/~brutzman/kelp/KelpForestDesignPaper.pdf' name='reference'/>
<meta content='Kelp Forest 3D models' name='subject'/>
<meta content='Revisions Copyright (c) 2006, Daly Realism and Don Brutzman. Original content has permissions for free use. Please provide
<meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/Billboard.x3d' name='identifier'/>
<meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
<meta content='../license.html' name='license'/>
</head>
<Scene>
<Background groundAngle='1.309 1.571' groundColor='0.1 0.1 0.0 0.4 0.25 0.2 0.6 0.6 0.6' skyAngle='1.309 1.571' skyColor='0.0 0.5 1.0 0.0
<Viewpoint description='Text message from ahead' position='0 -5 45'/>
<Viewpoint description='Text message Billboard effect' orientation='0 1 0 0.86' position='37.01 -5 29.59'/>
<Billboard axisOfRotation='0 1 0'>
<Inline url='
"../KelpForestExhibit/IntroductionMessage.wrl"
"../KelpForestExhibit/IntroductionMessage.x3d"
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForest
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForest
</Billboard>
<Inline url='
"../KelpForestExhibit/KelpTank.wrl"
"../KelpForestExhibit/KelpTank.x3d"
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForest
"http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForest
</Scene>
</X3D>
Edit Billboard
DEF
USE
containerField
children
axisOfRotation
0
1
0
bboxCenter
0
0
0
bboxSize
-1
-1
-1
OK
Cancel
Help
23:15
INS

Billboard example

Starting at initial viewpoint and navigating with mouse or arrow keys reveals that Billboard Text remains facing the viewer, improving readability

web|3D CONSORTIUM

Billboard	**Billboard is a Grouping node that can contain most nodes. Content faces the user, rotating about the specified axis. Set axisOfRotation=0 0 0 to fully face the user's camera.** Hint: **Put Billboard as close to the geometry as possible, nested inside Transform for local coordinate system.** Hint: **don't put Viewpoint inside a Billboard.** Hint: **insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
axisOfRotation	**[axisOfRotation: accessType inputOutput, type SFVec3f CDATA "0 1 0"]** axisOfRotation direction is relative to local coordinate system. Hint: axis 0 0 0 always faces viewer.
bboxCenter	**[bboxCenter: accessType initializeOnly, type SFVec3f CDATA "0 0 0"]** Bounding box center: position offset from origin of local coordinate system.
bboxSize	**[bboxSize: accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]** Bounding box size: automatically calculated, can be specified as an optimization or constraint.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

Collision node

Defines camera-to-object collision-detection properties between child geometry and user

- *enabled*='true' blocks user navigation through the geometry
- *enabled*='false' allows user navigation through the geometry

Not used for object-to-object collision detection

Authors can detect when collision occurs

- SFTime outputOnly event *collideTime*
- SFBool outputOnly event *isActive*

Collision detection and terrain following

Terrain following depends on +Y axis being "up"

- Other coordinate systems are possible but do not match this X3D convention
- Thus datasets using other coordinates must be converted to match

WALK mode is another form of collision detection

- Viewer's camera drops until NavigationInfo avatar rests on geometry serving as the ground plane
- Step-over distance (an *avatarSize* parameter) governs whether user can rise over obstacles

Collision *proxy* field

Child geometry may be quite detailed, irregular

- Complicating collision-detection calculations and thus slowing rendering performance

Can substitute SFNode *proxy* child as alternate

- Shape containing a Box, Sphere or Cylinder can provide simplifying geometric alternative
- *proxy* geometry is not rendered

```
<Collision DEF='Example' enabled='true'>
    <Shape containerField='proxy'><Cylinder/></Shape>
    <Inline url='SomeComplicatedObject.x3d'/>
</Collision>
```

Collision hints and warnings

`<NavigationInfo type=' "WALK" "FLY" '/>`
modes support camera-to-object collision detection

Only polygonal geometry can be used for collision detection

- No points or lines
- Special limitation: no Text node collisions
- Nevertheless you can achieve the same collision effects by adding a transparent Box or other shape, thus providing necessary polygons as boundaries

Collision.x3d - Editor

Collision.x3d

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN" "http://www.web3d.org/specifications/x3d-3.1.dtd">
<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation='http://www.web3d.
  <head>
    <meta content='Collision.x3d' name='title'/>
    <meta content='Illustrate Collision node: set enabled="true" to block zooming through glass.' name='description'/>
    <meta content='Don Brutzman and Leonard Daly' name='creator'/>
    <meta content='1 June 1998' name='created'/>
    <meta content='13 June 2004' name='translated'/>
    <meta content='7 January 2008' name='modified'/>
    <meta content='http://web.nps.navy.mil/~brutzman/kelp' name='reference'/>
    <meta content='http://web.nps.navy.mil/~brutzman/kelp/KelpForestDesignPaper.pdf'
    <meta content='Kelp Forest 3D models' name='subject'/>
    <meta content='Revisions Copyright (c) 2006, Daly Realism and Don Brutzman. Origi
    <meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/KelpForestExhibit
    <meta content='http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-Viewing
    <meta content='X3D-Edit, https://savage.nps.edu/X3D-Edit' name='generator'/>
    <meta content='../license.html' name='license'/>
  </head>
  <Scene>
    <NavigationInfo speed='3' type='"FLY" "ANY"'/>
    <Viewpoint description='Outside Tank' orientation='0.21 0.97 -0.14 1.202' positio
    <Viewpoint description='Inside Tank' orientation='0.21 0.97 -0.14 1.202' position
    <Collision enabled='false'>
      <Inline url='"../KelpForestExhibit/KelpTank.wrl" "../KelpForestExhibit/KelpTank.x3d" "http://X3dGraphics.com/examples/X3dForWebAuthors/
    </Collision>
  </Scene>
</X3D>
```

Edit Collision

DEF ◉ USE ○

containerField

☐ children

enabled ☑

collideTime

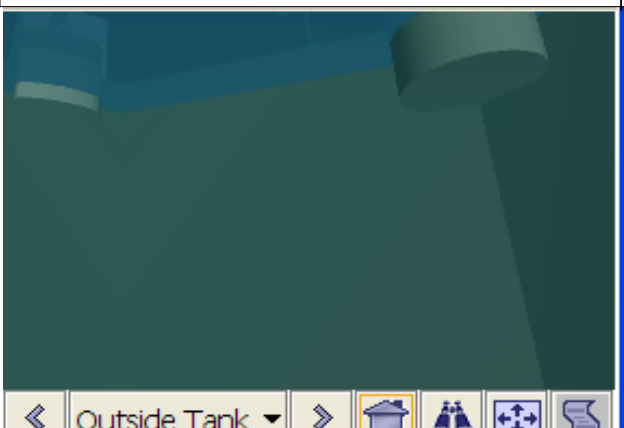
axisOfRotation

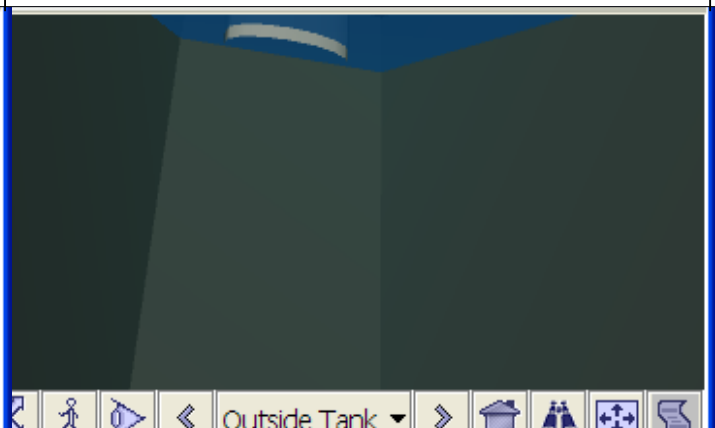
bboxCenter 0 0 0

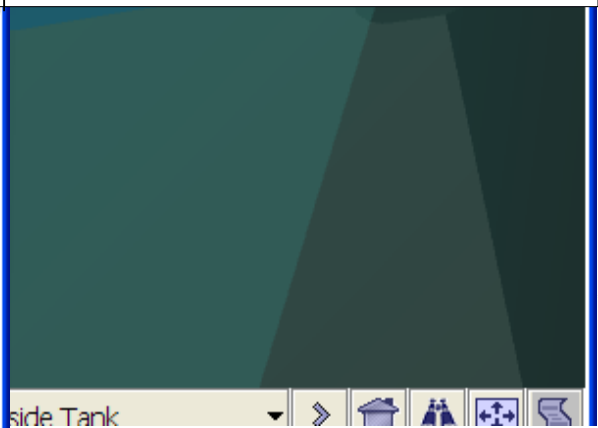
bboxSize -1 -1 -1

OK Cancel Help

initial view outside tank glass	zoom into tank, collision off	blocked by glass, collision on







Collision example

Example screen shots first show the viewer being stopped by glass geometry, then the viewer passing through the tank glass for a closer view.

Collision *enabled*="true" or *enabled*="false" result in different navigation responses.

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Collision	**Collision detects camera-to-object contact using current Viewpoint and NavigationInfo avatarSize. Collision is a Grouping node that handles collision detection for its children. Collision can contain a single proxy child node for substitute collision-detection geometry. Note: proxy geometry is not rendered. Note: PointSet, IndexedLineSet, LineSet and Text do not trigger collisions.** **Hint: improve performance using proxy for simpler contact-calculation geometry.** **Hint: NavigationInfo types ""WALK" "FLY"" support camera-to-object collision detection.** **Hint: insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
bboxCenter	**[bboxCenter: accessType initializeOnly, type SFVec3f CDATA "0 0 0"]** Bounding box center: position offset from origin of local coordinate system.
bboxSize	**[bboxSize: accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]** Bounding box size: automatically calculated, can be specified as an optimization or constraint.
enabled	**[enabled: accessType inputOutput, type SFBool (true|false) "true"]** Enables/disables collision detection for children and all descendants. Hint: former name "collide" in VRML 97 specification.
isActive	**[isActive: accessType outputOnly, type SFBool (true|false) #FIXED ""]** isActive true/false events are sent when triggering the sensor. isActive=true when view-object collision occurs, isActive=false when view-object collision no longer occurs.
collideTime	**[collideTime: accessType outputOnly, type SFTime CDATA #FIXED ""]** Time of collision between camera (avatar) and geometry.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

Additional Resources

File formatting

X3D-Edit has a Netbeans capability for formatting

- *Alt-shift-F* ***F****ormat* acts upon highlighted text blocks, also available via right-click menu
- Warning: do not reformat embedded ECMAscript source code

X3D Canonicalization (C14N) also reformats X3D

- Performed prior to examples being placed in archive
- Can invoke in X3D-Edit using C14N button
- Preferred method for file formatting

Pretty-print HTML capabilities

Pretty print means to reformat nicely in HTML, usually with color coding

- facilitates reading and printing

X3D-Edit has this Netbeans feature

- File > Print to HTML

X3dToXhtml.xslt stylesheet

- Includes indices and hyperlinks to DEF/USE, ROUTEs, images, url values, prototypes, etc.
- Can be launched via XSL Transformation button
- Available via X3D-Edit > X3D > Export menu

BindingOperations.x3d (X3dToXhtml) - Mozilla Firefox

File Edit View History Bookmarks Tools GUtil! Help

http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.html

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE X3D PUBLIC "ISO//Web3D//DTD X3D 3.1//EN"   "http://www.web3d.org/specifications/x3d-3.1.dtd">

<X3D profile='Immersive' version='3.1' xmlns:xsd='http://www.w3.org/2001/XMLSchema-instance' xsd:noNamespaceSchemaLocation=' http://www.web3d.org/specifications/x3d-3.1.xsd '>
    <head>
        <meta name='title' content='BindingOperations.x3d'/>
        <meta name='description' content='Illustrate Viewpoint binding operations as described in Chapter 4 concepts. Display the browser console to see an event'/>
        <meta name='creator' content='Don Brutzman'/>
        <meta name='created' content='5 January 2008'/>
        <meta name='modified' content='5 January 2008'/>
        <meta name='reference' content=' http://X3dGraphics.com '/>
        <meta name='reference' content=' http://www.web3d.org/x3d/content/examples/help.html '/>
        <meta name='rights' content='Copyright Don Brutzman and Leonard Daly 2007'/>
        <meta name='subject' content=' X3D book, X3D graphics, X3D-Edit, http://www.x3dGraphics.com '/>
        <meta name='reference' content='BindingOperations.console.txt'/>
        <meta name='identifier' content=' http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.x3d '/>
        <meta name='generator' content='X3D-Edit, http://www.web3d.org/x3d/content/README.X3D-Edit.html'/>
        <meta name='license' content='../../license.html'/>
    </head>
    <!--

    Index for DEF nodes: BindingSequencerEngine, CenterJustify, ClickToAnimateView, Clock, Text1, Text2, Text3, Text4, TextTouchSensor, TimingSequencer, View1, View2, View3, View4
    Index for Viewpoint images: View1, View2, View3, View4, ClickToAnimateView

    -->
    <Scene>
        <!-- View1 ROUTEs:  [from BindingSequencerEngine.bindView1 to set_bind ] [from isBound to BindingSequencerEngine.view1Bound ] -->
        <Viewpoint DEF='View1' centerOfRotation='-6 0 0' description='Viewpoint 1' position='-6 0 5'/>
        <!-- View2 ROUTEs:  [from BindingSequencerEngine.bindView2 to set_bind ] [from isBound to BindingSequencerEngine.view2Bound ] -->
        <Viewpoint DEF='View2' centerOfRotation='-2 0 0' description='Viewpoint 2' position='-2 0 5'/>
        <!-- View3 ROUTEs:  [from BindingSequencerEngine.bindView3 to set_bind ] [from isBound to BindingSequencerEngine.view3Bound ] -->
        <Viewpoint DEF='View3' centerOfRotation='2 0 0' description='Viewpoint 3' position='2 0 5'/>
        <!-- View4 ROUTEs:  [from BindingSequencerEngine.bindView4 to set_bind ] [from isBound to BindingSequencerEngine.view4Bound ] -->
        <Viewpoint DEF='View4' centerOfRotation='6 0 0' description='Viewpoint 4' position='6 0 5'/>
        <Group>
            <Transform DEF='Text1' translation='-6 0 0'>
                <Shape>
                    <Text string='"View" "# 1"' solid='true'>
                        <FontStyle DEF='CenterJustify' justify='"MIDDLE" "MIDDLE"'/>
                    </Text>
                    <Appearance>
```

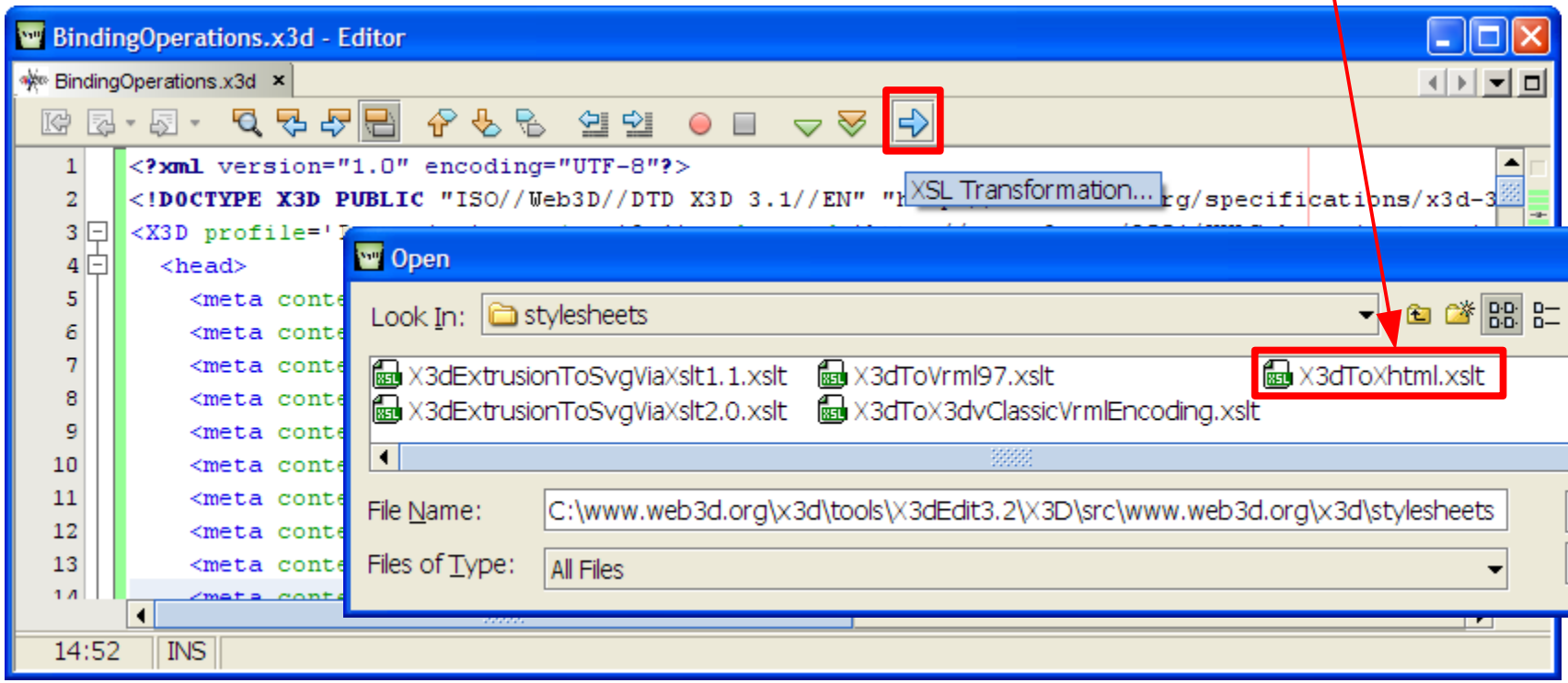
Find: xsl Next Previous Highlight all Match case

Done 0.359s 72.52.156.96 205.155.65.236 0:907 Now: Overcast, 54° F Sun: 55° F Mon: 54° F

Launching other XSLT stylesheets

Extensible Stylesheet Language for XML (XSLT) stylesheets support a variety of conversions

- X3dToVrml97.xslt
- X3dToClassicVRML.xslt
- X3dToXhtml.xslt
- others



Chapter Summary

Chapter Summary

Users explore X3D worlds by choosing predefined viewpoints and navigating through 3D space.

- Bindable nodes, so only one is active at a time
- Viewpoint lets authors identify key camera locations
- NavigationInfo provides options for moving around

Nodes to improve user navigability, interaction:

- Anchor makes geometric shapes linkable, like HTML
- Billboard for axis-aligned geometry facing the user
- Collision permits or blocks a user's current camera view from passing through collidable geometry

Suggested exercises

Demonstrate the ability to choose viewpoints and navigate in master Kelp Forest Exhibit scene

- Take screen snapshot image to show what you saw

Create a "guided tour" of multiple Viewpoints for navigating a scene of interest

Switch between EXAMINE, WALK and FLY navigation in one or more browsers

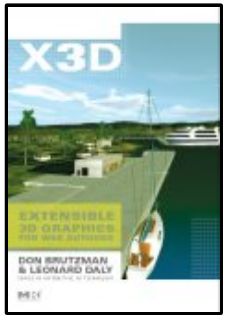
Demonstrate the Anchor node by linking some text to another scene or an external web page

Use Billboard for multiple Text descriptions, linked via Anchor to bind respective viewpoints

References

References 1

X3D: Extensible 3D Graphics for Web Authors
by Don Brutzman and Leonard Daly, Morgan Kaufmann Publishers, April 2007, 468 pages.



- Chapter 4, Viewing and Navigation
- http://x3dGraphics.com
- http://x3dgraphics.com/examples/X3dForWebAuthors

X3D Resources

- http://www.web3d.org/x3d/content/examples/X3dResources.html

References 2

X3D-Edit Authoring Tool

- https://savage.nps.edu/X3D-Edit

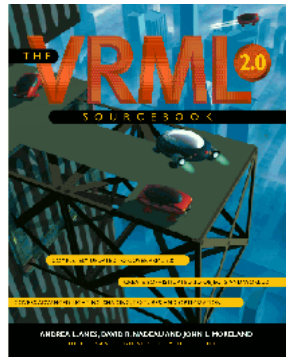
X3D Scene Authoring Hints

- http://x3dgraphics.com/examples/X3dSceneAuthoringHints.html

X3D Graphics Specification

- http://www.web3d.org/x3d/specifications
- Also available as help pages within X3D-Edit

References 3



VRML 2.0 Sourcebook by Andrea L. Ames, David R. Nadeau, and John L. Moreland, John Wiley & Sons, 1996.

