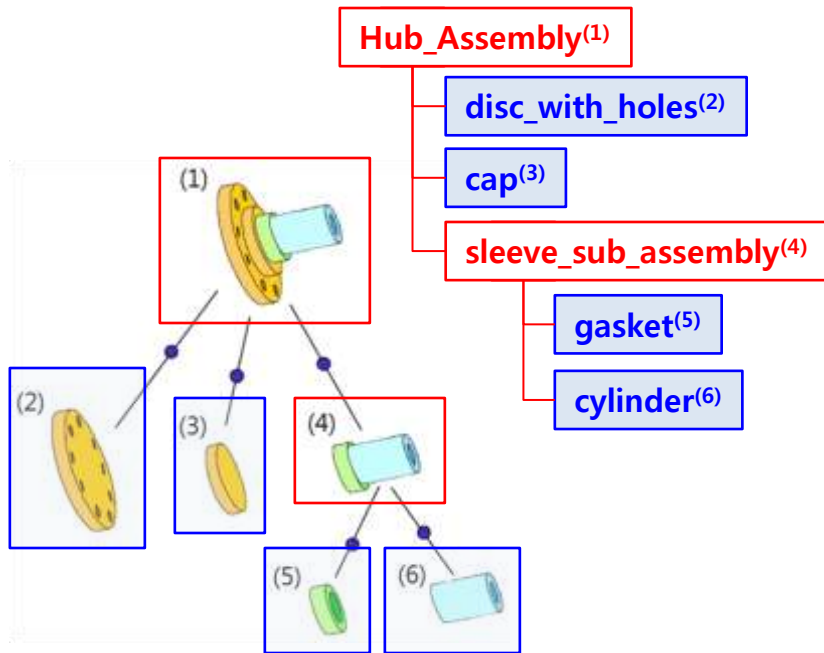


CAD-to-X3D Conversion

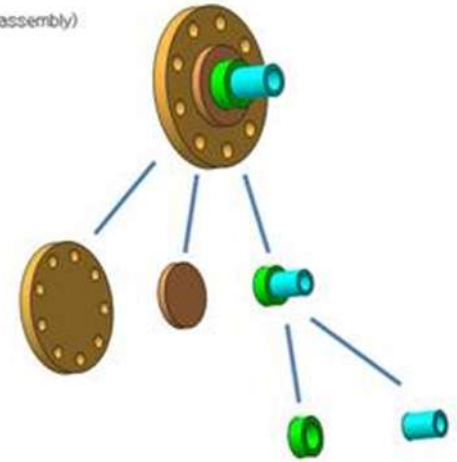
with product structure and external geometry referencing

Hyokwang Lee
PartDB Co., Ltd. and Web3D Korea Chapter
adpc9@partdb.com

CATIA Hub_Assembly model

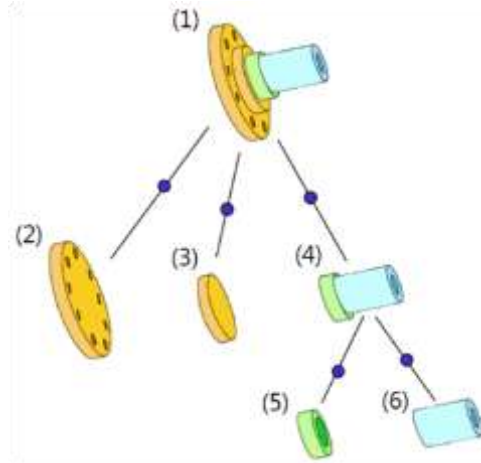
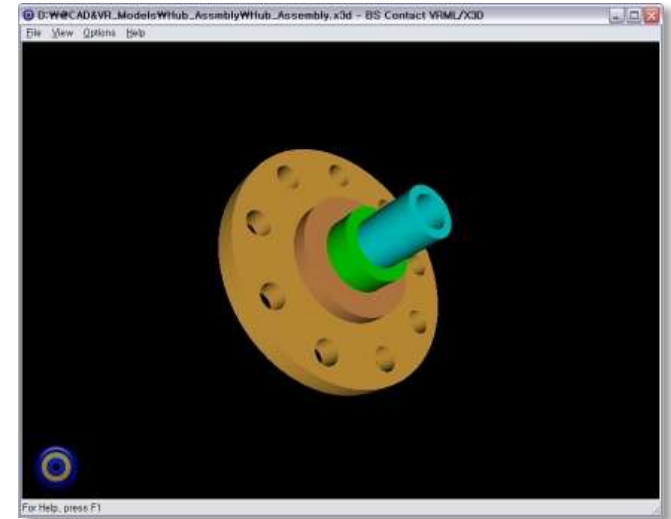
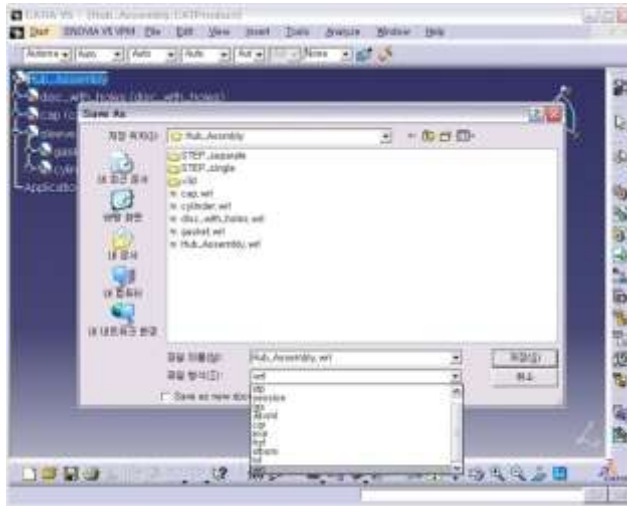