- http://www.wiley.com/legacy/compbooks/vrml2sbk/cover/cover.htm
- http://www.web3d.org/x3d/content/examples/Vrml2.0Sourcebook
- Chapter 26 – Viewpoint

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CGEMS, SIGGRAPH, Eurographics

The Computer Graphics Educational Materials Source(CGEMS) site is designed for educators

- to provide a source of refereed high-quality content
- as a service to the Computer Graphics community
- freely available, directly prepared for classroom use
- http://cgems.inesc.pt

X3D for Web Authors recognized by CGEMS! ☺

- Book materials: X3D-Edit tool, examples, slidesets
- Received jury award for Best Submission 2008

CGEMS supported by SIGGRAPH, Eurographics

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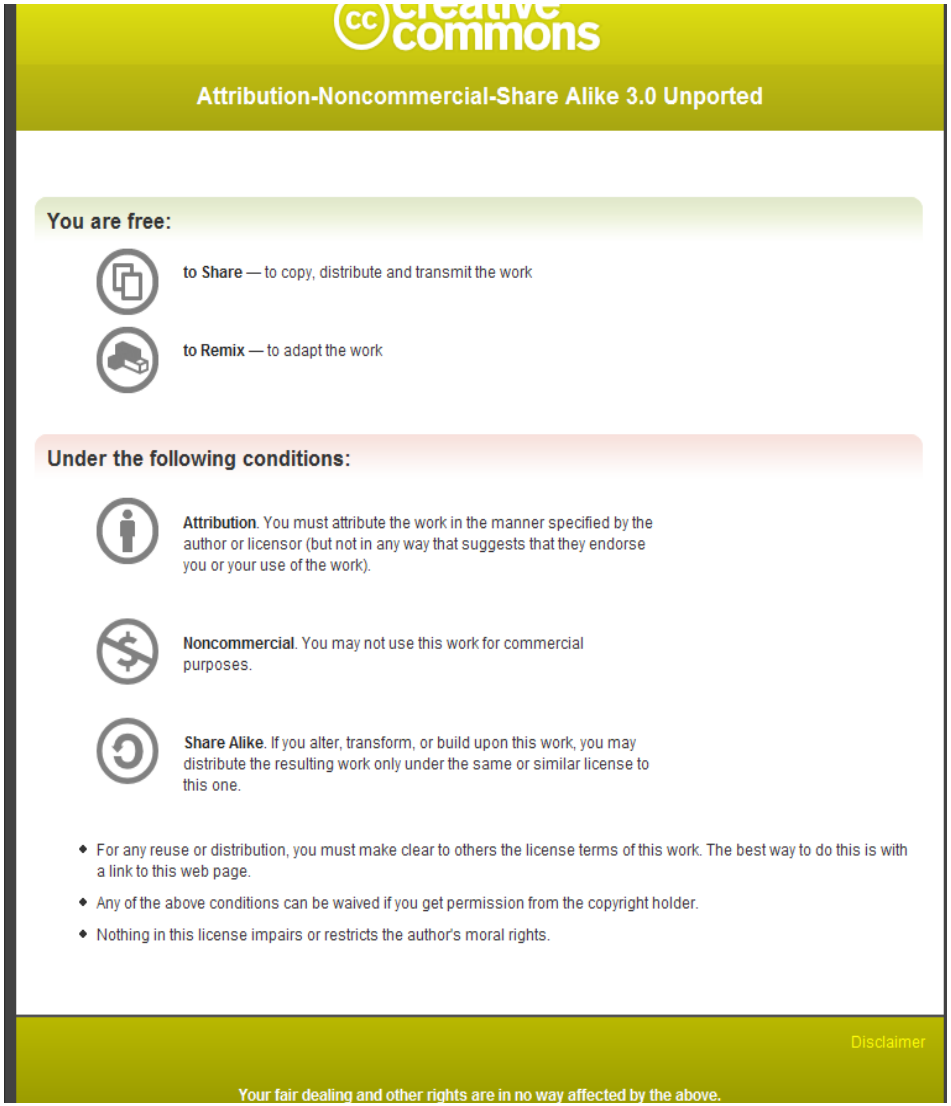

Open-source license
for X3D-Edit software and X3D example scenes

http://www.web3d.org/x3d/content/examples/license.html

X3D Graphics for Web Authors

Chapter 4

Viewing and Navigation

But the eyes, though they are no sailors, will never be satisfied with any model, however fashionable, which does not answer all the requisitions of art.

Henry David Thoreau, 1849

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Chapter Overview

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Overview: Viewing and Navigation

Users explore X3D worlds by choosing predefined viewpoints and navigating through 3D space.

- Bindable nodes, so only one is active at a time
- Viewpoint lets authors identify key camera locations
- NavigationInfo provides options for moving around

Related nodes improve navigability, interaction

- Anchor makes geometric shapes linkable
- Billboard keeps child geometry facing the user
- Collision can allow or prevent a user's view from passing through geometry

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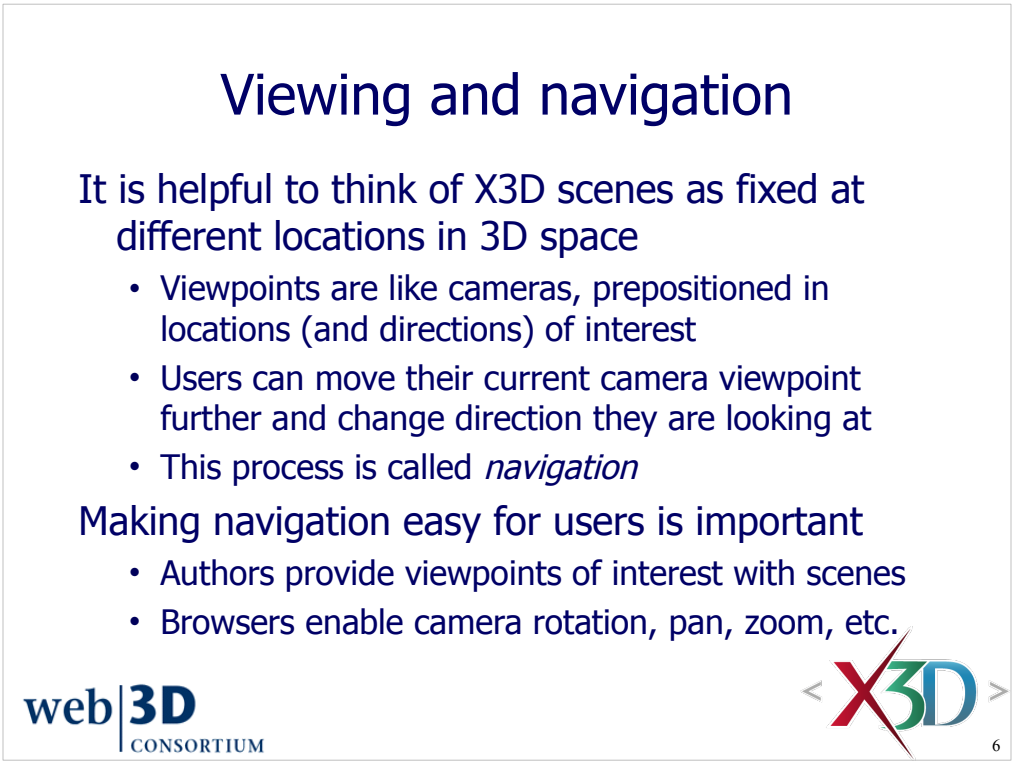
Concepts



Difficult navigation leads to users becoming “lost in space” or, worse yet from an author's perspective, simply leaving the scene because it is incomprehensible.

Goals of viewing and navigation

- Viewing a scene from different vantage points that reveal aspects of interest, document key locations, or help to tell a story
- Navigating changes in the user's view of a scene effectively, by moving from place to place in an intuitive manner
- Making geometric objects selectable so that users can transport to another viewpoint, launch into another scene, or receive other web content
- Taking advantage of viewpoint location for special interactive techniques, such as user-facing billboard rotations and terrain following

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Bindable nodes

Bindable nodes have a special property:
only one can be active at a time

- Bindable nodes are Viewpoint, NavigationInfo, Background, TextureBackground, Fog
- Each implements X3DBindableNode type interface for consistency
- First nodes found in scene become active by default

Implemented using a stack

- Similar to spring-loaded tray of plates in cafeteria
- One (and only one) is active, on top
- One can be pulled off top, sent off to the side
- One can be pulled to top, pushing down others

The key point here about bindable nodes is that only one of each type of node can be active and bound at a given moment.

The first bindable node (of each type) that is found in a scene becomes active by default. Any bindable nodes found within an Inline scene are added to the stack, but thes Inlined nodes cannot become active automatically by default.

Four types of X3DBindableNode types:

- X3DViewpointNode: Viewpoint, OrthoViewpoint, GeoViewpoint
- NavigationInfo, GeoViewpoint
- X3DBackgroundNode: Background, TextureBackground
- Fog (but not LocalFog)

Background, TextureBackground, Fog nodes are covered in Chapter 11, Lighting and Environment nodes.

Stack (data structure) description: http://en.wikipedia.org/wiki/Stack_(data_structure)

Stereo glasses are still possible with a single bound Viewpoint since the left/right eye disparities are computed as offsets from that single location and orientation.

Binding example

Basic user operation is pretty simple:

- just select the desired Viewpoint

Complex example follows, stepping through binding stack operations

- Advanced details
- BindingOperations.x3d
- Animated with scripting
- Console results found in BindingOperations.console.txt

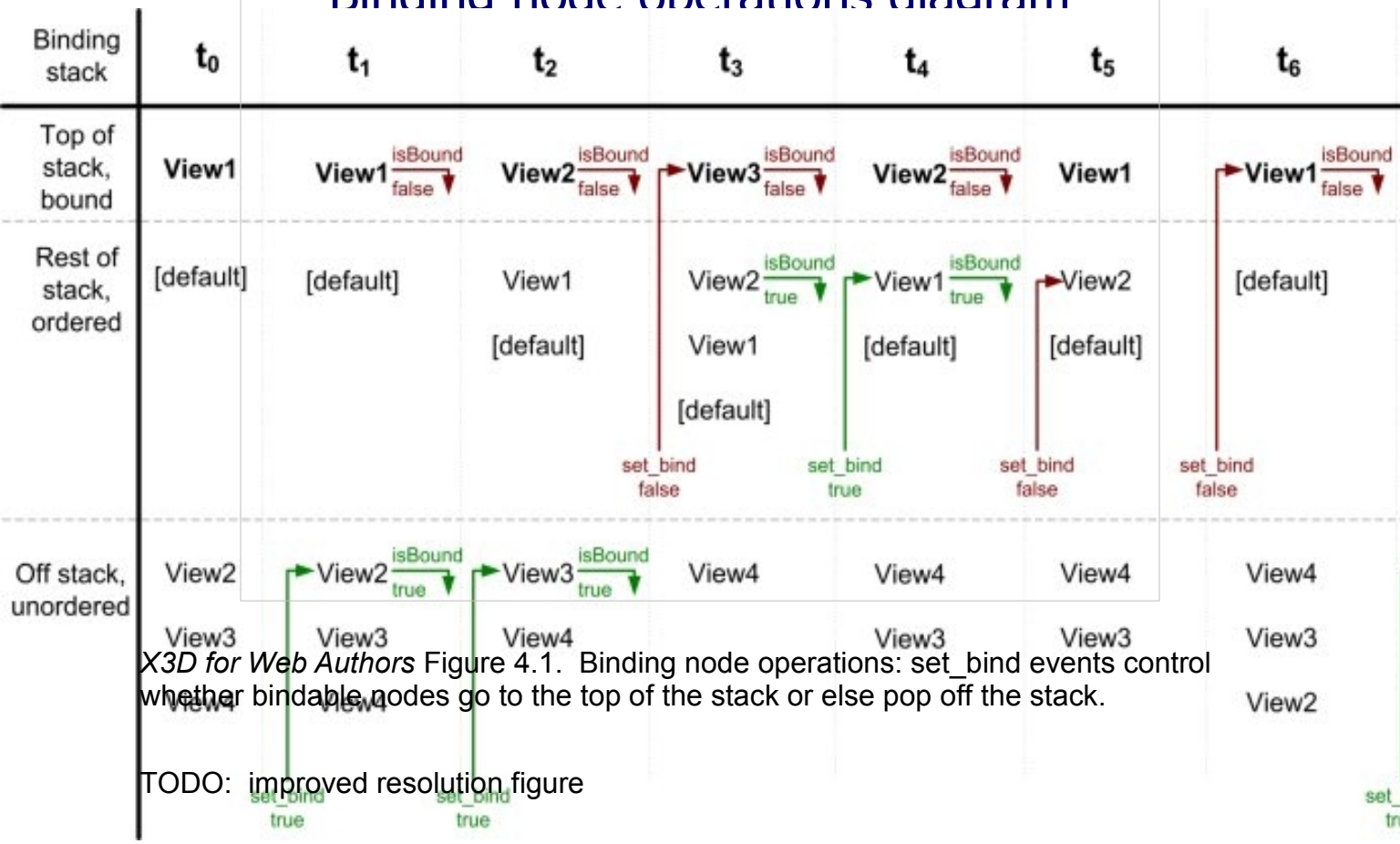
New users please skip ahead to Nodes and Examples

Related chapter for event passing: Chapter 8, User Interactivity Nodes

Example scene, expected output:

http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.x3d

http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.console.txt



X3D for Web Authors Figure 4.1. Binding node operations: set_bind events control whether bindable nodes go to the top of the stack or else pop off the stack.

TODO: improved resolution figure

Example scene, expected output:

http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.x3d

http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.console.txt

Binding node operations 1

- **Time t0**. The initial loading of the scene has first `<Viewpoint DEF='View1'/>` active and bound to the top of the binding stack. Other viewpoints are off the binding stack.
- If no viewpoints are provided in the scene, then the default `<Viewpoint position='0 0 10'/>` defined in the X3D Specification is used.

- **Time t1**. When the user selects View2 from the viewpoint list, it receives a *set_bind="true"* event and goes to the top of the binding stack. View2 also issues an *isBound="true"* event, and View1 issues an *isBound="false"* event as it moves down the stack.

These steps refer to preceding diagram

Binding node operations 2

- **Time t2**. Similar to the previous transitions in step t1, View3 receives a *set_bind="true"* event and responds with an *isBound="true"* event, while View2 issues an *isBound="false"* event and pushes View1 further down the stack.

- **Time t3**. View3 receives a *set_bind="false"* event, triggering a corresponding *isBound="false"* event and dropping off the stack completely. Because View2 is the next node on the binding stack, it pops to the top to become the active Viewpoint node. View2 also issues an *isBound="true"* event.

These steps refer to preceding diagram

Binding node operations 3

- **Time t4**. The user now selects View1 from the browser's viewpoint list, so View1 receives a *set_bind="true"* event and sends a corresponding *isBound="true"* event. View2 is no longer bound, and is pushed down the binding stack.
- **Time t5**. View2 receives a *set_bind="false"* event while on the binding stack but unbound, and as a result, it is taken completely off the binding stack.
- **Time t6**. View1 is now removed off the binding stack via a *set_bind="false"* event, leaving no other defined Viewpoint nodes on the stack.

These steps refer to preceding diagram

Binding node operations 4

- **Time t7**. With no Viewpoint nodes remaining on the stack to bind, default viewpoint values are used: `<Viewpoint position='0 0 10'/>`. The user then selects the previously unbound View4 from the viewpoint list.
- **Time t8**. View4 remains as the bound viewpoint with no further viewpoints remaining on the stack.

Same process for all X3D bindable node stacks:

- Viewpoint/OrthoViewpoint/GeoViewpoint, NavigationInfo/GeoViewpoint, Fog, Background/TextureBackground

These steps refer to preceding diagram

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X3D Nodes and Examples

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Viewpoint node

It is helpful to think of X3D scenes as being fixed solidly in 3D space, positioned and oriented exactly where placed by the scene author

Viewing a scene is thus a matter of navigating the current user point of view through space

Viewpoint nodes let X3D scene authors predefine locations and orientations of particular interest

- Sometimes viewpoints are animated and moving
- Freedom of viewpoint is exciting and engaging, also a major advantage over fixed-viewpoint video

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Viewpoint list

Viewpoint list is optional browser-provided feature that lists currently available viewpoints

- Provides description information for viewpoints
- Simplifies user selection of viewpoints
- Thus supports navigation within a scene

Viewpoints are listed in the order that they appear in the "extended scene graph"

- First includes order of definition in primary scene
- Then includes viewpoints provided by Inline and prototype instances, inserted in order within the list
- Authors need to order Viewpoints carefully so that user navigation, understanding is best supported

Viewpoint list:

- X3d Abstract Specification, 23.2.5 Viewpoint list
- http://web3d.org/x3d/specifications/ISO-IEC-19775-1.2-X3D-AbstractSpecification/Part01/components/navigation.html#ViewpointList

Viewpoint *description*

Each Viewpoint is given a *description* string to help users decide which view to select

- Clear, understandable descriptions can guide users
- Use an object's name first when many viewpoints follow, so they are more easily identified in a list
- Use whitespace instead of underscores for better readability

Viewpoints are primary user tool for navigation

- Browsers provide Viewpoint List to show and select descriptions
- So authors should always include *description*!

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Viewpoint *position, orientation*

A Viewpoint node defines a specific *position* and *orientation* for looking at a 3D scene

- Similar to a "virtual camera" vantage point

Default Viewpoint *position* is (0 0 10)

- out 10 m on +Z axis, looking back towards origin

Any changes to Viewpoint *orientation* are made relative to that default direction (along -Z axis)

- Different initial direction than other orientations
- Visualize the situation and then use right-hand rule to figure out the correct *orientation* value

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Viewpoint calculator

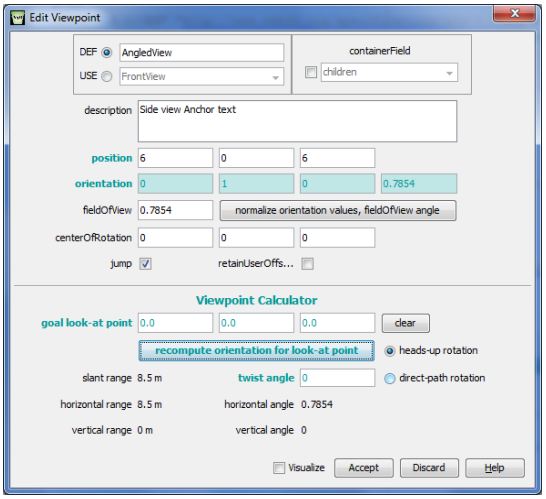
Viewpoint Calculator provided as an author-assist tool to compute Viewpoint orientation to a given point

Inputs:

position

goal look-at point

twist angle about viewing axis

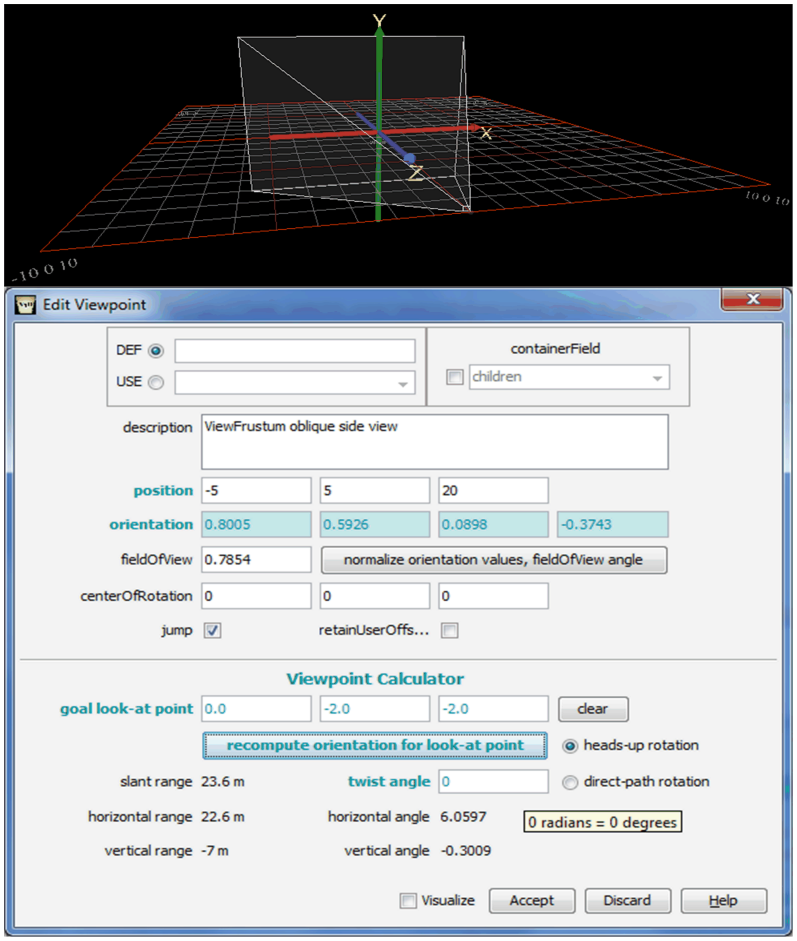


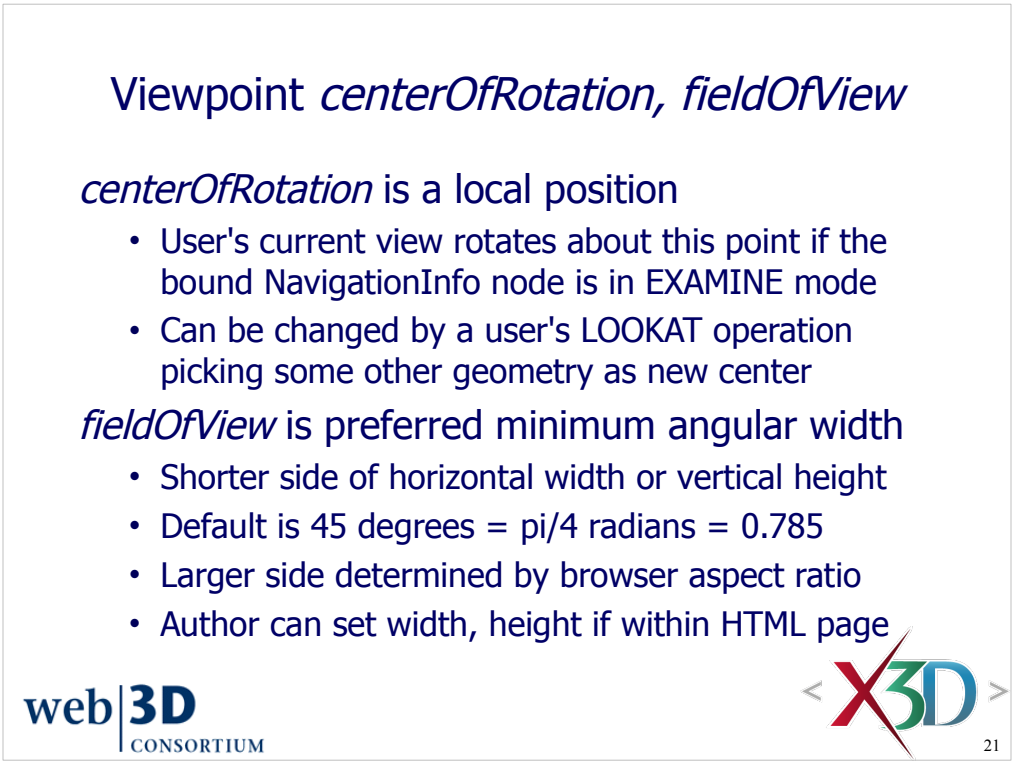
Output:

orientation

http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter14-Prototypes/ViewFrustumExample.x3d

http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter14-Prototypes/ViewpointCalculator.png





From X3D specification for Viewpoint node:

"The *fieldOfView* field specifies a preferred minimum viewing angle from this viewpoint in radians. A small field of view roughly corresponds to a telephoto lens; a large field of view roughly corresponds to a wide-angle lens. The field of view shall be greater than zero and smaller than π. The value of *fieldOfView* represents the minimum viewing angle in any direction axis perpendicular to the view."