CATIA Hub Assembly
(6 Files)

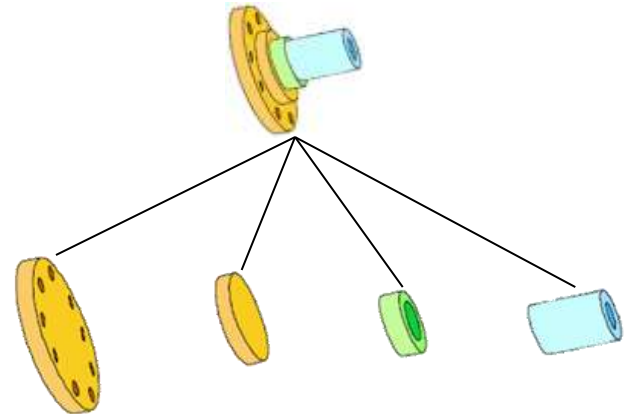
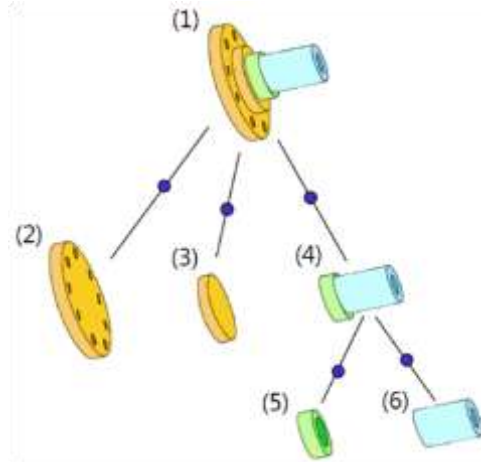
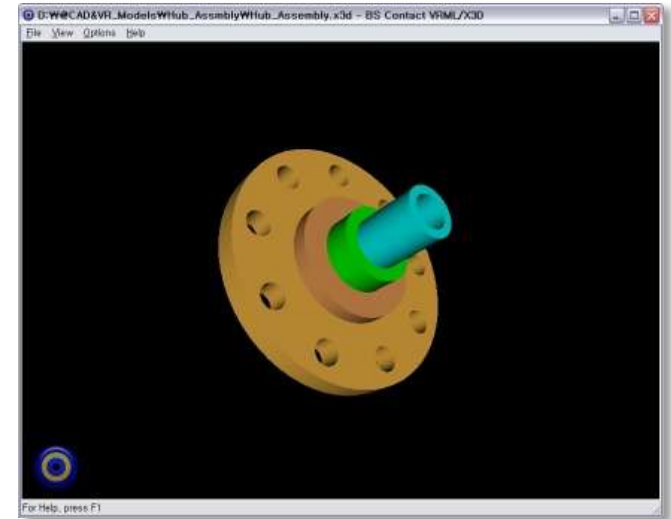
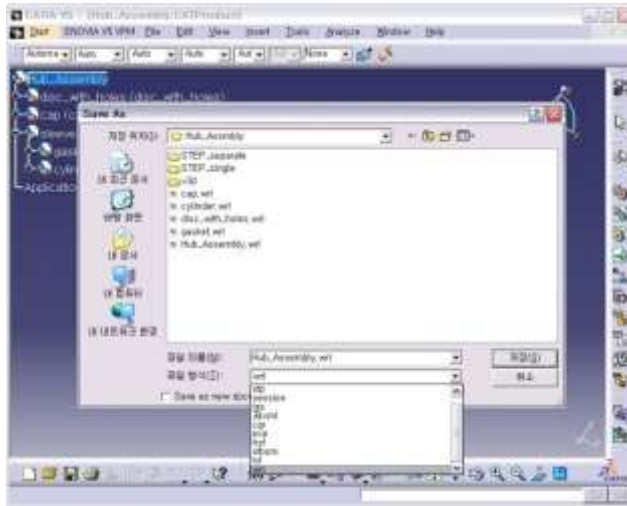


cap.CATPart	51KB
cylinder.CATPart	55KB
disc_with_holes.CATPart	109KB
gasket.CATPart	56KB
Hub_Assembly.CATProduct	19KB
sleeve_sub_assembly.CATProduct	14KB

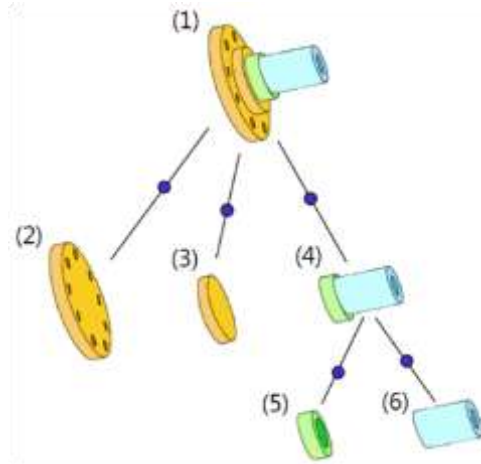
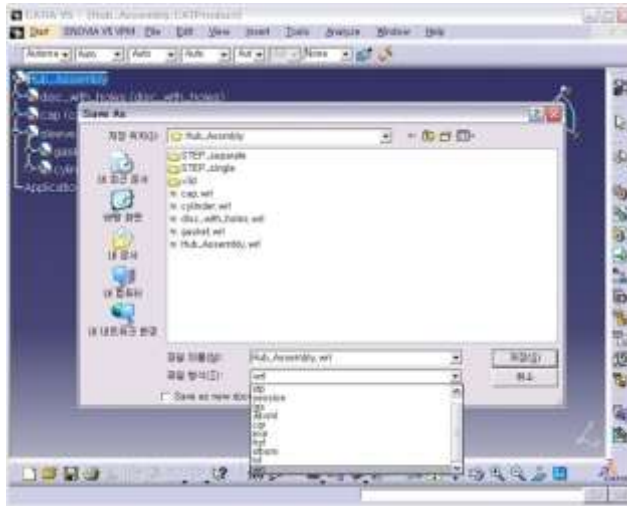
Simple Conversion of Hub_Assembly into X3D



Simple Conversion of Hub_Assembly into X3D

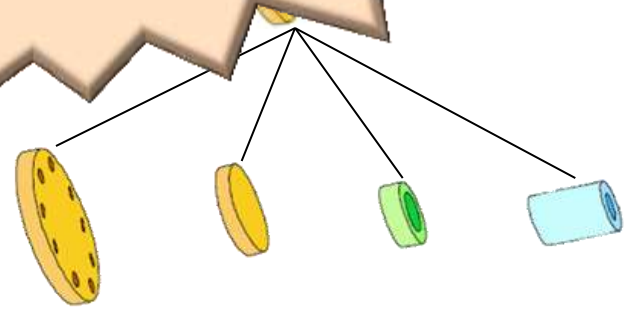
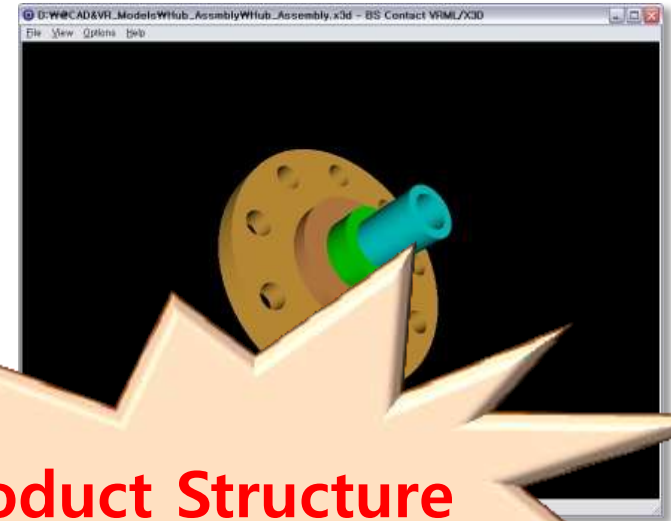


Simple Conversion of Hub_Assembly into X3D



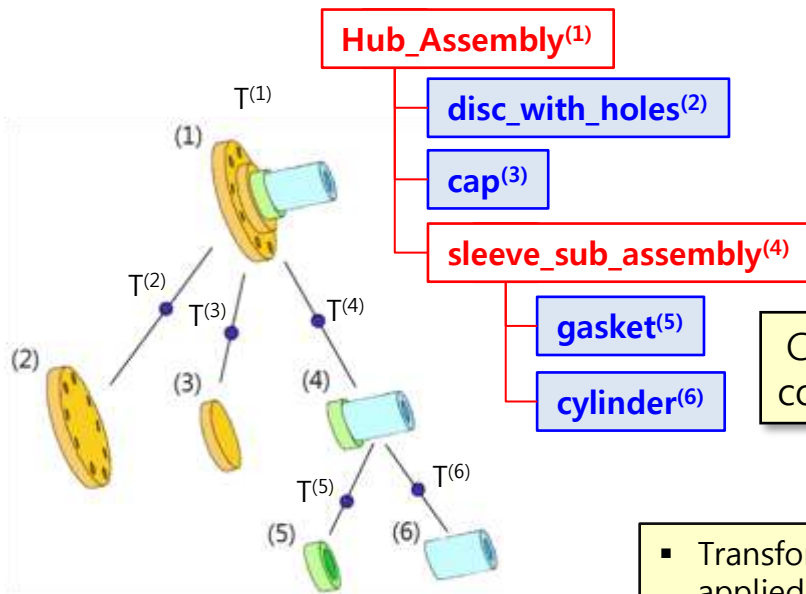
Save as
VRML

**Product Structure
disappeared!!**



Representing a CAD assembly in X3D

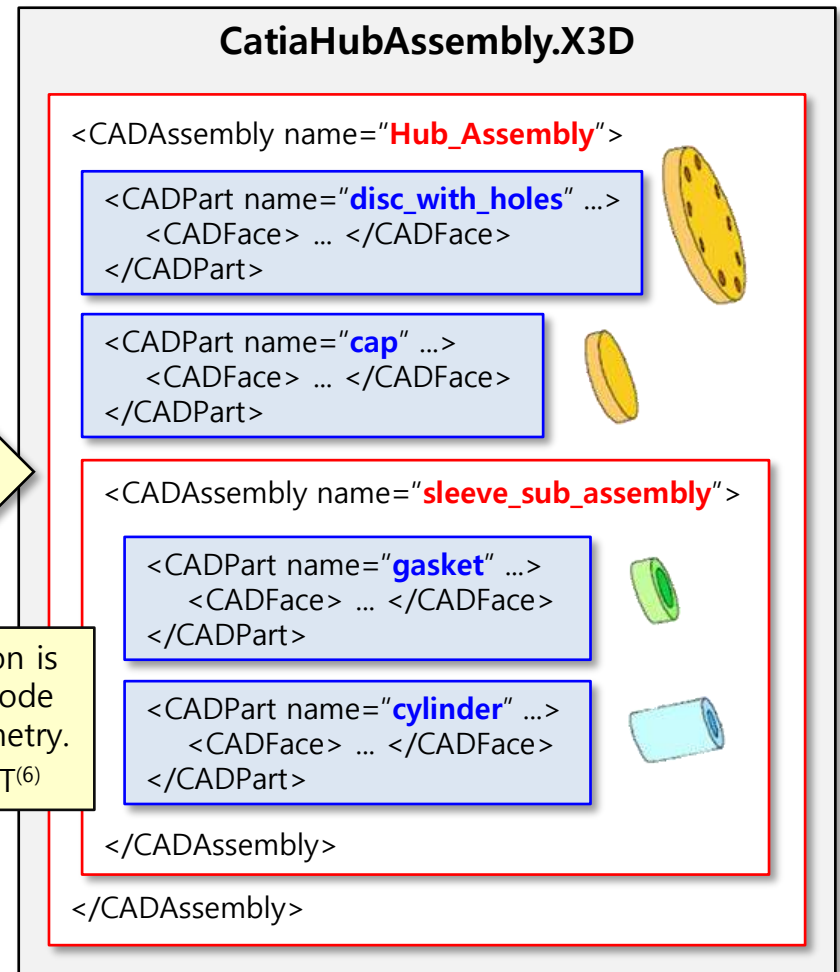
- Hub_Assembly represented in a single X3D file
 - Assembly structure : **CADAssembly, CADPart**
 - Geometry : **CADFace**