"[...] the smaller of display width or display height determines which angle equals the fieldOfView"

- X3d Abstract Specification, 23.4.6 Viewpoint
- http://web3d.org/x3d/specifications/ISO-IEC-19775-1.2-X3D-AbstractSpecification/Part01/components/navigation.html#Viewpoint

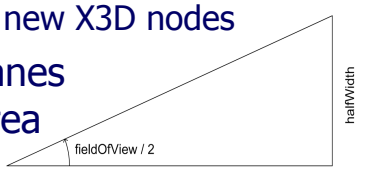
ViewFrustum prototype

ViewFrustum is a helpful visualization prototype

- Prototypes simplify creation of new X3D nodes

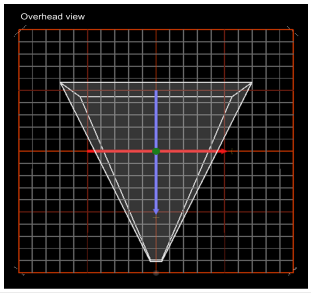
Shows near and far clipping planes that truncate the viewable area

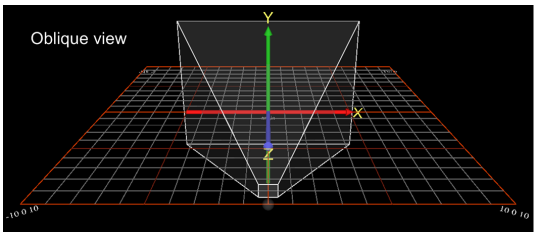
- Depends on Viewpoint and NavigationInfo parameters



Near clipping plane distance = *avatarSize[0]*
Far clipping plane distance = *visibilityLimit*

nearHalfWidth = tan(*fieldOfView* / 2) * *avatarSize[0]*;
farHalfWidth = tan(*fieldOfView* / 2) * *visibilityLimit*;





http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter14-Prototypes/ViewFrustrumExample.x3d

ViewFrustrum is now available in the X3D-Edit palette for easy drag/drop addition.

Prototypes (including this one) are covered in detail in Chapter 14. Example use:

```
<ExternProtoDeclare appinfo='Display view frustum associated with a given pair of Viewpoint NavigationInfo nodes'
 name='ViewFrustum' url='"ViewFrustumPrototype.x3d#ViewFrustum"
"http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter14-Prototypes/ViewFrustumPrototype.x3d#ViewFrustum"'>
 <field accessType='initializeOnly' name='ViewpointNode' type='SFNode'/>
 <field accessType='initializeOnly' name='NavigationInfoNode' type='SFNode'/>
 <field accessType='inputOutput' name='lineColor' type='SFColor'/>
 <field accessType='inputOutput' name='frustumColor' type='SFColor'/>
 <field accessType='inputOutput' name='transparency' type='SFFloat'/>
 <field accessType='inputOutput' name='aspectRatio' type='SFFloat'/>
 <field accessType='initializeOnly' name='trace' type='SFBool'/>
</ExternProtoDeclare>
<!-- Example use -->
<ProtoInstance name='ViewFrustum'>
 <fieldValue name='ViewpointNode'>
  <Viewpoint DEF='TestViewpoint' fieldOfView='0.78'/>
 </fieldValue>
 <fieldValue name='NavigationInfoNode'>
  <NavigationInfo DEF='TestNavigationInfo' avatarSize='1 1.6 0.75' visibilityLimit='15'/>
 </fieldValue>
 <fieldValue name='lineColor' value='0.9 0.9 0.9'/>
 <fieldValue name='frustumColor' value='0.8 0.8 0.8'/>
 <fieldValue name='transparency' value='0.75'/>
</ProtoInstance>
```

Viewpoint *jump*

jump can be a tricky field (but is not often used)

- *jump*='true' when a Viewpoint is selected means that the current view position and orientation is modified according to NavigationInfo *transitionType*
- *jump*='true' is usual default
- *jump*='false' is an advanced technique
  - User's view doesn't appear to change when new Viewpoint is selected
  - New Viewpoint is bound, but given offsets to match prior user position and orientation (hence no jumping)
  - Example use: changing bound viewpoint when moving from one floor into an elevator, then to another floor

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<X3D>

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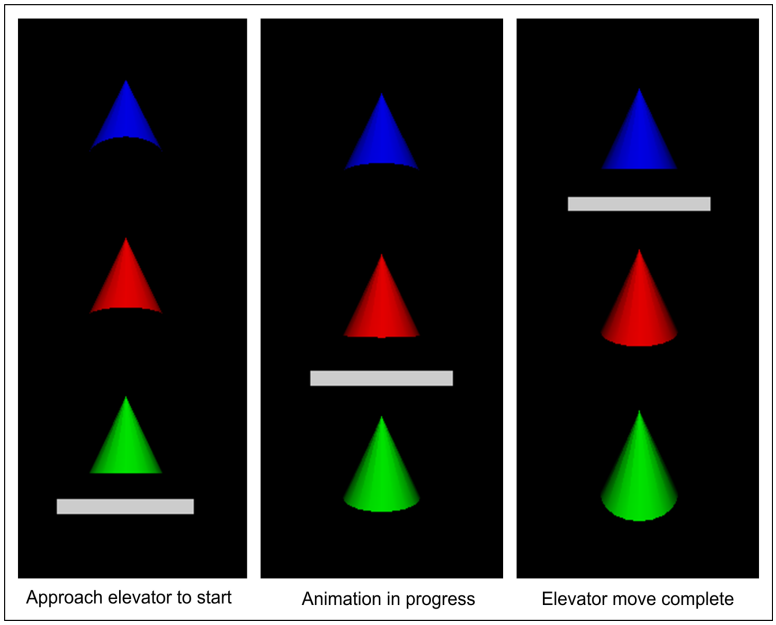
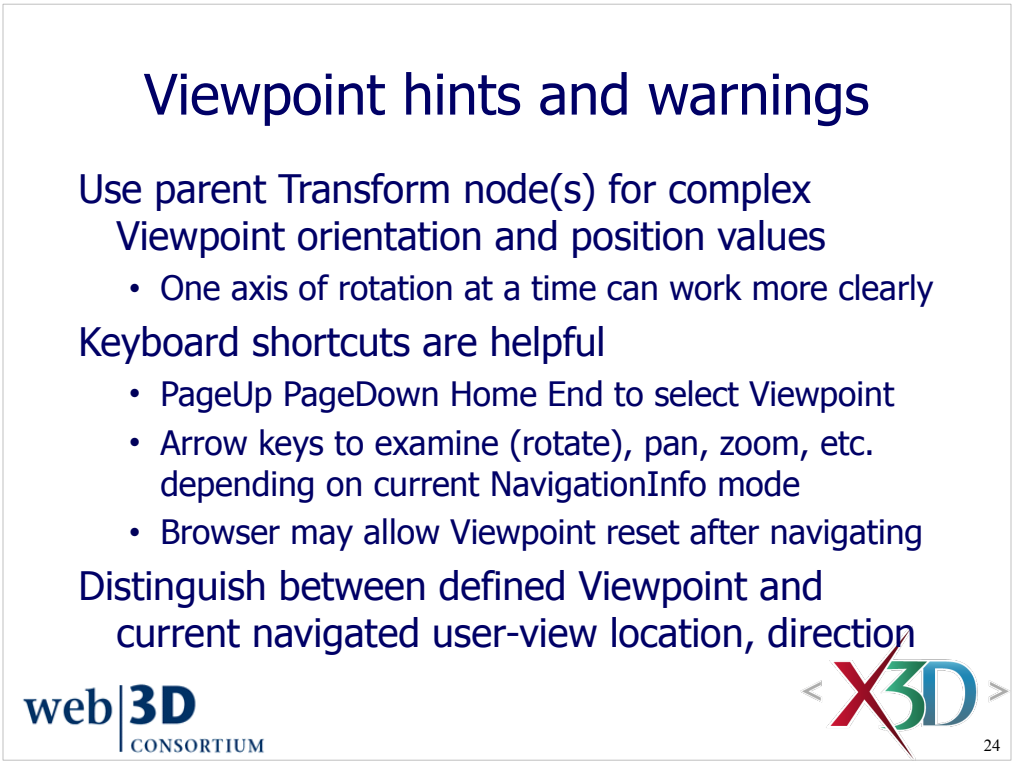
Example demonstrating Viewpoint *jump* field:

http://www.web3d.org/x3d/content/examples/Basic/X3dSpecification/Elevator.x3d
http://www.web3d.org/x3d/content/examples/Basic/X3dSpecification/ElevatorAnimation.png

Sequence of screen snapshots follows. Navigate towards the elevator platform by using the up-arrow key to move forward. Once you are close enough to the bottom cone, a ProximitySensor triggers the animation to start.



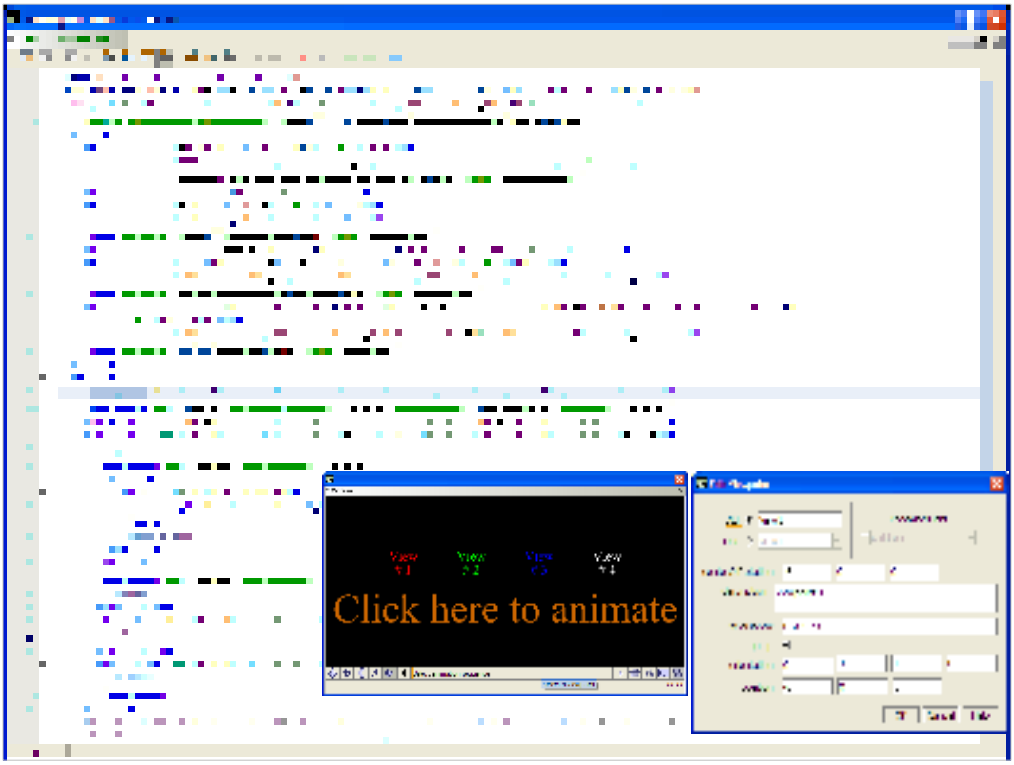


Remember that initial Viewpoint direction is looking down the negative Z axis, and so any rotation changes are with respect to that direction. A helpful technique is to point in that direction, then consider how the Viewpoint *orientation* changes from that axis.

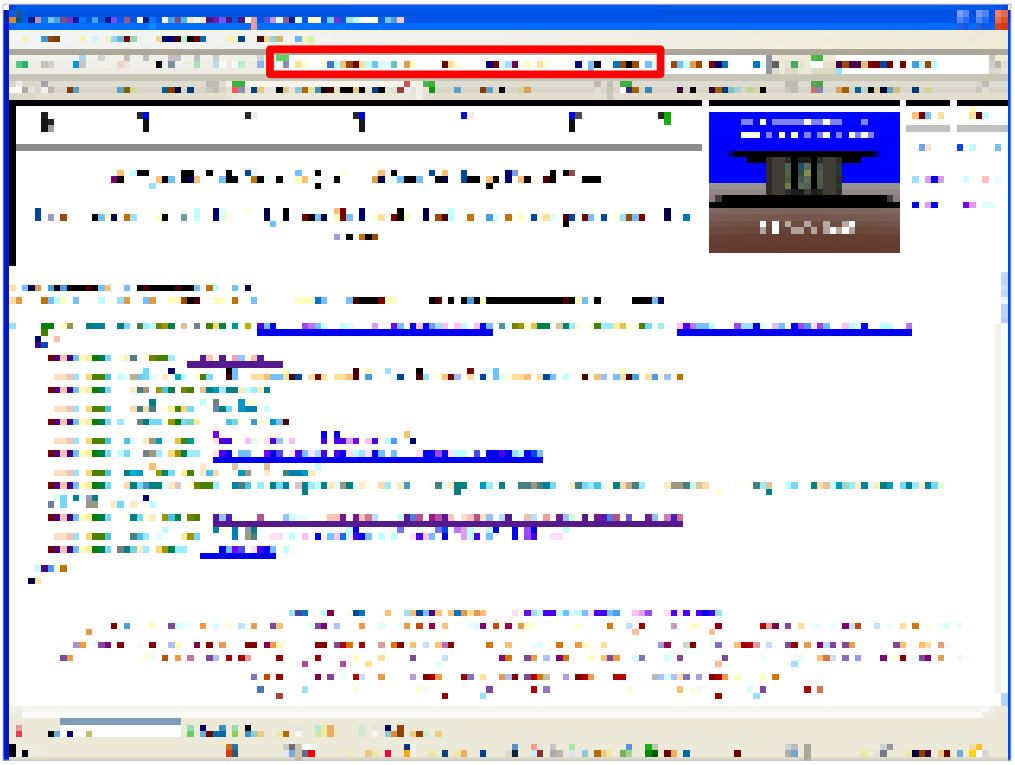
Try changing Viewpoint *position* and *orientation* to change direction of view. Then also try modifying a parent Transform *translation* and *rotation* values. Examples:

- <Viewpoint position="2 1 0" orientation="1 0 0 0.1"/>
- <Transform rotation="0 1 0 0.2"><Viewpoint position="2 1 0"/></Transform>

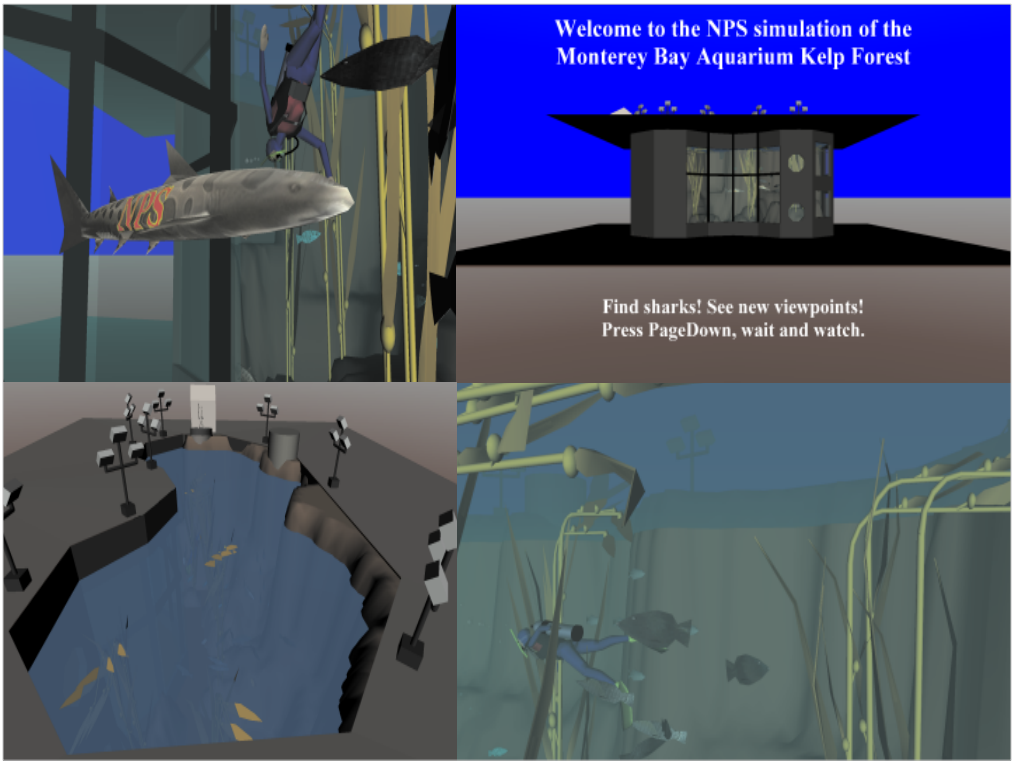
Note X3D-Edit feature (found in right-click context menu) that lets you wrap a new parent node around the selected node.



http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.x3d



http://www.x3dbook.com/examples/X3dForWebAuthors/KelpForestExhibit
then select Kelp Forest Main



TODO: better image resolution

Viewpoint	Viewpoint provides a specific location and direction where the user may view the scene. Background, Fog, NavigationInfo, TextureBackground and Viewpoint are bindable nodes.
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
description	**[description: accessType initializeOnly, type SFString CDATA #IMPLIED]** Text description or navigation hint to be displayed for this Viewpoint. **Hint:** use spaces, make descriptions clear and readable. **Warning:** without description, Viewpoint is unlikely to appear on browser Viewpoints menu. Hint: many XML tools substitute XML character references automatically if needed (like & for & or " for "). **Interchange profile hint:** this field may be ignored.
position	**[position: accessType inputOutput, type SFVec3f CDATA "0 0 10"]** Position (x, y, z in meters) relative to local coordinate system.
orientation	**[orientation: accessType inputOutput, type SFRotation CDATA "0 0 1 0"]** Rotation (axis, angle in radians) of Viewpoint, relative to default -Z axis direction in local coordinate system. **Hint:** this is orientation _change_ from default direction (0 0 -1). **Hint:** complex rotations can be accomplished axis-by-axis using parent Transforms.
fieldOfView	**[fieldOfView: accessType inputOutput, type SFFloat CDATA "0.785398" (0..pi)]** Preferred minimum viewing angle from this viewpoint in radians. Small field of view roughly corresponds to a telephoto lens, large field of view roughly corresponds to a wide-angle lens. **Hint:** modifying Viewpoint distance to object may be better for zooming. **Warning:** fieldOfView may not be correct for different window sizes and aspect ratios. **Interchange profile hint:** this field may be ignored.
jump	**[jump: accessType inputOutput, type SFBool (true|false) "true"]** Transition instantly by jumping, or smoothly animate to this Viewpoint. **Hint:** set jump=true for smooth camera motion when going to this viewpoint.
centerOfRotation	**[centerOfRotation: accessType inputOutput, type SFVec3f CDATA "0 0 0"]** centerOfRotation point relates to NavigationInfo EXAMINE mode.
set_bind	**[set_bind: accessType inputOnly, type SFBool (true|false) #FIXED ""]** Sending event set_bind=true makes this node active. Sending event set_bind=false makes this node inactive. Thus setting set_bind to true/false will pop/push (enable/disable) this Viewpoint.
bindTime	**[bindTime: accessType outputOnly, type SFTime CDATA #FIXED ""]** Event sent when node becomes active/inactive.
isBound	**[isBound: accessType outputOnly, type SFBool (true|false) #FIXED ""]** Event true sent when node becomes active, event false sent when unbound by another node.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

http://www.web3d.org/x3d/content/X3dTooltips.html#Viewpoint

OrthoViewpoint

OrthoViewpoint provides an orthographic perspective-free view of a scene from a specific location and direction

- *fieldOfView* minX, maxX, minY, maxY values (default -1 -1, 1 1) define minimum and maximum extents of view, provided in units of local coordinate system
- For a rectangular display:
  width/height = (maxX-minX)/(maxY-minY)
- <component name='Navigation' level='3'/>
- Caution: often disorienting, special uses only

All other OrthoViewpoint fields are identical to Viewpoint.

OrthoViewpoint is part of the same bindable stack as Viewpoint and GeoViewpoint nodes. Only one can be bound at a single time.

Orthographic views are often used in Computer Aided Design (CAD) plans. However they can disorient a user and make a scene look quite strange, so it is usually best to avoid including them in most scenes.

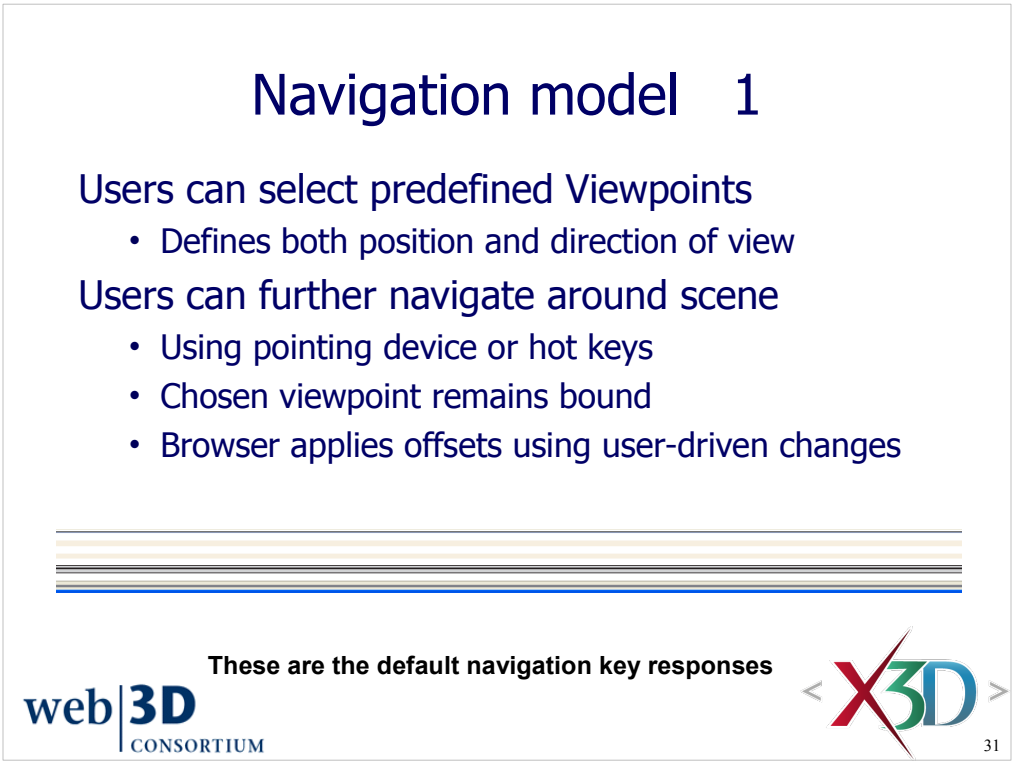
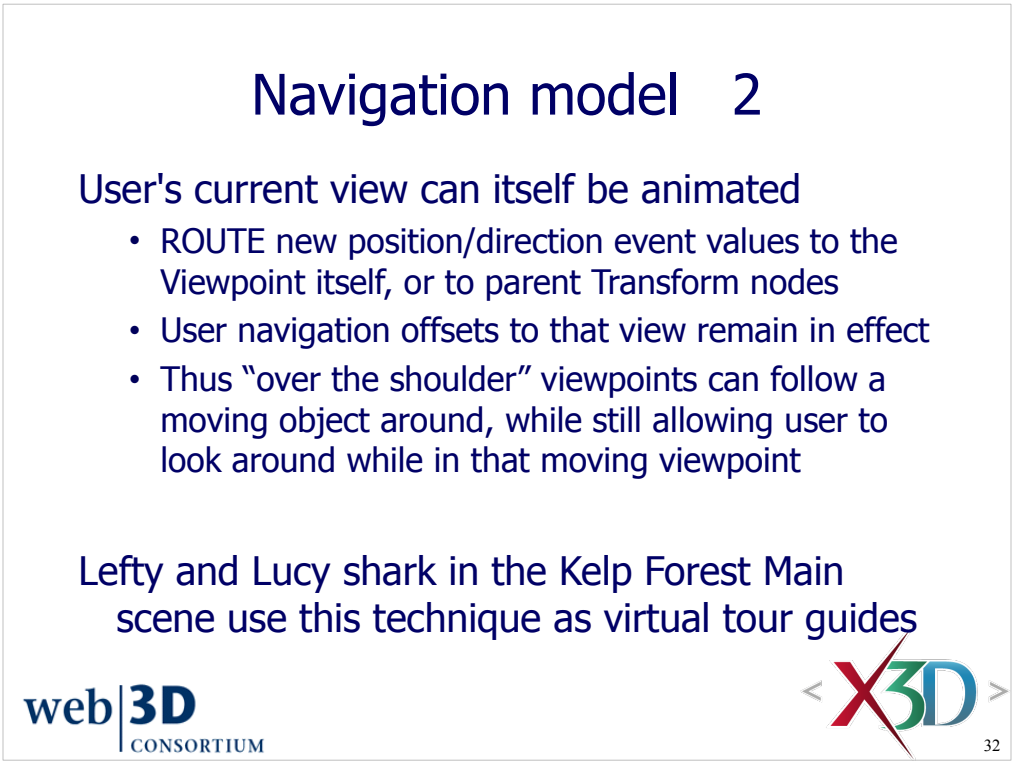


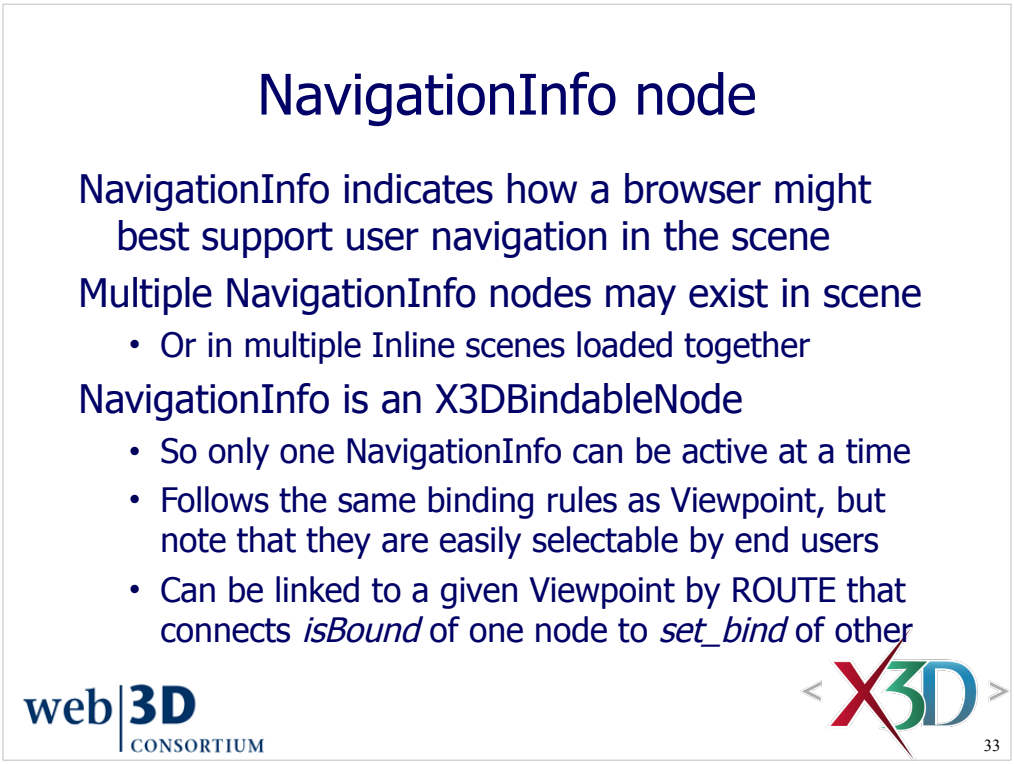
Figure 4.9. Recommended Keyboard Navigation Keys and Responses

Browsers are allowed to offer variations in default key navigation. This is specified in X3D Abstract Specification Annex G: Recommended Navigation Behaviours. Excerpt:

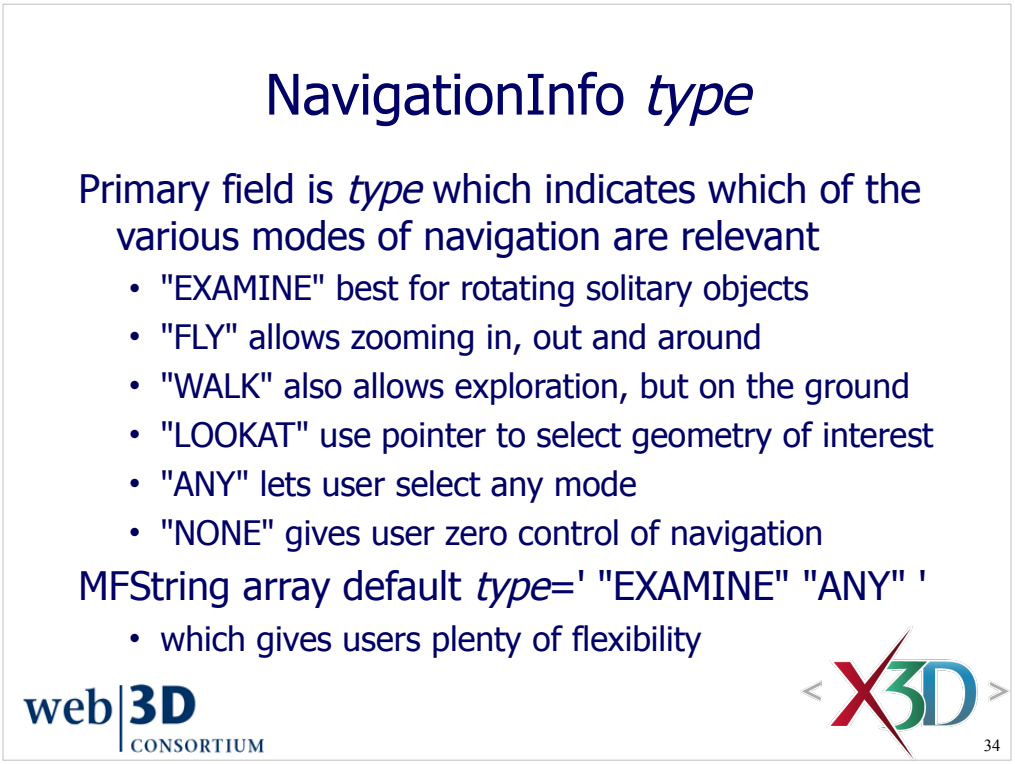
> This annex describes basic X3D scene navigation recommended practice. This recommended practice describes a browser-independent standardized keyboard interface which implements X3D frequently used scene interactivity. Features that imply interactivity are fundamental in X3D. The author expects to be able to specify multiple viewpoints in a predicable sequence, the ability to point and select, and to enable continuous navigation within the scene. Likewise the interactor expects to be able to exercise scene functionality using predictable methods.
>
> This recommended practice is intended to allow use of a core subset of the functionality of an X3D browser, not unnecessarily limit interactive functionality which may be provided by a browser.



Animation techniques are covered in Chapter 7, Event Animation and Interpolation.



ROUTE and animation techniques are covered in Chapter 7, Event Animation and Interpolation.

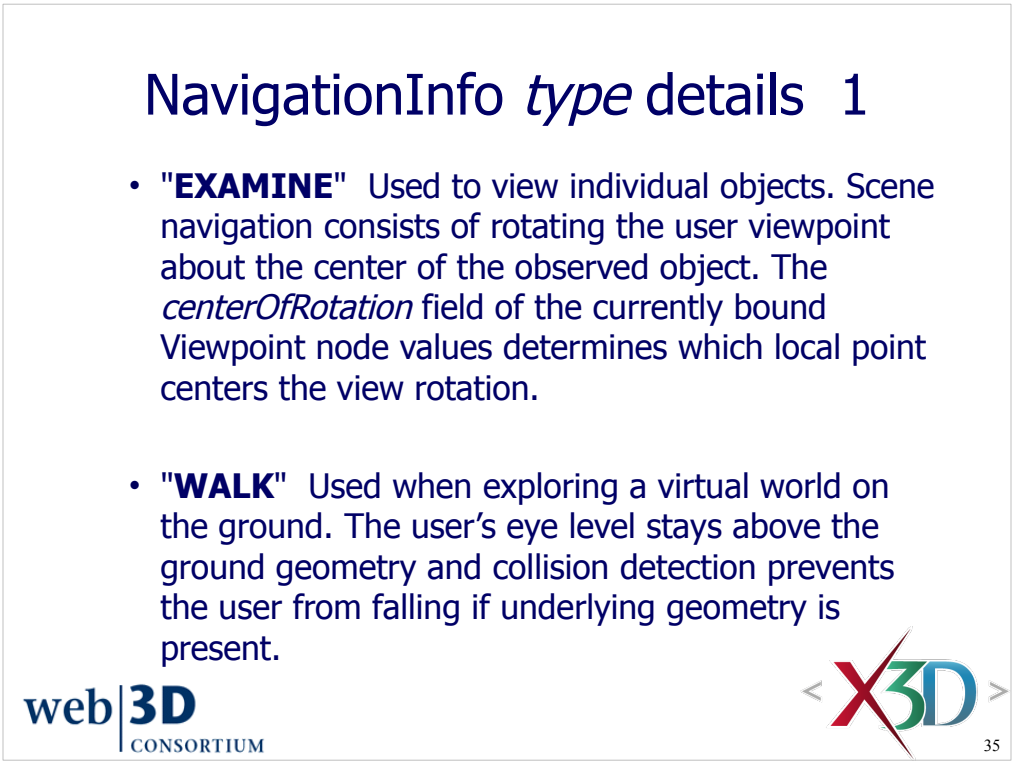


The first supported value in the *type* list is used once a NavigationInfo values. Other specified values are usually offered by the navigation interfaces of most browsers. Any navigation modes that are not listed in the *type* list are illegal for the current NavigationInfo node and should not be offered as user-selectable options.

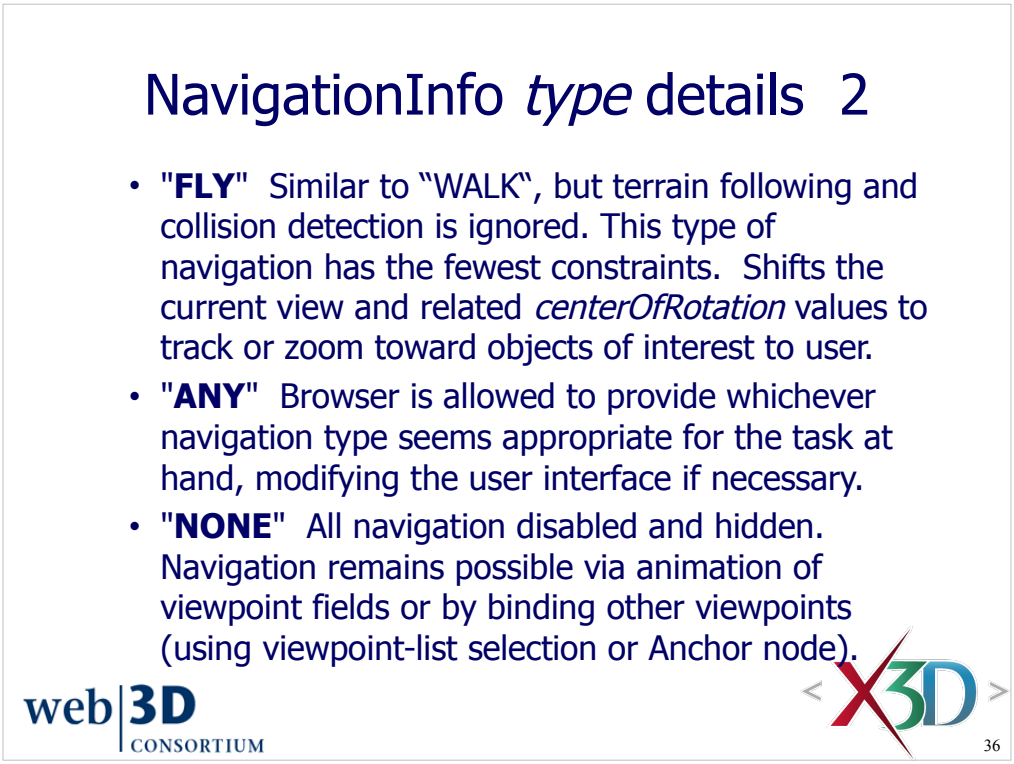
LOOKAT functionality is similar to user zooming in/out. *fieldOfView* does not change during this operation.

Note that browsers are also allowed to define their own specialty navigation types. In general, extensibility is good! However, there is little guarantee that such a mode will be available in other browsers. So, if you use an additional specialty *type* mode, be sure to also give the user another well-specified mode in the *type* list so that they can navigate satisfactorily.

Sometimes this flexibility lets authors and developers innovate as a group to develop good new practices. For example, given that it is a common browser feature, will we ever formalize a NavigationInfo *type* called “SHOWALL” or “FIT” in the X3D specification?



Default values for the *type* list are “EXAMINE” “ANY” which means that a NavigationInfo node will start in EXAMINE mode, but any other mode can be selected instead by the user at run time.



Navigation mode NONE means that a user cannot force navigation even if they want to. This is sometimes a useful authoring choice, but should only be applied sparingly and carefully since it can fool a user into thinking that the X3D player is frozen.