CATIA Hub Assembly
(6 Files)

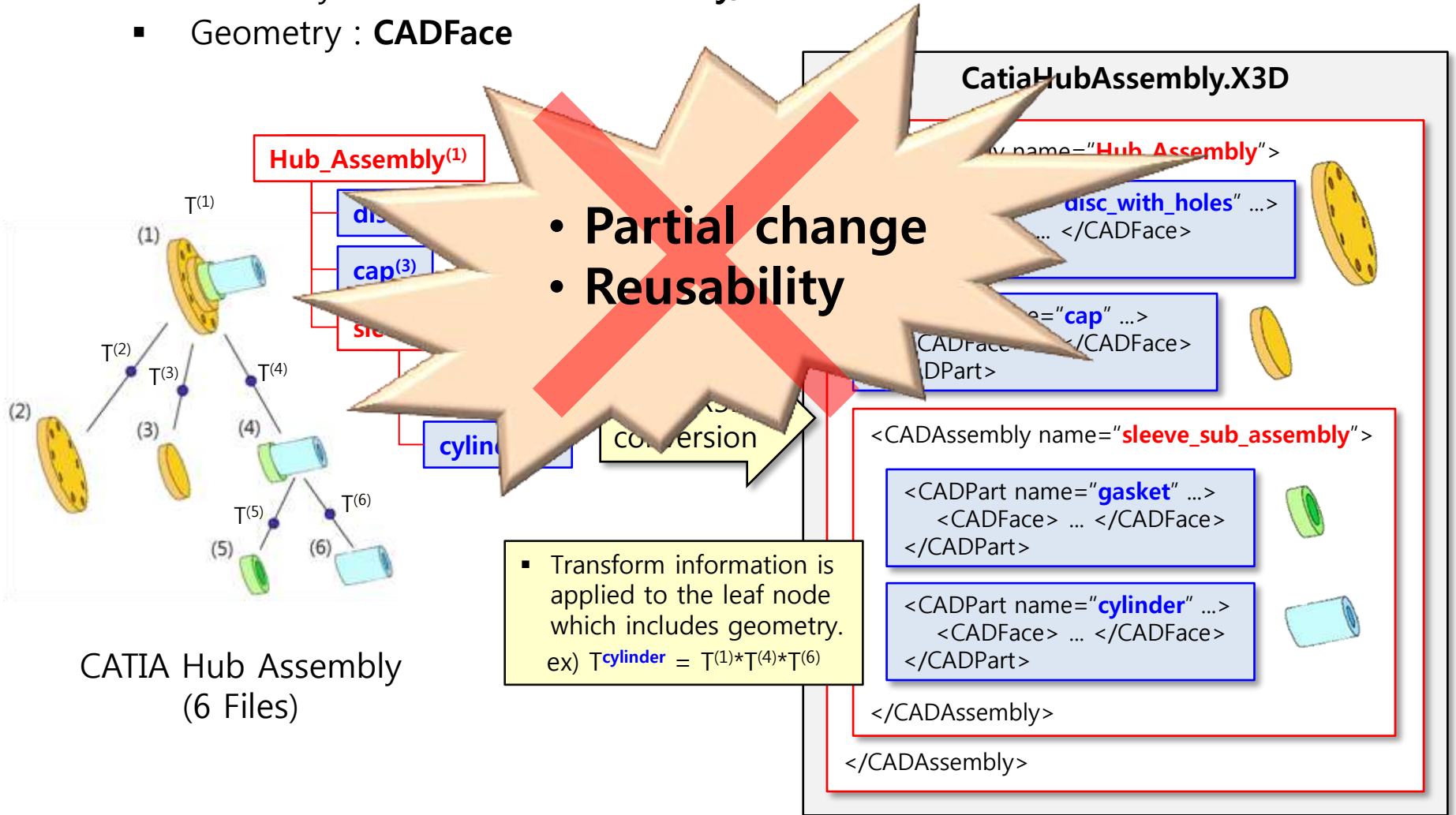
CAD2X3D
conversion

- Transform information is applied to the leaf node which includes geometry.
ex) $T_{cylinder} = T^{(1)} * T^{(4)} * T^{(6)}$



Representing a CAD assembly in X3D

- Hub_Assembly represented in a single X3D file
 - Assembly structure : **CADAssembly, CADPart**
 - Geometry : **CADFace**



CATIA Hub Assembly
(6 Files)