NavigationInfo speed, headlight

speed determines how fast navigation occurs

- Default value 1 meter/second is usually pretty slow
- Might need to vary widely from ground to space
- Might need multiple NavigationInfo nodes matching different viewpoints (high *speed* for flying, low *speed* for walking around or examining objects)

headlight is whether a light is shining ahead from user's point of view

- Otherwise one or more Light nodes is needed (covered in Chapter 11), or else world goes black

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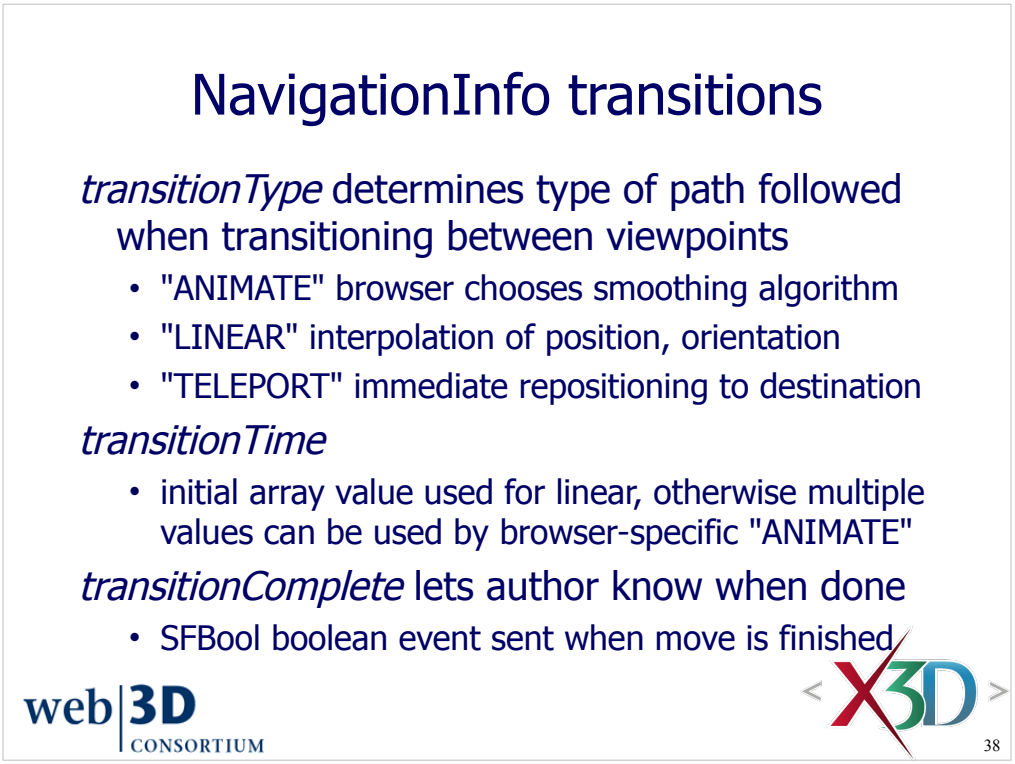
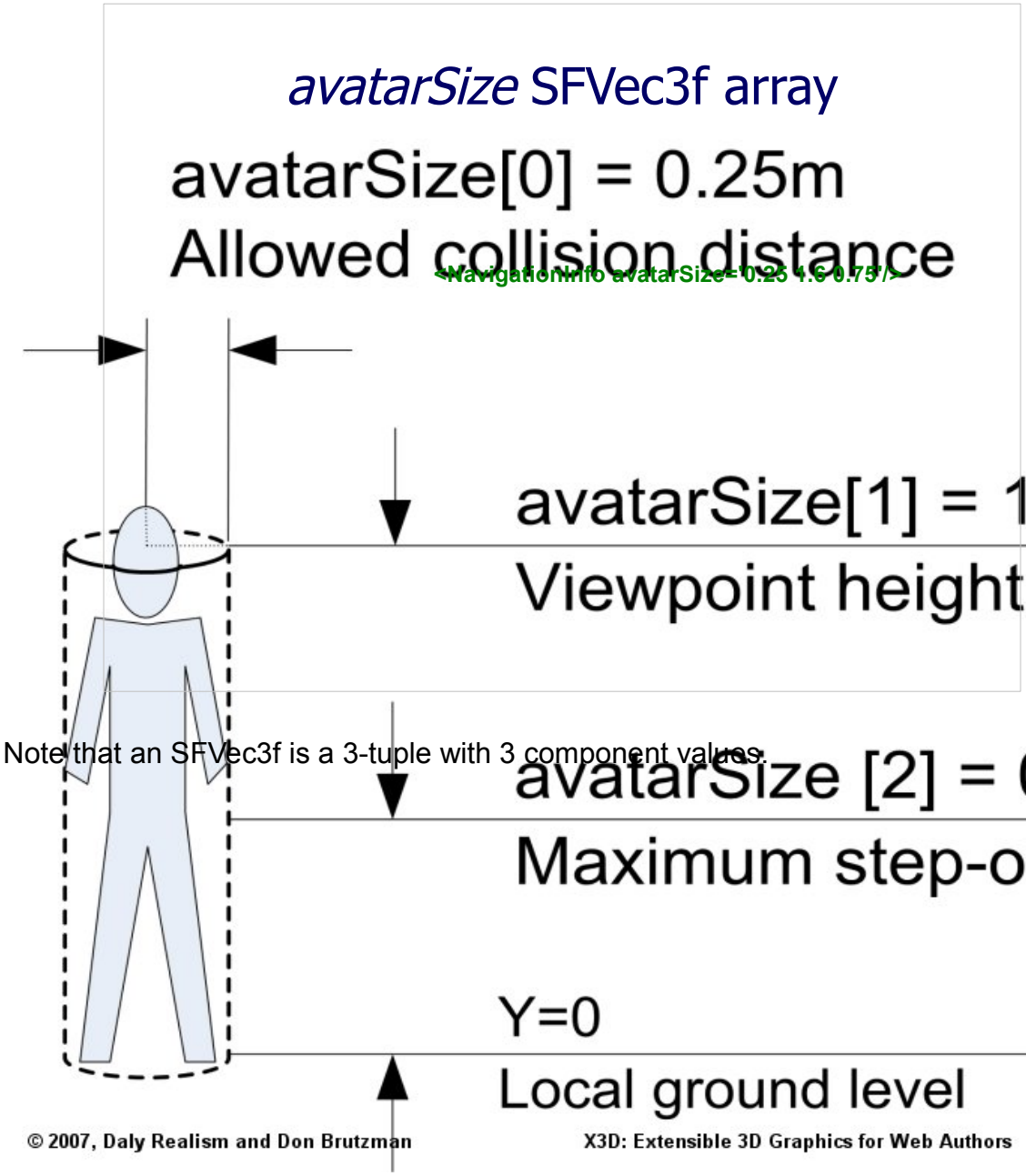


transitionType is an inputOutput MFString array of quoted string values

transitionTime is an inputOutput MFBool boolean array of time intervals

transitionComplete is an outputOnly SFTime value that can be used to trigger other animation or scripted behaviors.

Animation techniques are covered in Chapter 7, Event Animation and Interpolation and Chapter 9, Event Utilities and Scripting.



Note that an SFVec3f is a 3-tuple with 3 component values.

NavigationInfo *visibilityLimit*

visibilityLimit defines the maximum range that may be rendered by the browser

- Measured from the user's point of view
- Geometry beyond that distance are not drawn
- *visibilityLimit*='0.0' means no limits are imposed

Quality thumbrule: meet following relationship

- *avatarSize.collisionDistance* / *visibilityLimit* < 10,000
- Avoids floating-point roundoff error on graphics card and almost-coplanar polygon tearing/aliasing
- Exactly coplanar polygons still suffer from aliasing

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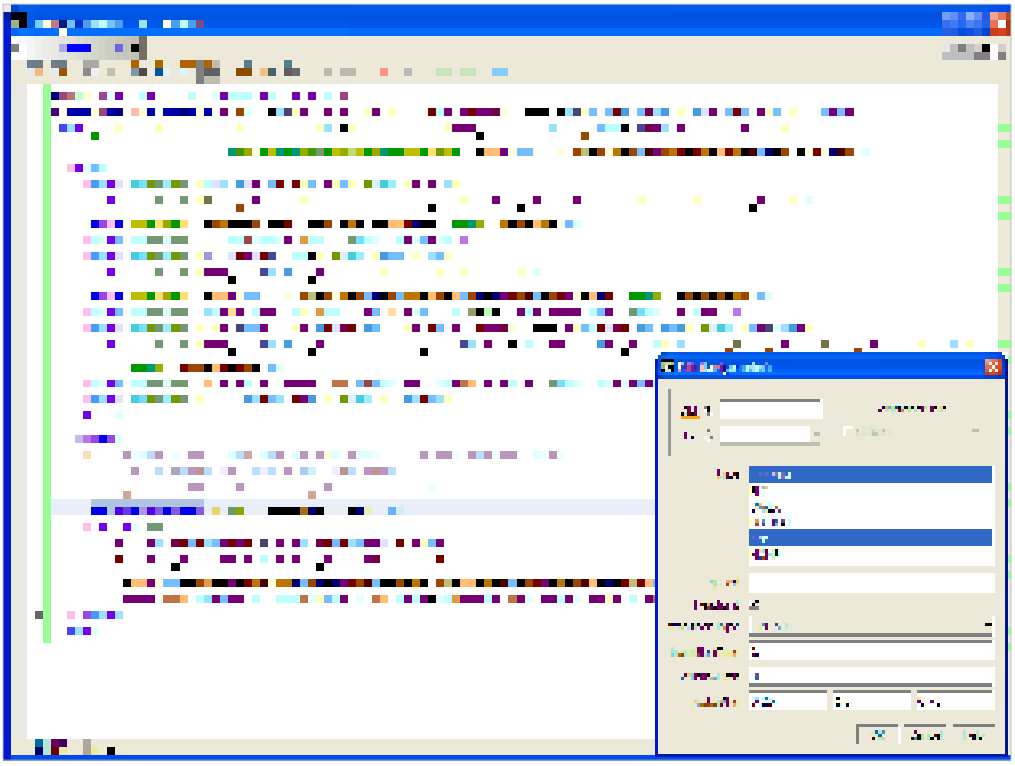
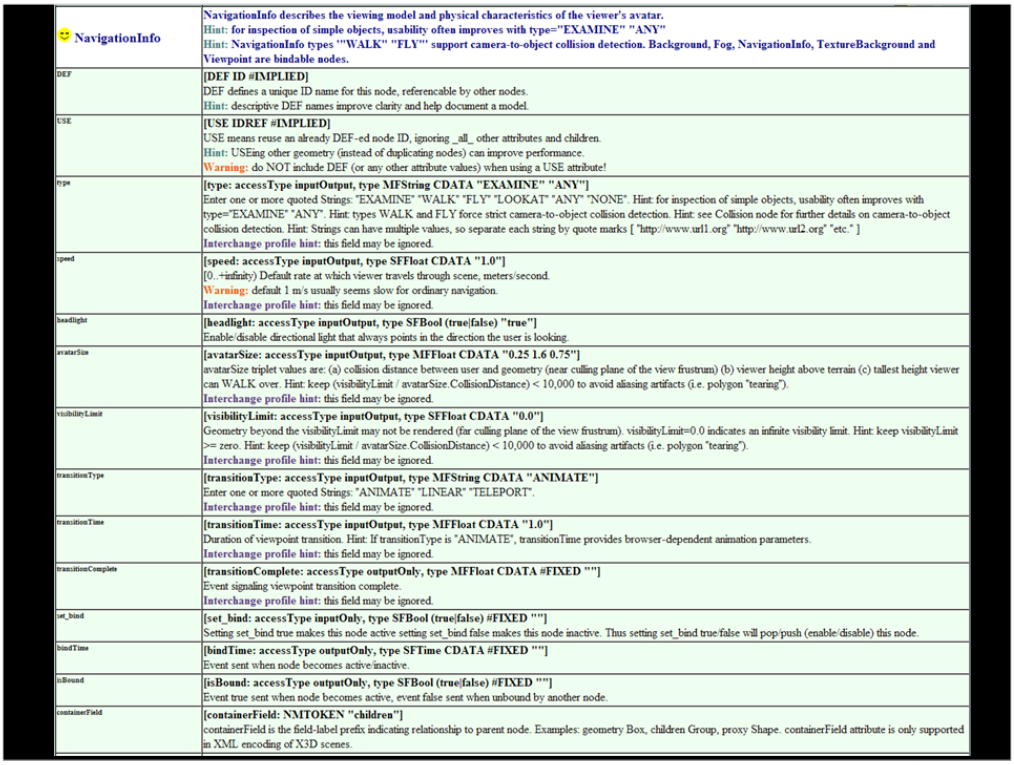
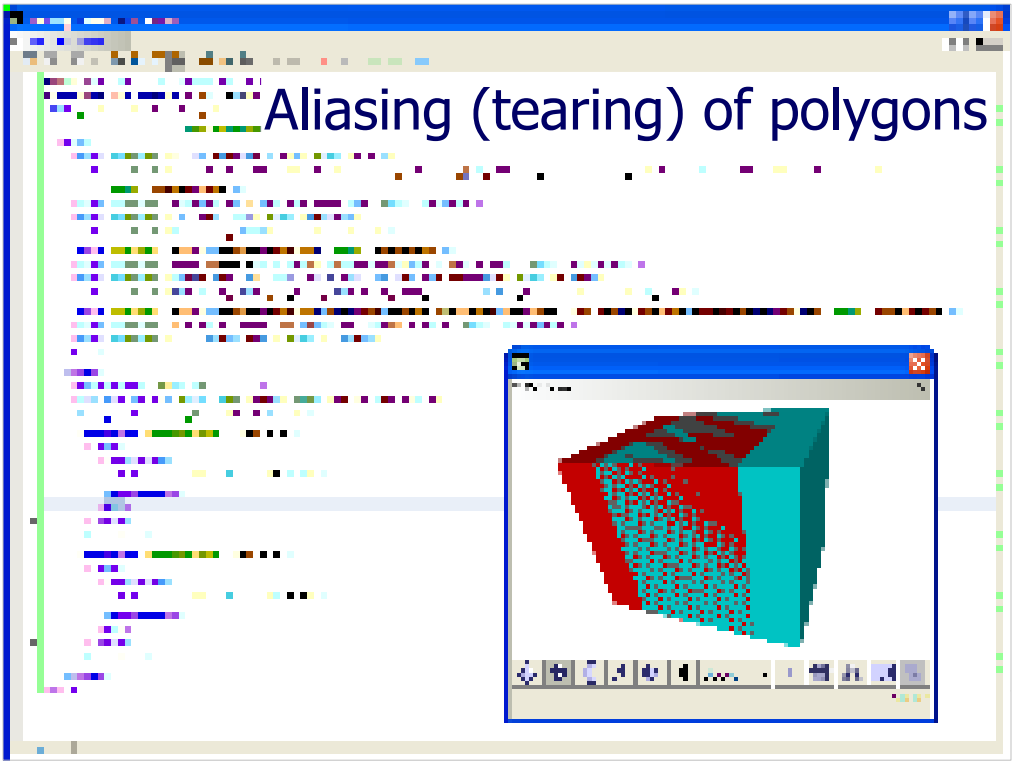


http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/NavigationInfo.x3d



NavigationInfo	NavigationInfo describes the viewing model and physical characteristics of the viewer's avatar. Hint: for inspection of simple objects, usability often improves with type="EXAMINE" "ANY" Hint: NavigationInfo types ""WALK" "FLY"" support camera-to-object collision detection. Background, Fog, NavigationInfo, TextureBackground and Viewpoint are bindable nodes.
DEF	[DEF ID #IMPLIED] DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	[USE IDREF #IMPLIED] USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
type	[type: accessType inputOutput, type MFString CDATA "EXAMINE" "ANY"] Enter one or more quoted Strings: "EXAMINE" "WALK" "FLY" "LOOKAT" "ANY" "NONE". Hint: for inspection of simple objects, usability often improves with type="EXAMINE" "ANY". Hint: types WALK and FLY force strict camera-to-object collision detection. Hint: see Collision node for further details on camera-to-object collision detection. Hint: Strings can have multiple values, so separate each string by quote marks ["http://www.url1.org" "http://www.url2.org" "etc."] Interchange profile hint: this field may be ignored.
speed	[speed: accessType inputOutput, type SFFloat CDATA "1.0"] [0..+infinity) Default rate at which viewer travels through scene, meters/second. Warning: default 1 m/s usually seems slow for ordinary navigation. Interchange profile hint: this field may be ignored.
headlight	[headlight: accessType inputOutput, type SFBool (true|false) "true"] Enable/disable directional light that always points in the direction the user is looking.
avatarSize	[avatarSize: accessType inputOutput, type MFFloat CDATA "0.25 1.6 0.75"] avatarSize triplet values are: (a) collision distance between user and geometry (near culling plane of the view frustrum) (b) viewer height above terrain (c) tallest height viewer can WALK over. Hint: keep (visibilityLimit / avatarSize.CollisionDistance) < 10,000 to avoid aliasing artifacts (i.e. polygon "tearing"). Interchange profile hint: this field may be ignored.
visibilityLimit	[visibilityLimit: accessType inputOutput, type SFFloat CDATA "0.0"] Geometry beyond the visibilityLimit may not be rendered (far culling plane of the view frustrum). visibilityLimit=0.0 indicates an infinite visibility limit. Hint: keep visibilityLimit >= zero. Hint: keep (visibilityLimit / avatarSize.CollisionDistance) < 10,000 to avoid aliasing artifacts (i.e. polygon "tearing"). Interchange profile hint: this field may be ignored.
transitionType	[transitionType: accessType inputOutput, type MFString CDATA "ANIMATE"] Enter one or more quoted Strings: "ANIMATE" "LINEAR" "TELEPORT". Interchange profile hint: this field may be ignored.
transitionTime	[transitionTime: accessType inputOutput, type MFFloat CDATA "1.0"] Duration of viewpoint transition. Hint: If transitionType is "ANIMATE", transitionTime provides browser-dependent animation parameters. Interchange profile hint: this field may be ignored.
transitionComplete	[transitionComplete: accessType outputOnly, type MFFloat CDATA #FIXED ""] Event signaling viewpoint transition complete. Interchange profile hint: this field may be ignored.
set_bind	[set_bind: accessType inputOnly, type SFBool (true|false) #FIXED ""] Setting set_bind true makes this node active setting set_bind false makes this node inactive. Thus setting set_bind true/false will pop/push (enable/disable) this node.
bindTime	[bindTime: accessType outputOnly, type SFTime CDATA #FIXED ""] Event sent when node becomes active/inactive.
isBound	[isBound: accessType outputOnly, type SFBool (true|false) #FIXED ""] Event true sent when node becomes active, event false sent when unbound by another node.
containerField	[containerField: NMTOKEN "children"] containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.

http://www.web3d.org/x3d/content/X3dTooltips.html#NavigationInfo



Aliasing (sometimes called *tearing*) occurs when the rendering engine is not able to detect which polygon is closer to the viewer. Equal floating point values (or floating-point roundoff error) that leads to coincident polygons causes this problem. Essentially pixels from each polygon are overwriting each other.

In this example, most of each unit box is defined to be directly superimposed and coincident with the other box.

Moving the viewpoint varies the aliasing pattern a lot, because the floating-point roundoff error is still occurring but with slightly different values.

Relevant joke:

- *Patient*: Doctor, doctor, my arm hurts when I raise it over my head like this!
- *Doctor*: In that case, don't raise your arm.

Moral of the story: don't do that, avoid coplanar polygons.

Antialiasing is the general name for techniques to avoid this problem, most are automatically applied by hardware.

http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/AliasingExample.x3d

Anchor node

- Anchor is another grouping node that can contain other nodes
- Geometry rendered by contained nodes is active and can be selected by user
  - User clicking on Anchor geometry launches url link (.html .x3d mailto: etc.)
    - thus similar to HTML anchor tag `<a href="url">link</a>`
  - Alternatively can select a viewpoint in the scene (similar to HTML bookmark)
- Selected link can replace current X3D scene, or else launch into another browser window

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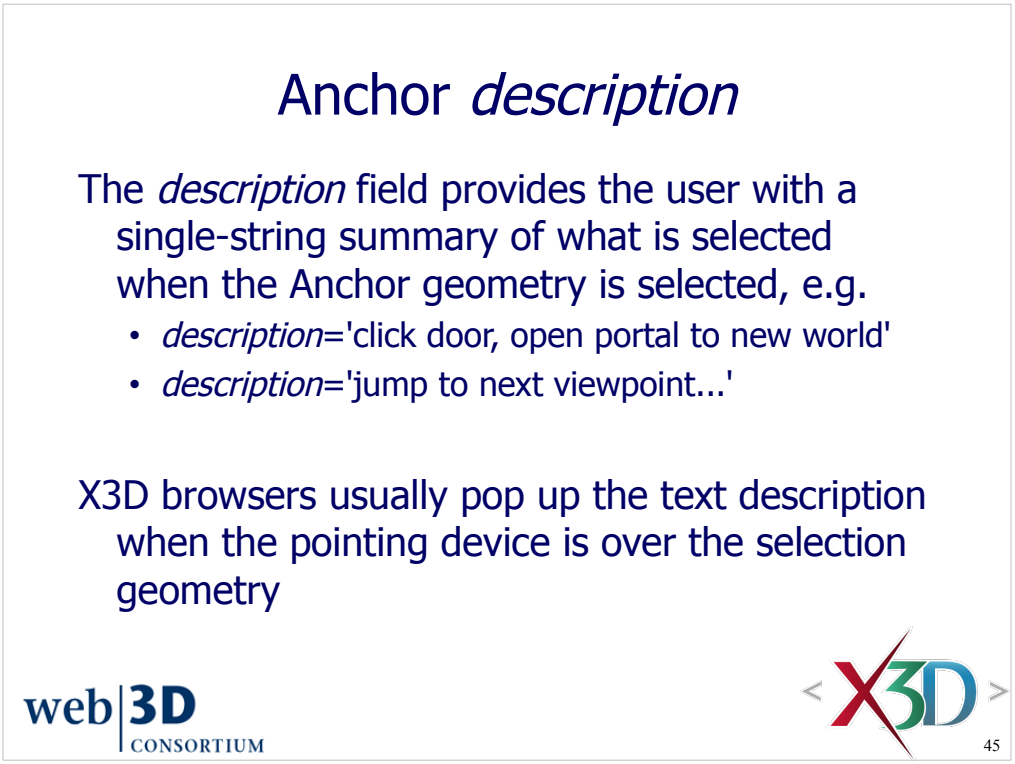
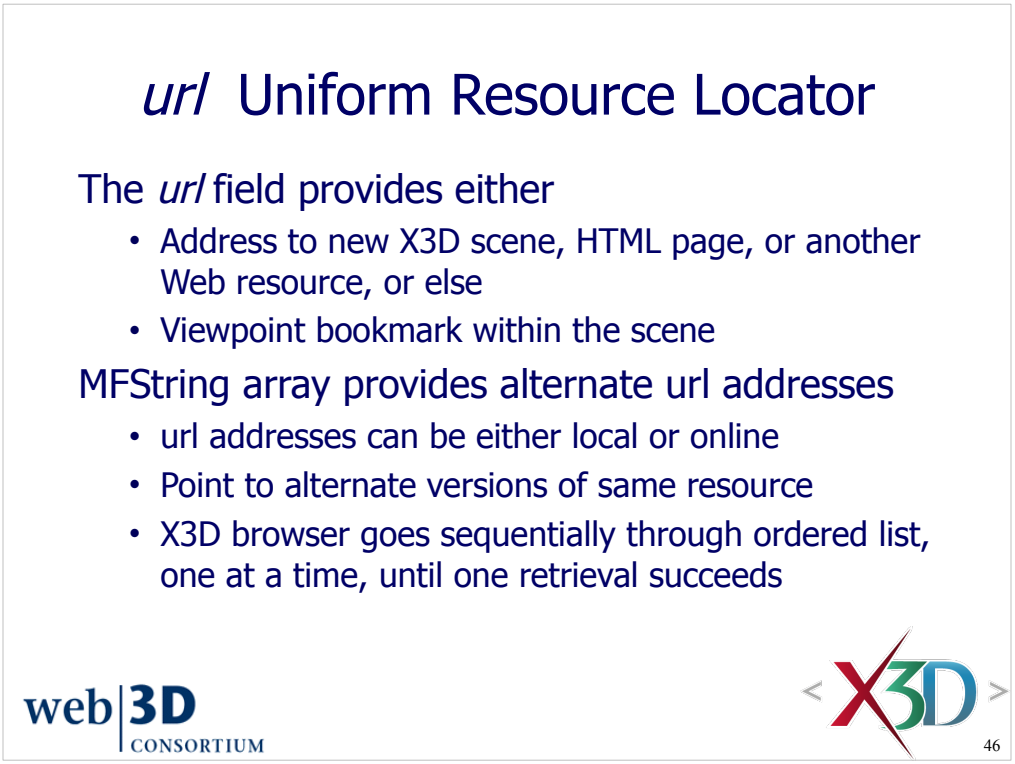
HTML 4.01 Recommendation, Section 12 Links:

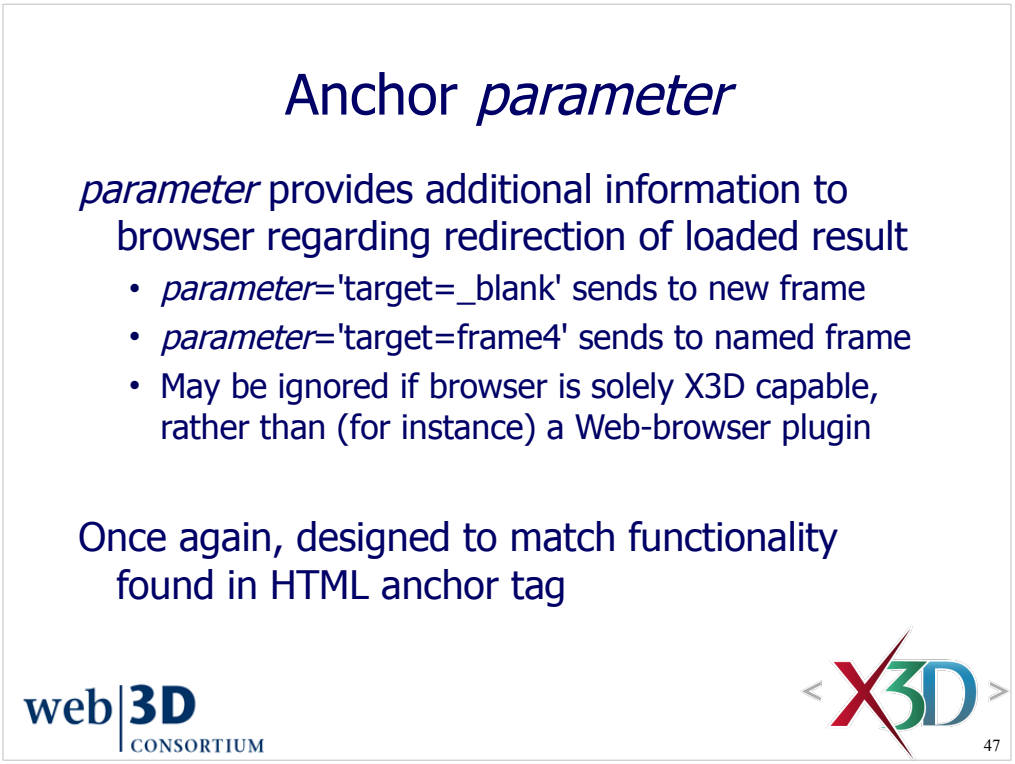
http://www.w3.org/TR/html401/struct/links.html#h-12.1



Anchor *description* is similar to Viewpoint *description*.

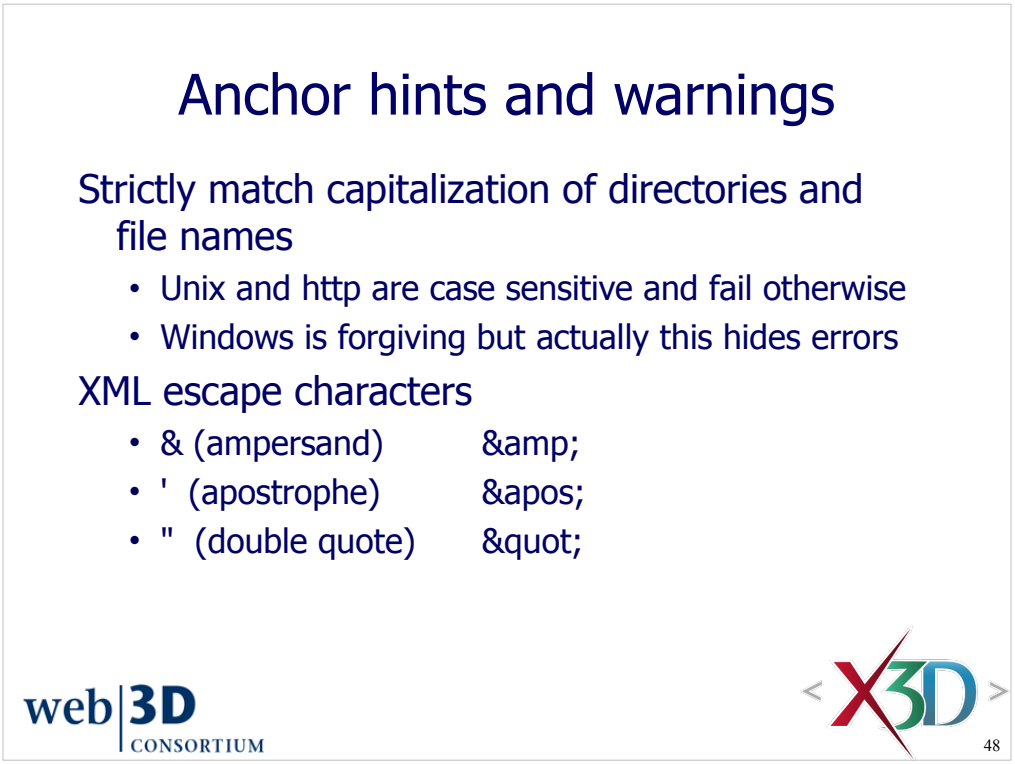


Anchor *url* rules match those for Inline *url*.



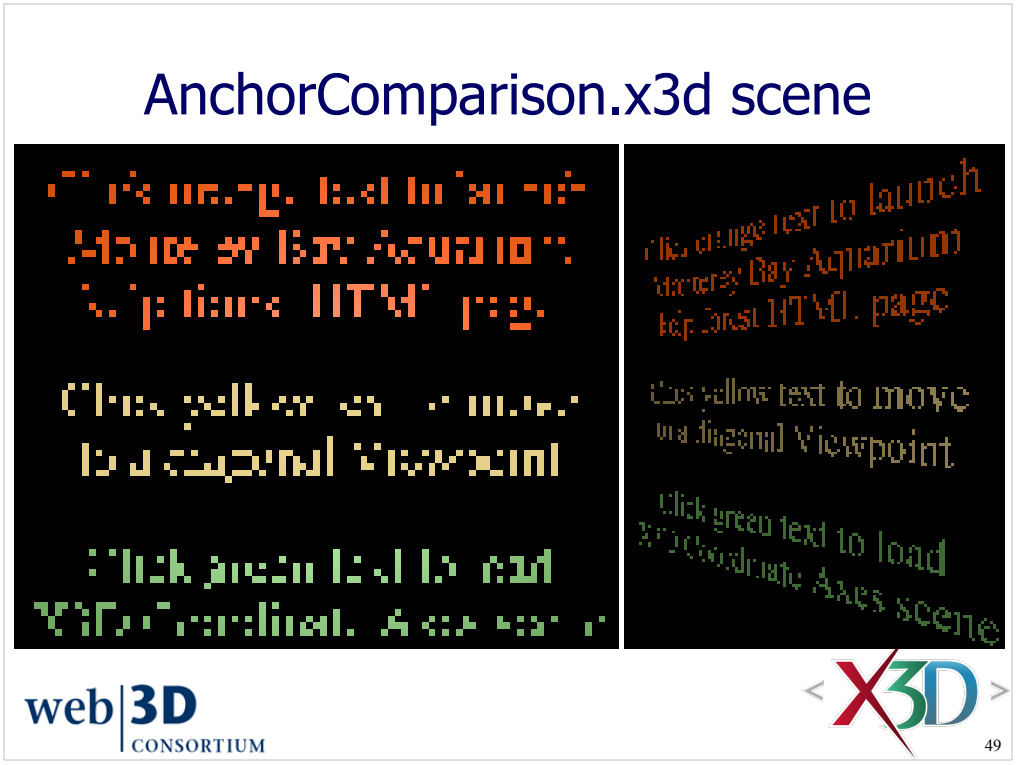
HTML 4.01 Recommendation, Section 16.3 Specifying target frame information:

http://www.w3.org/TR/html401/present/frames.html#adef-target



HTML 4.01 Recommendation, Section 24 Character entity references in HTML 4:

http://www.w3.org/TR/html401/sgml/entities.html

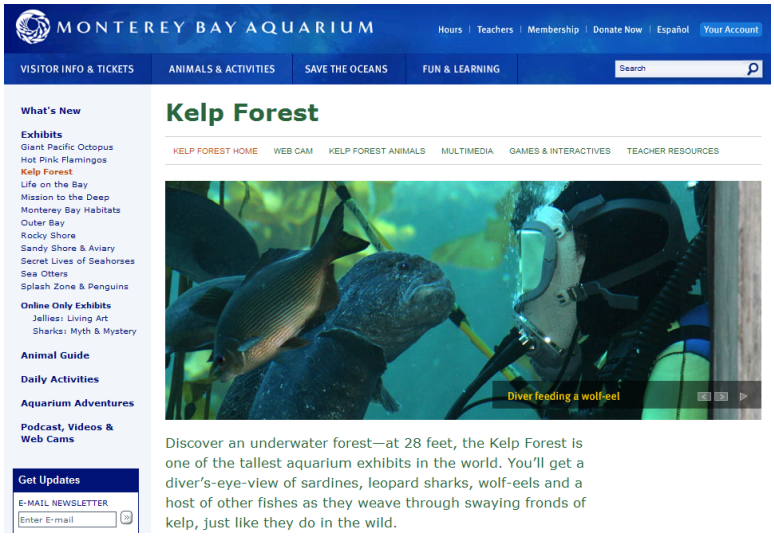


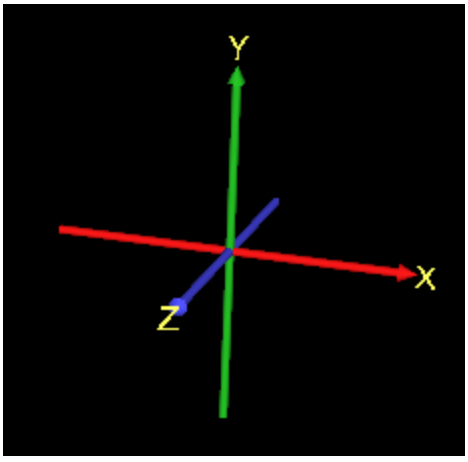
http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/AnchorComparison.x3d

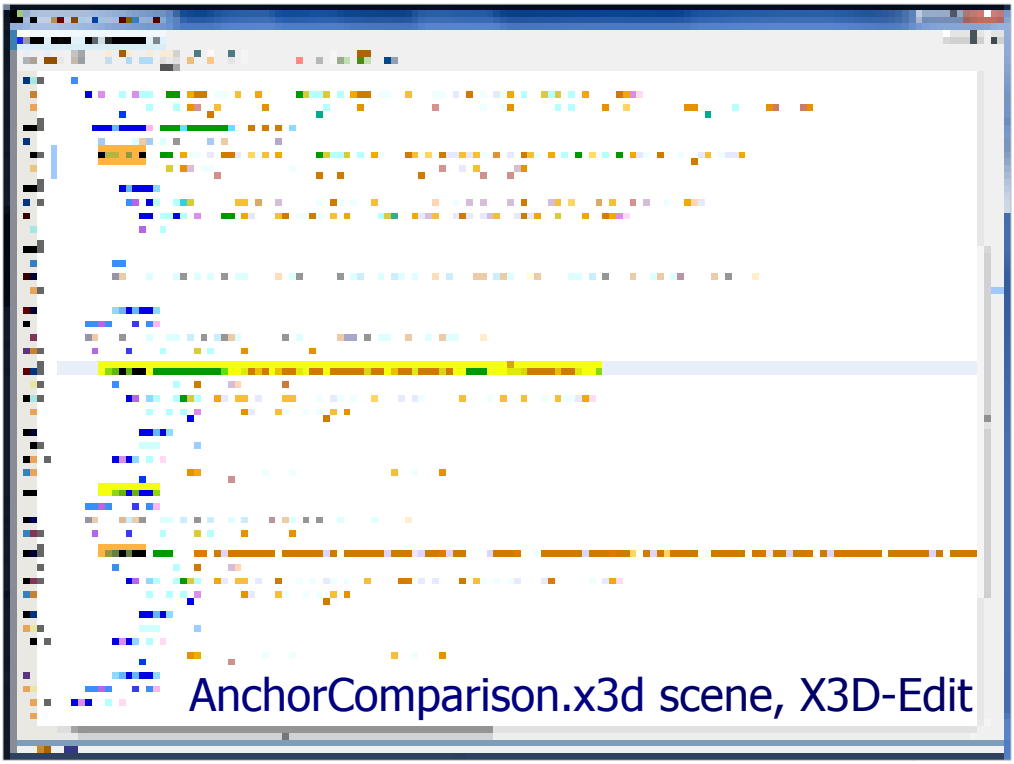
http://www.montereybayaquarium.org/efc/kelp.asp

Viewpoint link: #AngledView

"http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter03-Grouping/CoordinateAxes.x3d

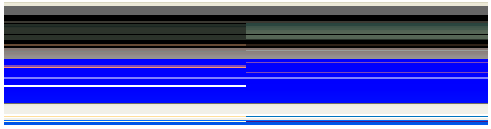


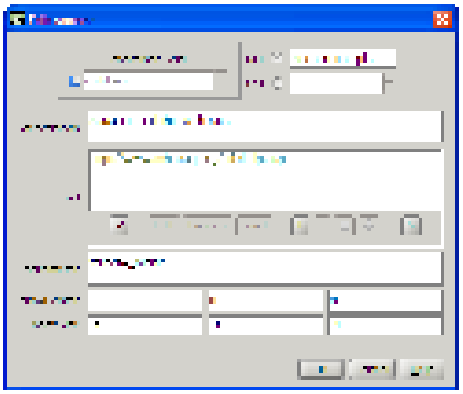




http://X3dGraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/AnchorComparison.x3d

Anchor example scene, editor





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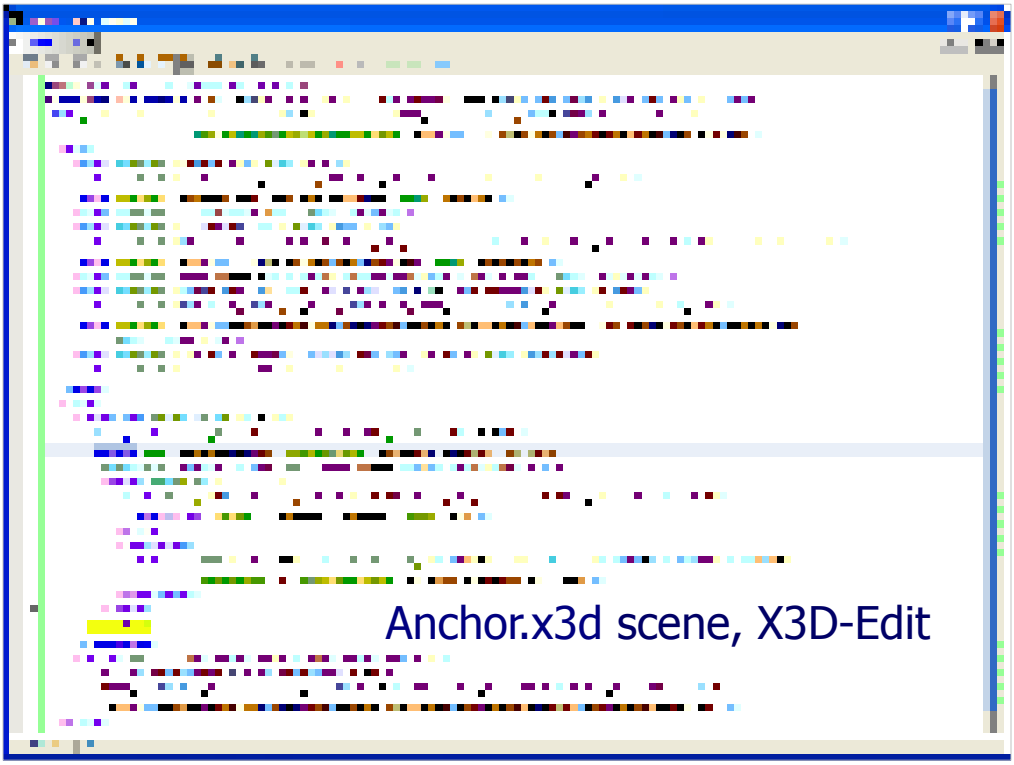
http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/Anchor.x3d



http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/Anchor.x3d

⚓ Anchor	**Anchor is a Grouping node that can contain most nodes. Clicking Anchored geometry loads content specified by the url field. Loaded content completely replaces current content, if parameter is same window.** **Hint: insert a Shape node before adding geometry or Appearance.**
DEF	**[DEF ID #IMPLIED]** DEF defines a unique ID name for this node, referencable by other nodes. **Hint:** descriptive DEF names improve clarity and help document a model.
USE	**[USE IDREF #IMPLIED]** USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. **Hint:** USEing other geometry (instead of duplicating nodes) can improve performance. **Warning:** do NOT include DEF (or any other attribute values) when using a USE attribute!
description	**[description: accessType inputOutput, type SFString CDATA #IMPLIED]** Text description to be displayed for action of this node. Hint: many XML tools substitute XML character references automatically if needed (like & for & or " for "). **Interchange profile hint:** this field may be ignored.
url	**[url: accessType inputOutput, type MFString CDATA #IMPLIED]** Address of replacement world, activated by clicking Anchor geometry. **Hint:** jump to a world's internal viewpoint by appending viewpoint name (e.g. #ViewpointName, someOtherCoolWorld.wrl#GrandTour). **Hint:** jump to a local viewpoint by only using viewpoint name (e.g. #GrandTour). **Hint:** Strings can have multiple values, so separate each string by quote marks ["http://www.url1.org" "http://www.url2.org" "etc."]. **Hint:** XML encoding for " is " (a character entity). **Warning:** strictly match directory and filename capitalization for http links! **Hint:** can replace embedded blank(s) in url queries with %20 for each blank character. **Hint:** pop up a new window with url value as follows: "JavaScript:window.open('popup.html','popup','width=240,height=240');location.href='HelloWorld.wrl'"
parameter	**[parameter: accessType inputOutput, type MFString CDATA #IMPLIED]** Passed parameter that signals web browser how to redirect url loading. Hint: set parameter to target=_blank to load target url into a blank frame. Hint: set parameter to target=frame_name to load target url into another frame. Hint: Strings can have multiple values, so separate each string by quote marks. ["http://www.url1.org" "http://www.url2.org" "etc."]. **Interchange profile hint:** this field may be ignored.
bboxCenter	**[bboxCenter: accessType initializeOnly, type SFVec3f CDATA "0 0 0"]** Bounding box center: position offset from origin of local coordinate system.
bboxSize	**[bboxSize: accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"]** Bounding box size: automatically calculated, can be specified as an optimization or constraint.
containerField	**[containerField: NMTOKEN "children"]** containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	**[class CDATA #IMPLIED]** class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

http://www.web3d.org/x3d/content/X3dTooltips.html#Anchor

Billboard node

Billboard is another X3DGroupingNode

Child-content geometry faces user

- Special effect that improves readability or visibility

axisOfRotation determines Billboard pivot point

- Relative to local coordinate system
- Default is *axisOfRotation*='0 1 0' which swivels about vertical (Y axis)
- Rotations unpredictable when view above (on axis)
- Define *axisOfRotation*='0 0 0' for circular rotation in any direction, always fully facing the user