Heavyweight CAD Data

- **Size (CATIA) : 1,154 MB**
- **# of files : 4054**

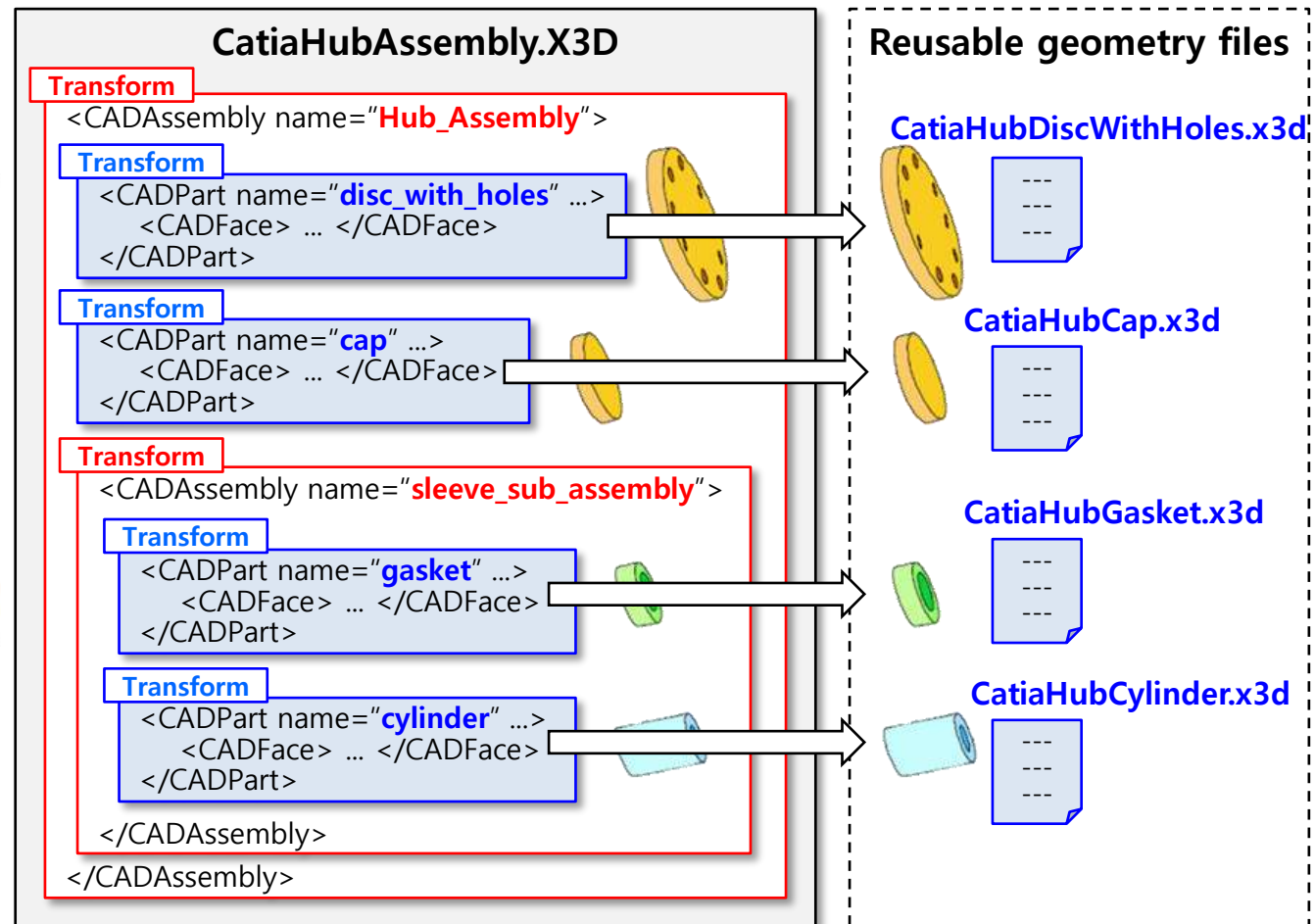
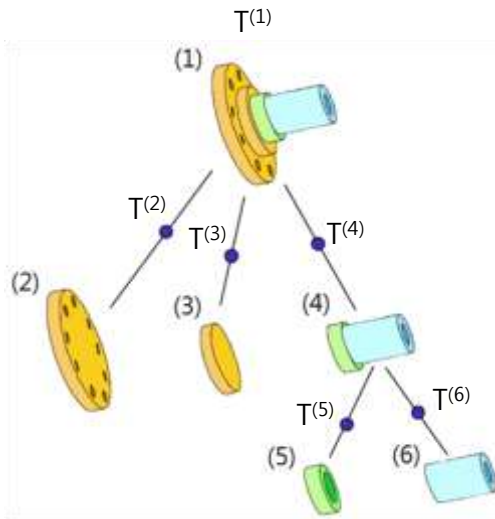


```
stl
igs
model
stp
3dmap
3dxml
cgr
hcg
vps
wrl
```

Format	# of files	Size(MB)
3DXML	1	136
HOOPS	1	105
VRML	1	1,136
IGES	1	1,934
STEP	1	1,287

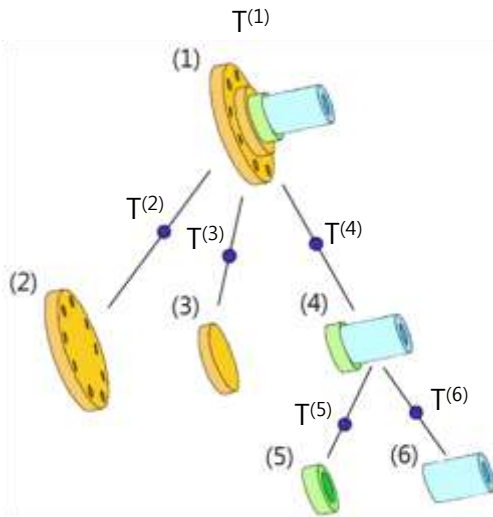
Representing a CAD assembly in X3D

- Hub_Assembly represented in **multiple X3D files**
 - An assembly structure file with transforms conserved separate
 - Externally referenced geometry files



Suggestions

- Conserving transform information separate for each assembly
 - Transform parent for each CADAssembly
 - A dummy CADAssembly for a CADPart



CatiaHubAssembly.X3D

```
<Transform DEF="T(1)">  
<CADAssembly name="Hub_Assembly">
```

```
<Transform DEF="T(2)">  
<CADAssembly name="disc_with_holes">  
<CADPart name="disc_with_holes" ...>  
<CADFace> ... </CADFace>  
</CADPart>  
</CADAssembly>  
</Transform>
```



```
<Transform DEF="T(3)">  
<CADAssembly name="cap">  
<CADPart name="cap" ...>  
<CADFace> ... </CADFace>  
</CADPart>  
</CADAssembly>  
</Transform>
```



```
<Transform DEF="T(4)">  
<CADAssembly name="sleeve_sub_assembly">
```

```
<Transform DEF="T(5)">  
<CADAssembly name="gasket">  
<CADPart name="gasket" ...>  
<CADFace> ... </CADFace>  
</CADPart>  
</CADAssembly>  
</Transform>
```



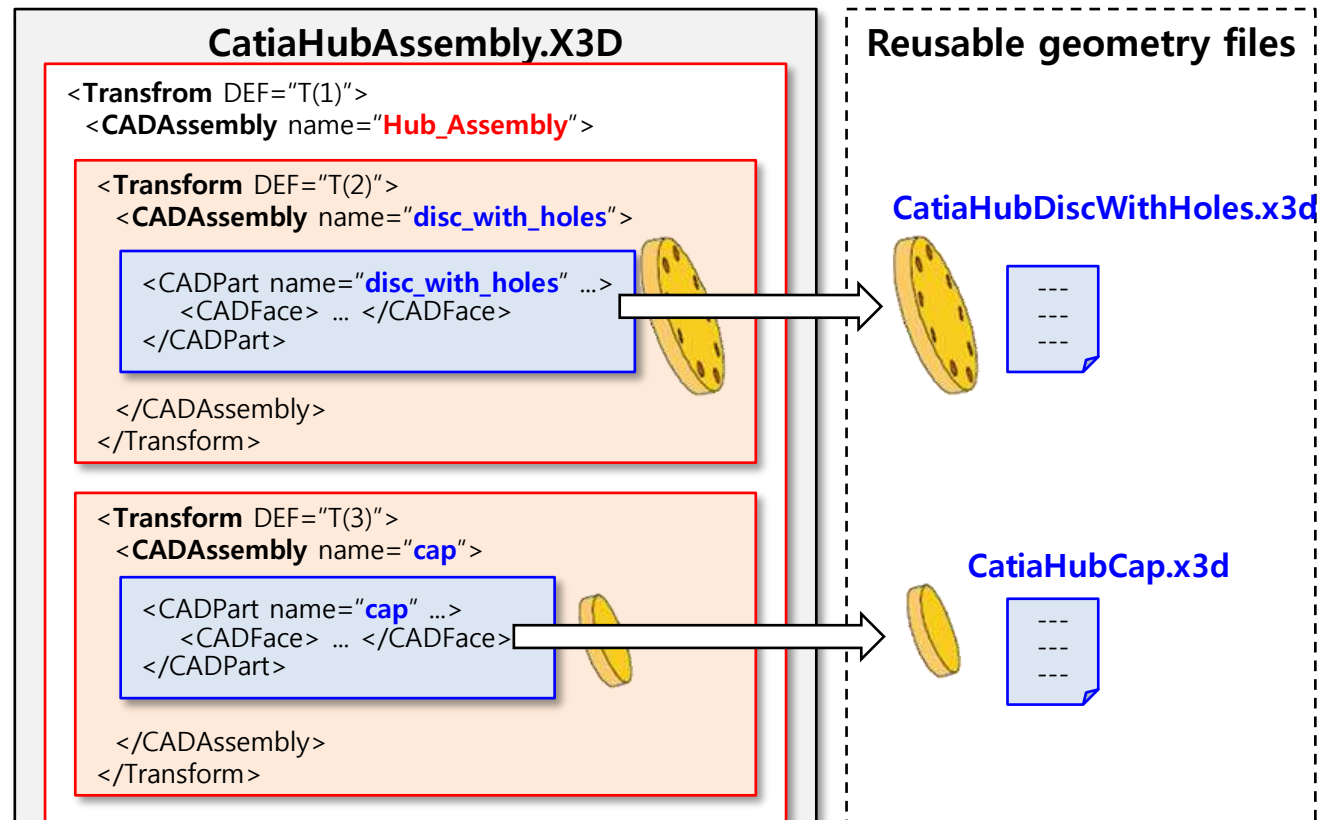
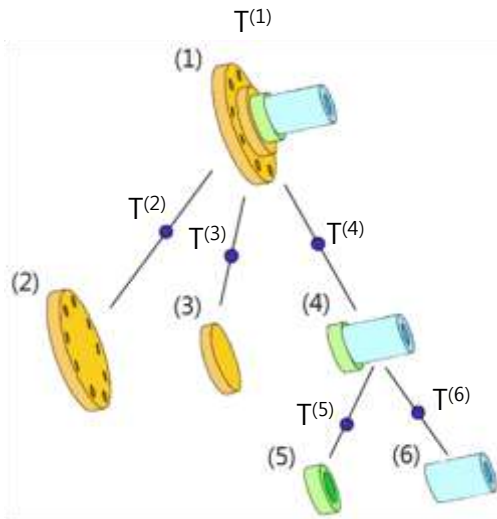
```
<Transform DEF="T(6)">  
<CADAssembly name="cylinder">  
<CADPart name="cylinder" ...>  
<CADFace> ... </CADFace>  
</CADPart>  
</CADAssembly>  
</Transform>
```



```
</CADAssembly>  
</Transform>  
</CADAssembly>  
</Transform>
```