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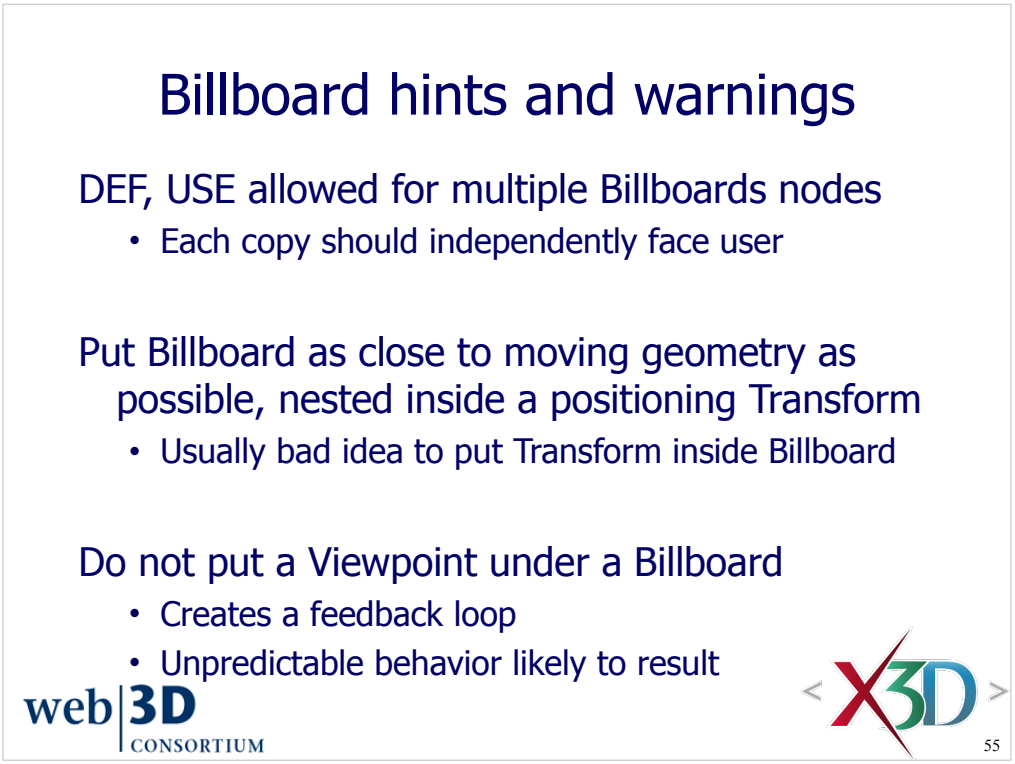
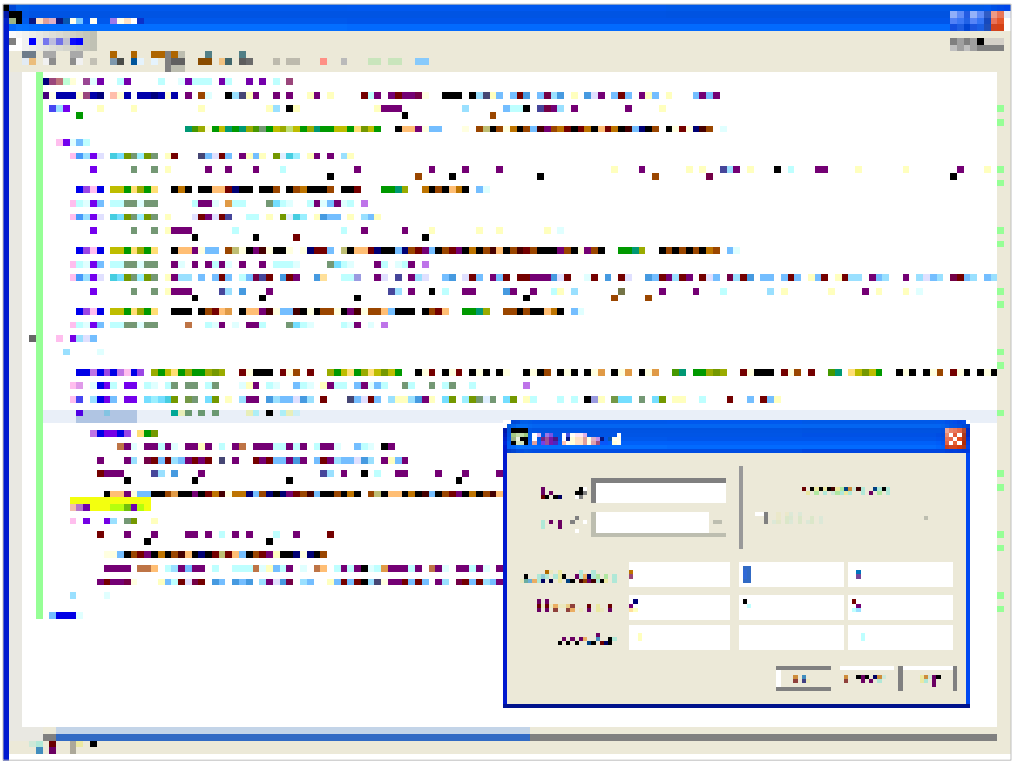
Unlike most other X3D fields, in this case a 0 0 0 vector value is allowed and given a special meaning.

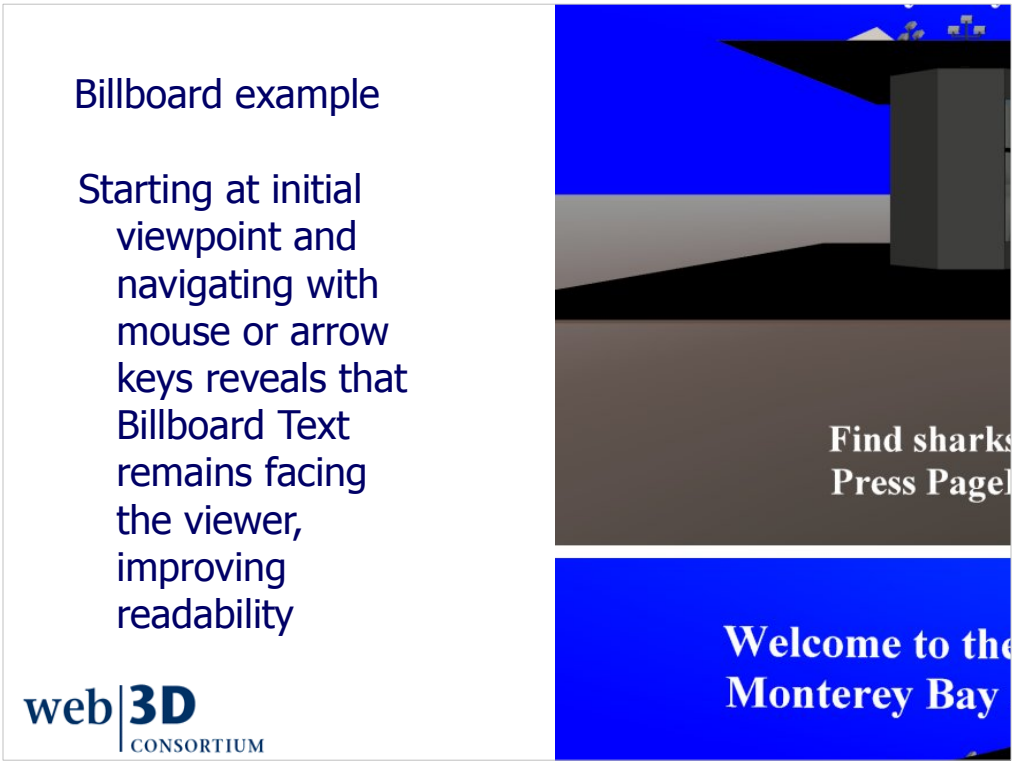


Put Transform nodes outside of the Billboard to move shapes where they need to be, then insert the Billboard just above the rotating object so that it stays in place while rotating to face the user's current view.

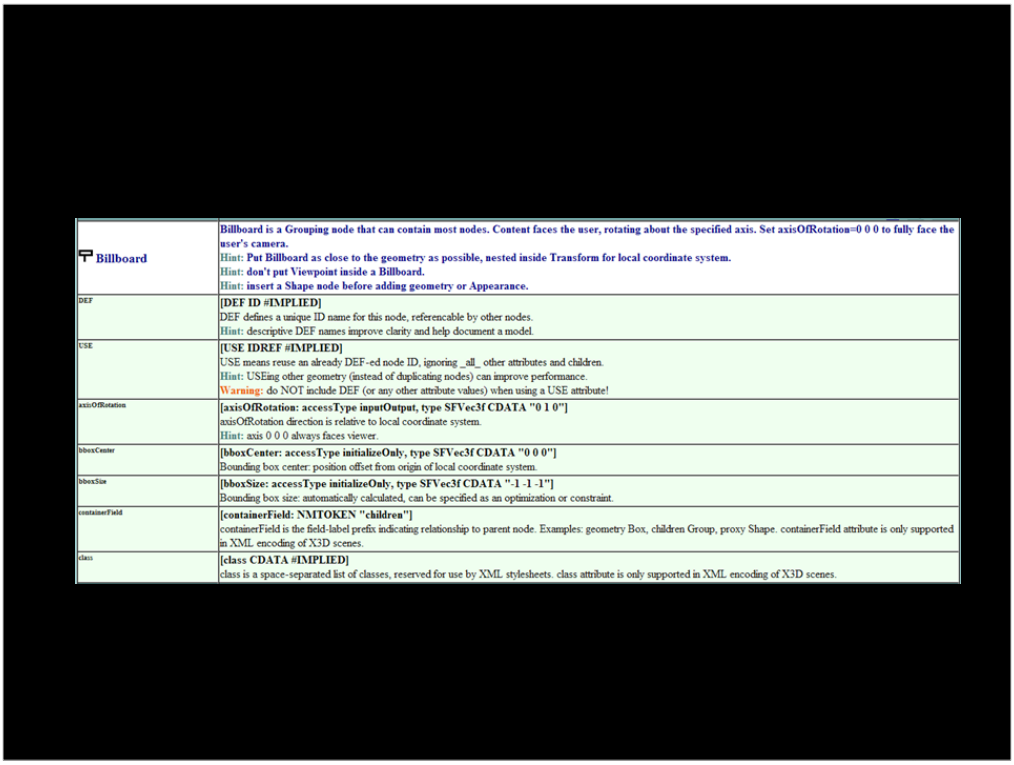
- Transform
  - Billboard
    - Shape



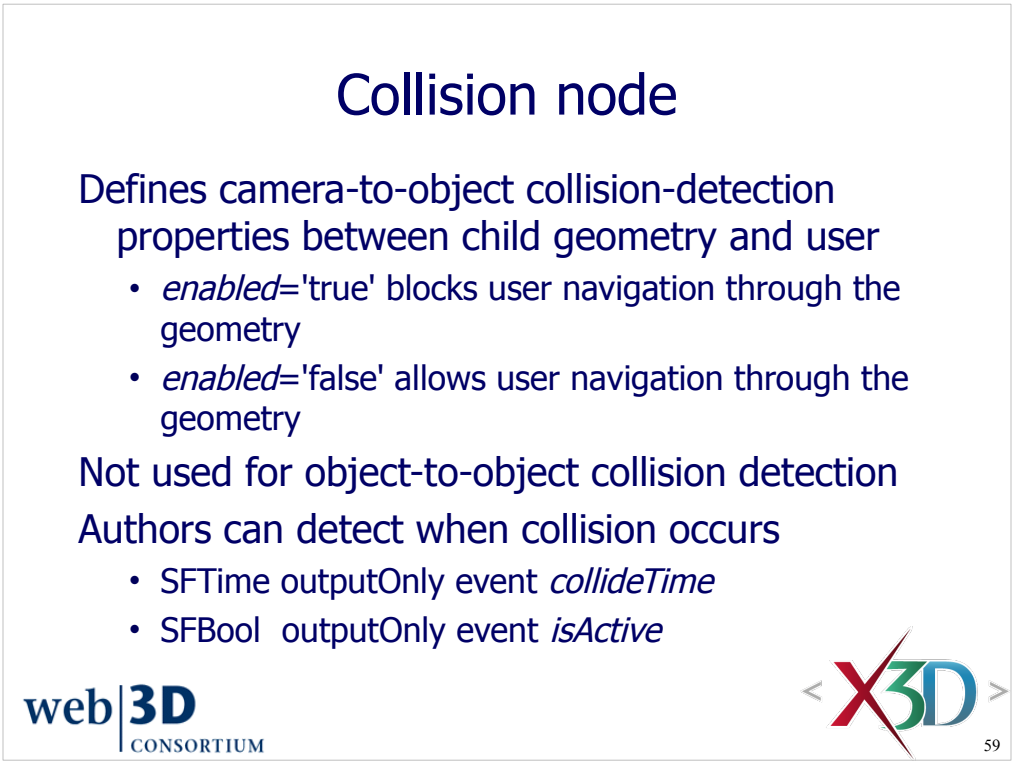
http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/Billboard.x3d



http://www.x3dbook.com/examples/X3dForWebAuthors/KelpForestExhibit/KelpForestMain.x3d



http://www.web3d.org/x3d/content/X3dTooltips.html#Billboard



Advanced object-to-object collision techniques are also possible using the RigidBodyPhysics component defined in X3D version 3.2.

Collision detection and terrain following

Terrain following depends on +Y axis being "up"

- Other coordinate systems are possible but do not match this X3D convention
- Thus datasets using other coordinates must be converted to match

WALK mode is another form of collision detection

- Viewer's camera drops until NavigationInfo avatar rests on geometry serving as the ground plane
- Step-over distance (an *avatarSize* parameter) governs whether user can rise over obstacles

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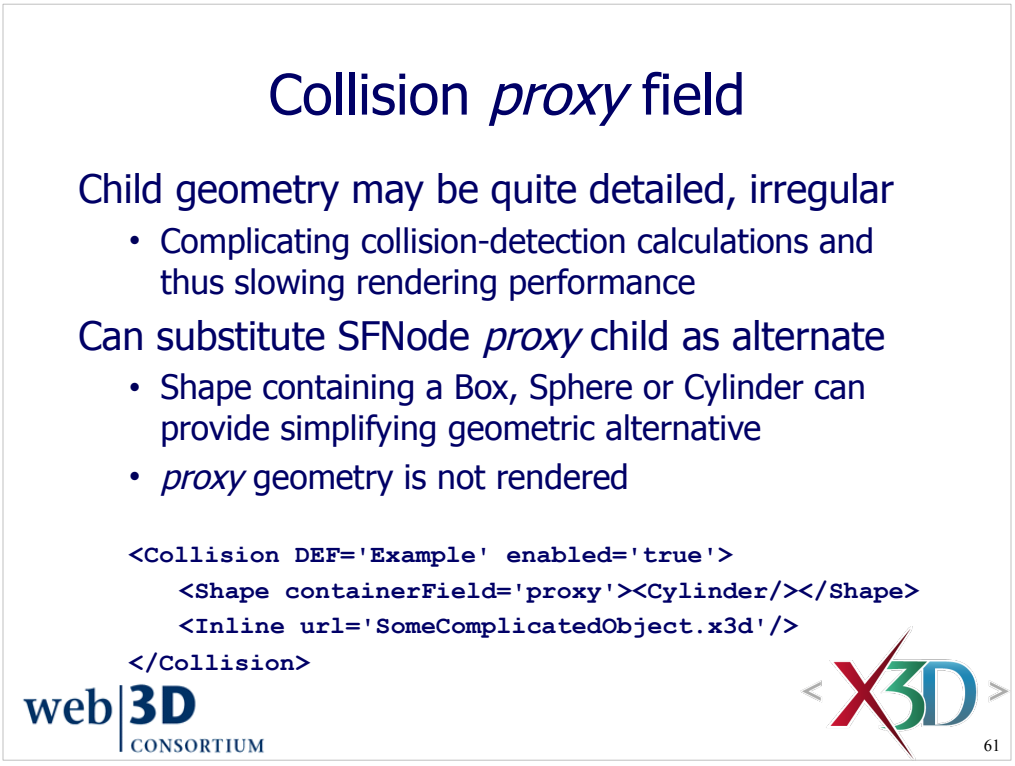

Note that proxy child can occur in any order as part of the Collision node's children. The following example also includes the optional default-valued attributes for *containerField*='children'.

```
<Collision DEF='Example' enabled='true'>
      <Group containerField='children' DEF='SomeComplicatedGeometry'/>
      <Shape containerField='proxy'>
            <Cylinder/>
      </Shape>
      <Inline containerField='children' url='AnotherComplicatedObject.x3d'/>
</Collision>
```

However, note that if reformatted in X3D Canonical Form as a preparation step for X3D Compressed Binary Encoding (CBE) , children nodes are sorted in order to group alike *containerField* values together. Additionally any default *containerField* values would be omitted. Thus the above example becomes:

```
<Collision DEF='Example' enabled='true'>
      <Shape containerField='proxy'>
            <Cylinder/>
      </Shape>
      <Group DEF='SomeComplicatedGeometry'/>
      <Inline url='AnotherComplicatedObject.x3d'/>
</Collision>
```

4.2.3 X3D canonical form

http://www.web3d.org/x3d/specifications/ISO-IEC-FCD-19776-3.2-X3DEncodings-CompressedBinary/Part03/concepts.html#X3DCanonicalForm

Collision hints and warnings

`<NavigationInfo type=' "WALK" "FLY" '/>`
modes support camera-to-object collision detection

Only polygonal geometry can be used for collision detection

- No points or lines
- Special limitation: no Text node collisions
- Nevertheless you can achieve the same collision effects by adding a transparent Box or other shape, thus providing necessary polygons as boundaries

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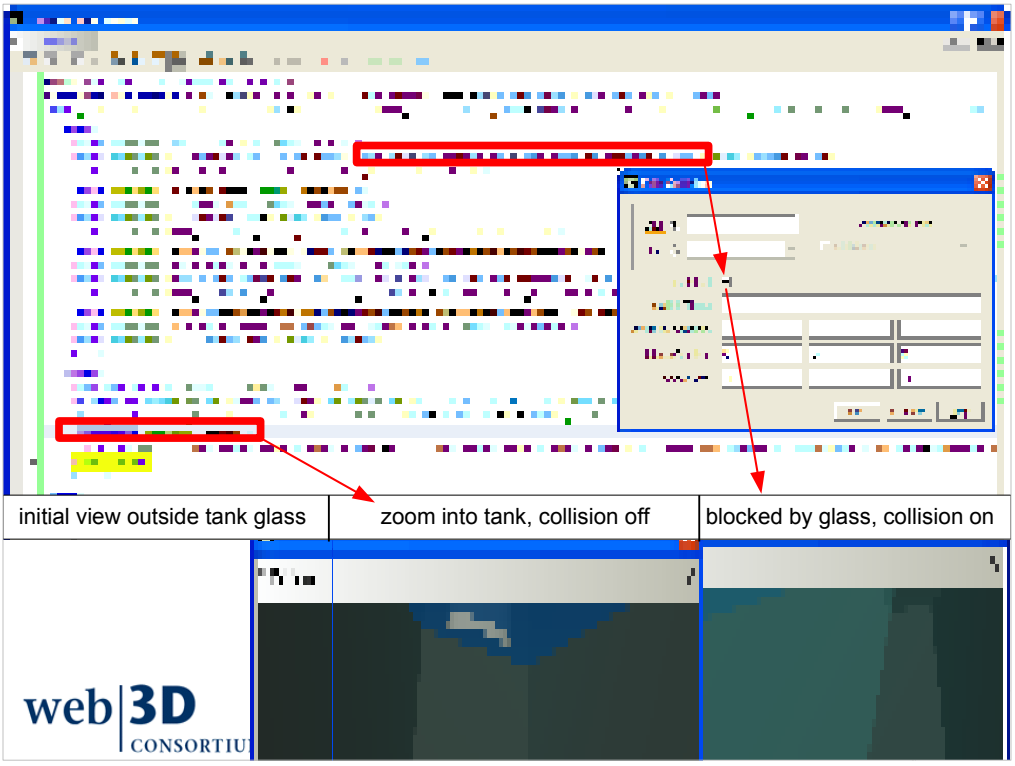

http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/Collision.x3d

Collision example

Example screen shots first show the viewer being stopped by glass geometry, then the viewer passing through the tank glass for a closer view.

Collision *enabled*="true" or *enabled*="false" result in different navigation responses.