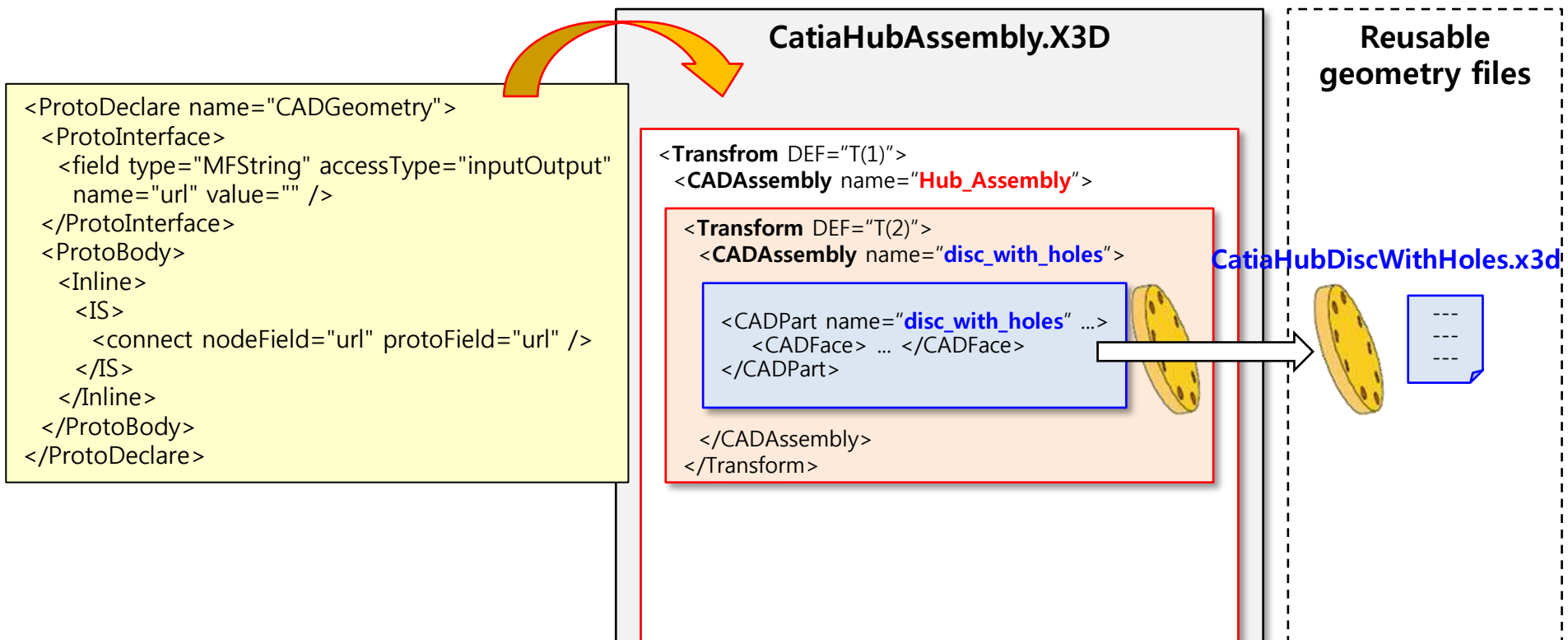

Suggestions

- External referencing of geometry files
 - A. Prototype with Inline
 - B. Inline



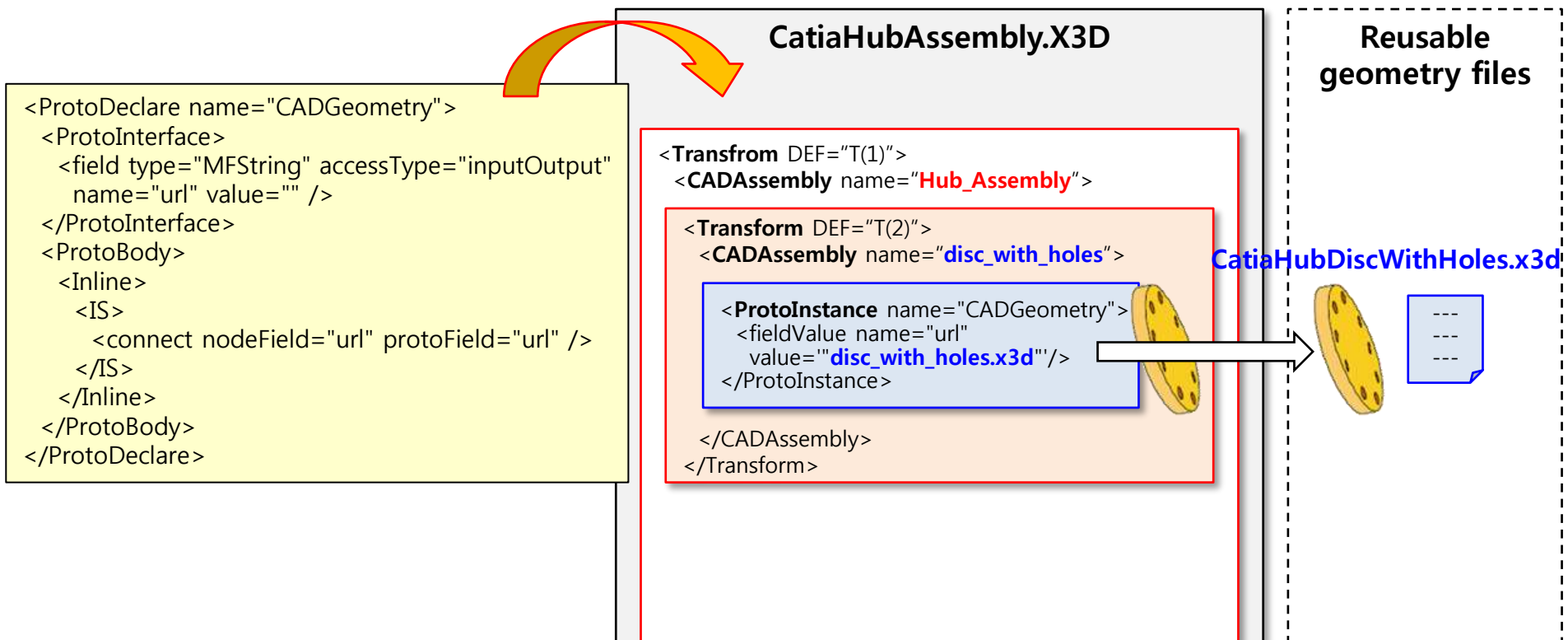
Suggestions

- External referencing of geometry files
 - A. Prototype with Inline
 - B. Inline