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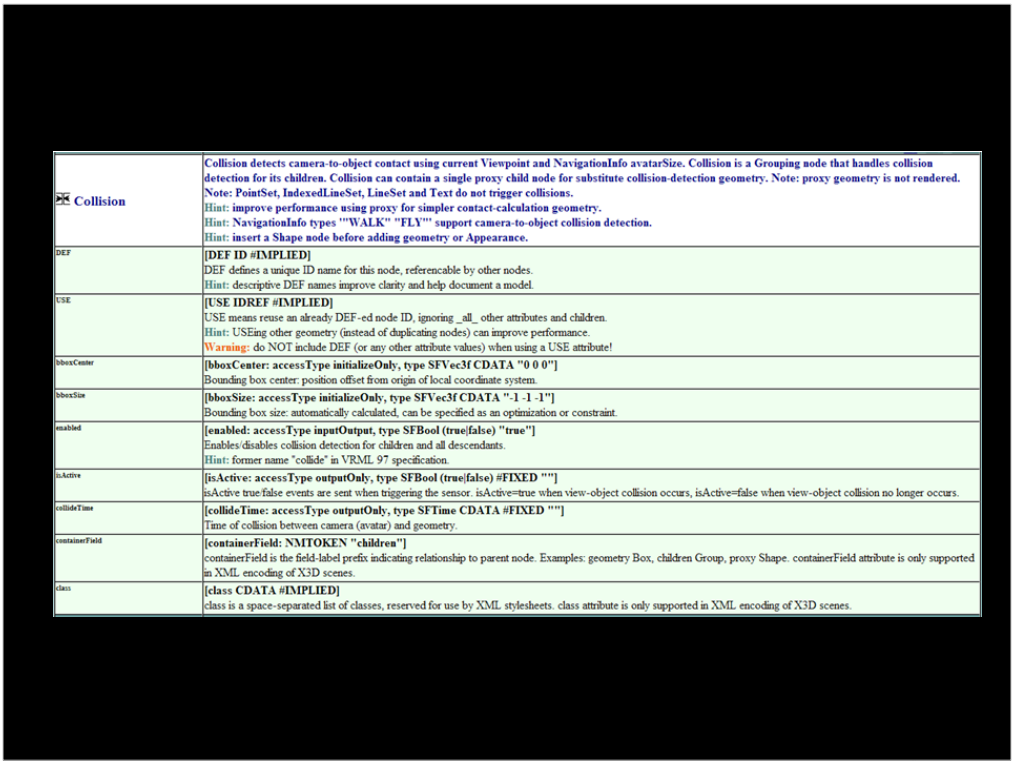
X3D for Web Authors, Figure 4.5



Collision	Collision detects camera-to-object contact using current Viewpoint and NavigationInfo avatarSize. Collision is a Grouping node that handles collision detection for its children. Collision can contain a single proxy child node for substitute collision-detection geometry. Note: proxy geometry is not rendered. Note: PointSet, IndexedLineSet, LineSet and Text do not trigger collisions. Hint: improve performance using proxy for simpler contact-calculation geometry. Hint: NavigationInfo types '"WALK" "FLY"' support camera-to-object collision detection. Hint: insert a Shape node before adding geometry or Appearance.
DEF	[DEF ID #IMPLIED] DEF defines a unique ID name for this node, referencable by other nodes. Hint: descriptive DEF names improve clarity and help document a model.
USE	[USE IDREF #IMPLIED] USE means reuse an already DEF-ed node ID, ignoring _all_ other attributes and children. Hint: USEing other geometry (instead of duplicating nodes) can improve performance. Warning: do NOT include DEF (or any other attribute values) when using a USE attribute!
bboxCenter	[bboxCenter: accessType initializeOnly, type SFVec3f CDATA "0 0 0"] Bounding box center: position offset from origin of local coordinate system.
bboxSize	[bboxSize: accessType initializeOnly, type SFVec3f CDATA "-1 -1 -1"] Bounding box size: automatically calculated, can be specified as an optimization or constraint.
enabled	[enabled: accessType inputOutput, type SFBool (true|false) "true"] Enables/disables collision detection for children and all descendants. Hint: former name "collide" in VRML 97 specification.
isActive	[isActive: accessType outputOnly, type SFBool (true|false) #FIXED ""] isActive true/false events are sent when triggering the sensor. isActive=true when view-object collision occurs, isActive=false when view-object collision no longer occurs.
collideTime	[collideTime: accessType outputOnly, type SFTime CDATA #FIXED ""] Time of collision between camera (avatar) and geometry.
containerField	[containerField: NMTOKEN "children"] containerField is the field-label prefix indicating relationship to parent node. Examples: geometry Box, children Group, proxy Shape. containerField attribute is only supported in XML encoding of X3D scenes.
class	[class CDATA #IMPLIED] class is a space-separated list of classes, reserved for use by XML stylesheets. class attribute is only supported in XML encoding of X3D scenes.

http://www.web3d.org/x3d/content/X3dTooltips.html#Collision

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Additional Resources

File formatting

X3D-Edit has a Netbeans capability for formatting

- *Alt-shift-F* ***F****ormat* acts upon highlighted text blocks, also available via right-click menu
- Warning: do not reformat embedded ECMAscript source code

X3D Canonicalization (C14N) also reformats X3D

- Performed prior to examples being placed in archive
- Can invoke in X3D-Edit using C14N button
- Preferred method for file formatting

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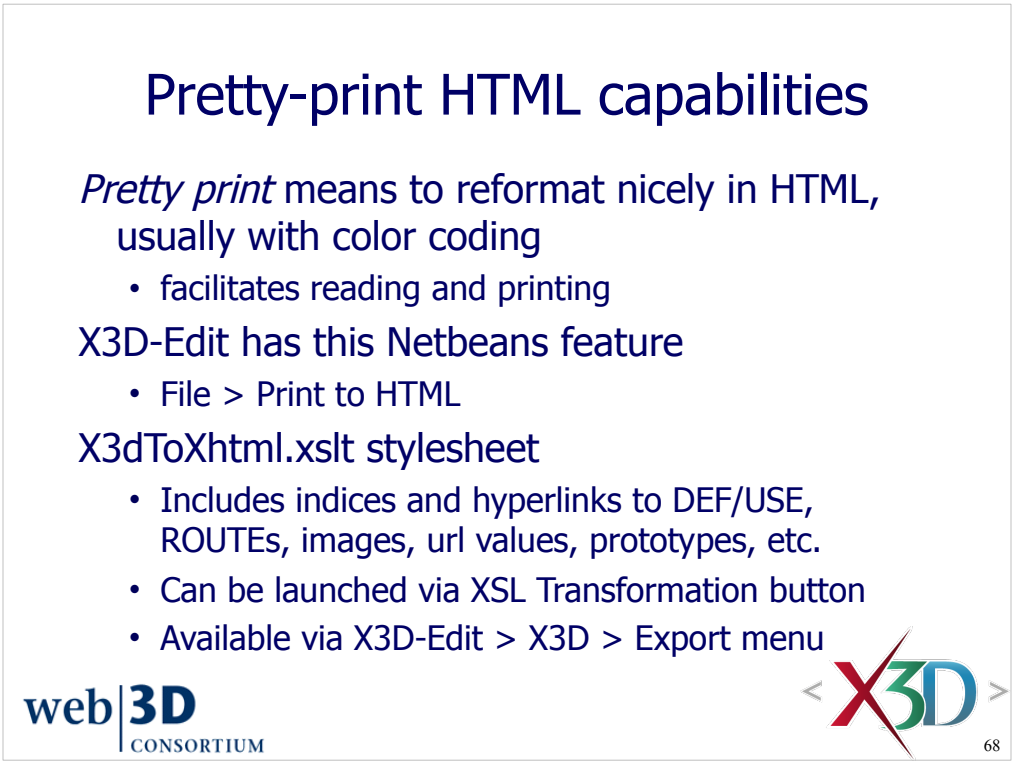
Source Editing in Netbeans 6.0+
http://www.netbeans.org/kb/60/java/editor-tips.html

X3D Canonical Form
http://www.web3d.org/x3d/specifications/ISO-IEC-19776-3-X3DEncodings-CompressedBinary/Part03/concepts.html#X3DCanonicalForm

Issue-tracker entry for C14N addition to X3D-Edit
https://www.movesinstitute.org/bugzilla/show_bug.cgi?id=1461

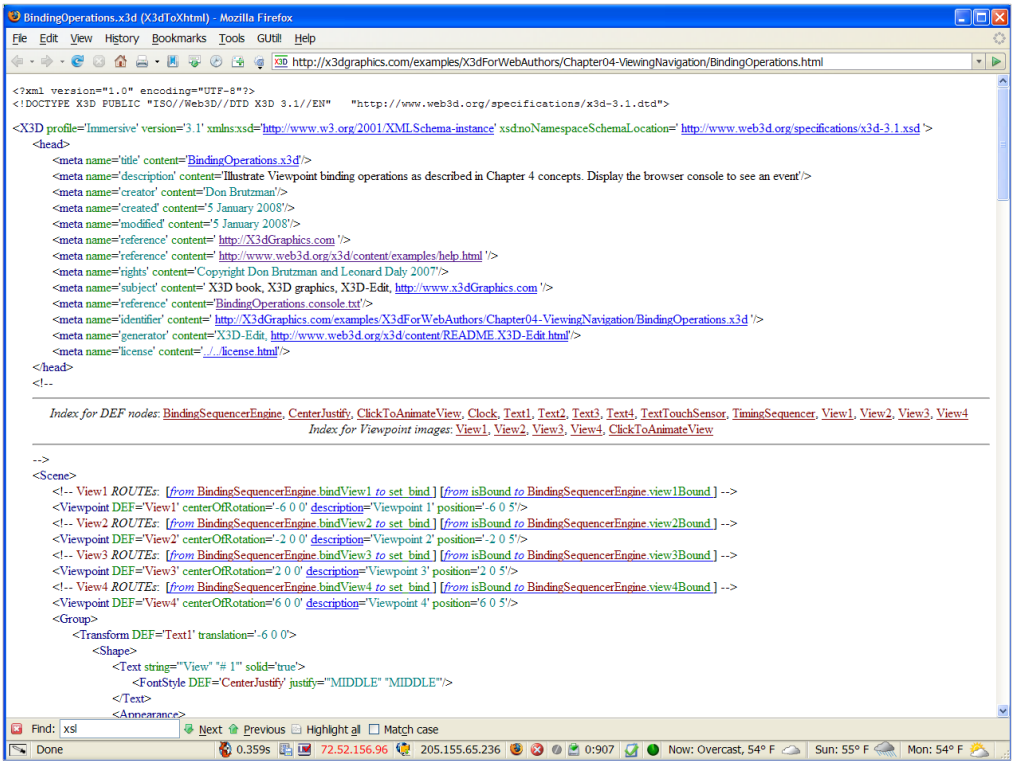
TODO: add C14N to X3D-Edit Tools menu



Tagset pretty-printing in XHTML (.html encoding), includes cross linking of DEF/USE/ROUTE and other features: *X3dToXhtml.xslt* and *X3dToXhtml.bat*

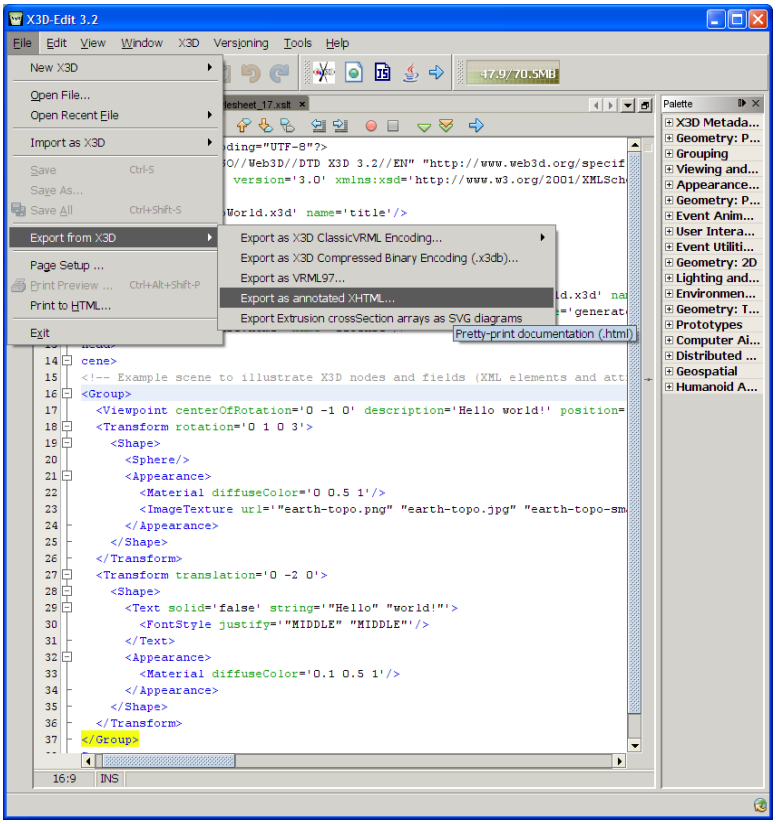
http://www.web3d.org/x3d/content/examples/help.html#Conversions

Issue-tracker entry for X3dToXhtml.xslt addition to X3D-Edit
https://www.movesinstitute.org/bugzilla/show_bug.cgi?id=1549



http://x3dgraphics.com/examples/X3dForWebAuthors/Chapter04-ViewingNavigation/BindingOperations.html

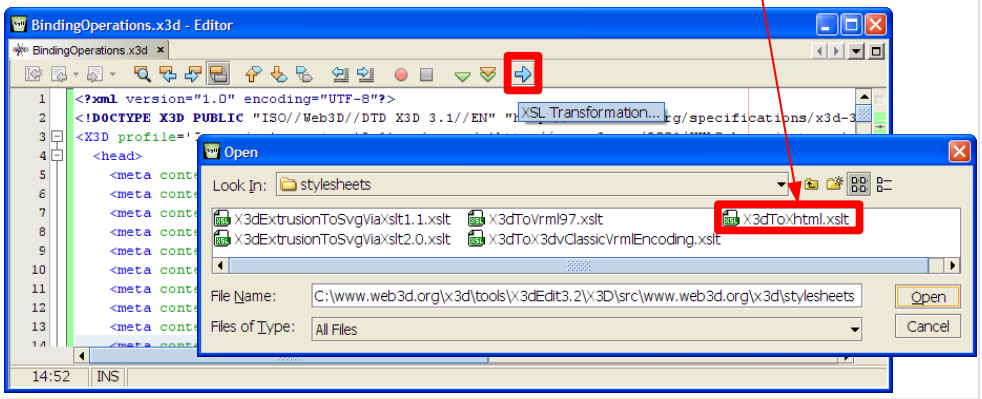
Example use is shown of *Export as Annotated XHTML*, which invokes *X3dToXhtml.xslt* stylesheet to make pretty-print HTML output:



Launching other XSLT stylesheets

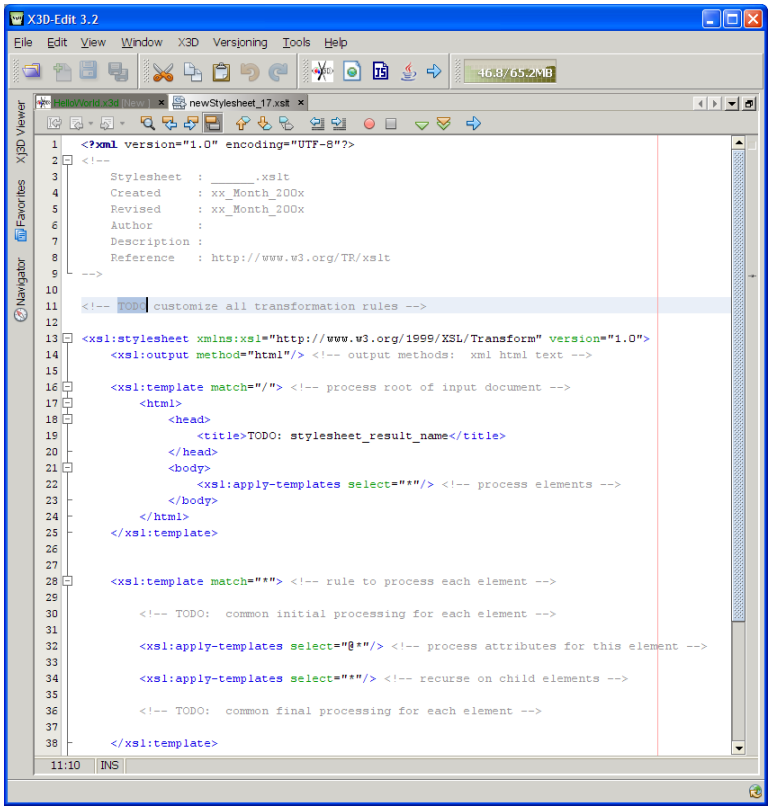
Extensible Stylesheet Language for XML (XSLT) stylesheets support a variety of conversions

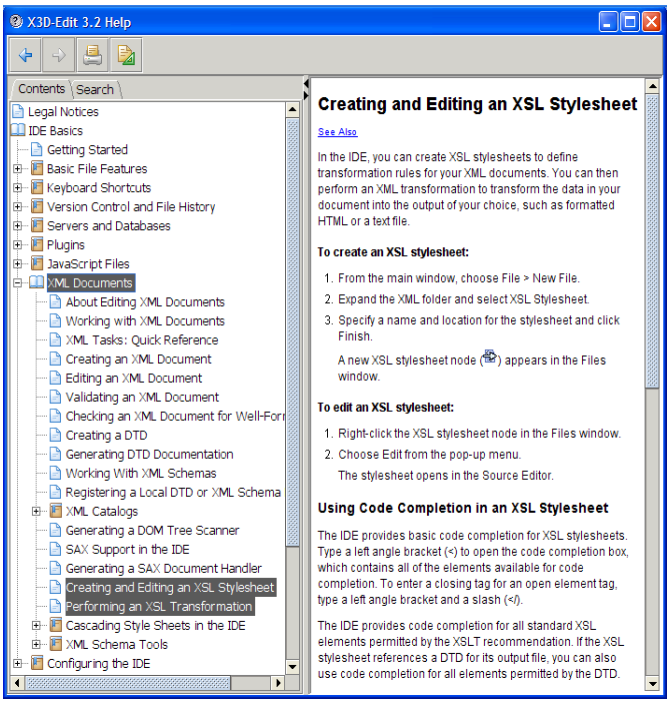
- X3dToVrml97.xslt
- X3dToClassicVRML.xslt
- X3dToXhtml.xslt
- others



Template for new stylesheet also available: *File > New X3D > New XSLT stylesheet...*

Under *Help* system, see *XML Documents > Creating and Editing an XSL Stylesheet, Performing an XSL Transformation*





Chapter Summary

Chapter Summary

Users explore X3D worlds by choosing predefined viewpoints and navigating through 3D space.

- Bindable nodes, so only one is active at a time
- Viewpoint lets authors identify key camera locations
- NavigationInfo provides options for moving around

Nodes to improve user navigability, interaction:

- Anchor makes geometric shapes linkable, like HTML
- Billboard for axis-aligned geometry facing the user
- Collision permits or blocks a user's current camera view from passing through collidable geometry

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Suggested exercises

Demonstrate the ability to choose viewpoints and navigate in master Kelp Forest Exhibit scene

- Take screen snapshot image to show what you saw

Create a "guided tour" of multiple Viewpoints for navigating a scene of interest

Switch between EXAMINE, WALK and FLY navigation in one or more browsers

Demonstrate the Anchor node by linking some text to another scene or an external web page

Use Billboard for multiple Text descriptions, linked via Anchor to bind respective viewpoints

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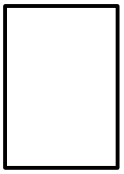
References

References 1

X3D: Extensible 3D Graphics for Web Authors by Don Brutzman and Leonard Daly, Morgan Kaufmann Publishers, April 2007, 468 pages.



- Chapter 4, Viewing and Navigation
- http://x3dGraphics.com
- http://x3dgraphics.com/examples/X3dForWebAuthors

X3D Resources

- http://www.web3d.org/x3d/content/examples/X3dResources.html

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References 2

X3D-Edit Authoring Tool

- https://savage.nps.edu/X3D-Edit

X3D Scene Authoring Hints

- http://x3dgraphics.com/examples/X3dSceneAuthoringHints.html

X3D Graphics Specification

- http://www.web3d.org/x3d/specifications
- Also available as help pages within X3D-Edit

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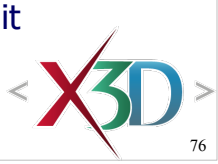

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References 3

VRML 2.0 Sourcebook by Andrea L. Ames, David R. Nadeau, and John L. Moreland, John Wiley & Sons, 1996.

- http://www.wiley.com/legacy/compbooks/vrml2sbk/cover/cover.htm
- http://www.web3d.org/x3d/content/examples/Vrml2.0Sourcebook
- Chapter 26 – Viewpoint

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- Received jury award for Best Submission 2008

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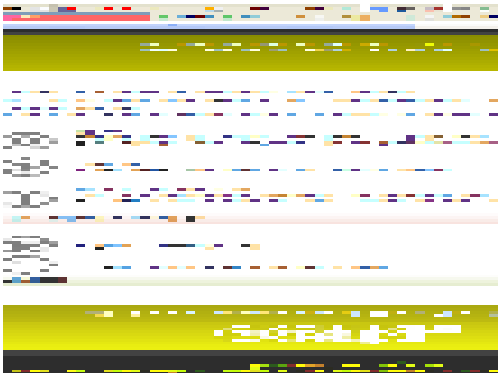

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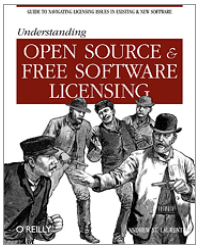
http://www.web3d.org/x3d/content/examples/license.html

Good references on open source:



Andrew M. St. Laurent, *Understanding Open Source and Free Software Licensing*, O'Reilly Publishing, Sebastopol California, August 2004. http://oreilly.com/catalog/9780596005818/index.html

Herz, J. C., Mark Lucas, John Scott, *Open Technology Development: Roadmap Plan*, Deputy Under Secretary of Defense for Advanced Systems and Concepts, Washington DC, April 2006. http://handle.dtic.mil/100.2/ADA450769