Suggestions

- External referencing of geometry files
 - A. Prototype with Inline
 - B. Inline



```

<ProtoDeclare name="CADGeometry">
  <ProtoInterface>
    <field type="MFString" accessType="inputOutput"
      name="url" value="" />
  </ProtoInterface>
  <ProtoBody>
    <Inline>
      <IS>
        <connect nodeField="url" protoField="url" />
      </IS>
    </Inline>
  </ProtoBody>
</ProtoDeclare>

```

CatiaHubAssembly.X3D

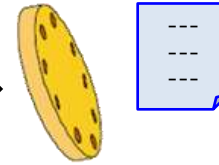
```

<Transform DEF="T(1)">
  <CADAssembly name="Hub Assembly">
    <Transform DEF="T(2)">
      <CADAssembly name="disc_with_holes">
        <ProtoInstance name="CADGeometry">
          <fieldValue name="url"
            value=""disc_with_holes.x3d"" />
        </ProtoInstance>
      </CADAssembly>
    </Transform>
    <Transform DEF="T(3)">
      <CADAssembly name="cap">
        <ProtoInstance name="CADGeometry">
          <fieldValue name="url"
            value=""cap.x3d"" />
        </ProtoInstance>
      </CADAssembly>
    </Transform>
    <Transform DEF="T(4)">
      <CADAssembly name="sleeve_sub_assembly">
        <Transform DEF="T(5)">
          <CADAssembly name="gasket">
            <ProtoInstance name="CADGeometry">
              <fieldValue name="url"
                value=""gasket.x3d"" />
            </ProtoInstance>
          </CADAssembly>
        </Transform>
        <Transform DEF="T(6)">
          <CADAssembly name="cylinder">
            <ProtoInstance name="CADGeometry">
              <fieldValue name="url"
                value=""cylinder.x3d"" />
            </ProtoInstance>
          </CADAssembly>
        </Transform>
      </CADAssembly>
    </Transform>
  </CADAssembly>
</Transform>

```

Reusable geometry files

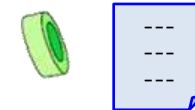
CatiaHubDiscWithHoles.x3d



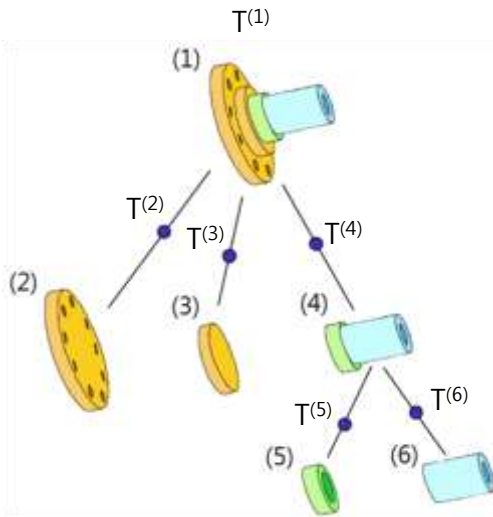
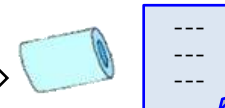
CatiaHubCap.x3d



CatiaHubGasket.x3d



CatiaHubCylinder.x3d



X3D Validation & Viewers

```
Output - X3D Quality Assurance (QA) x Hub_Assembly_proto.x3d x
----- Commence validation checks for Hub_Assembly_proto.x3d -----

Performing DOCTYPE check...
[X3dDoctypeChecker] success: valid XML declaration found: success: final X3D 3.1 DOCTYPE found.

Performing well-formed XML check...
Checking file:/D:/@CAD&VR_Models/Hub_Assmbly/x3d/Hub_Assembly_proto.x3d...
Well-formed XML check: pass

Performing DTD validation...
Checking file:/D:/@CAD&VR_Models/Hub_Assmbly/x3d/Hub_Assembly_proto.x3d...
XML DTD validation: pass

Performing X3D schema validation...
Checking file:/D:/@CAD&VR_Models/Hub_Assmbly/x3d/Hub_Assembly_proto.x3d...
XML schema validation: pass

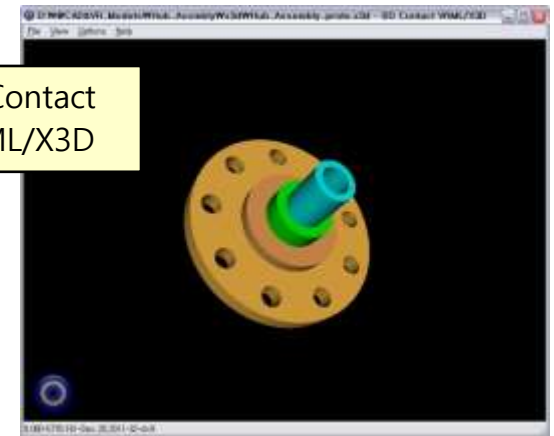
Performing X3dToClassicVrml.xslt conversion check...

Performing X3D regular expression (regex) values check...

Performing X3D Schematron check...

----- Validation checks complete for Hub_Assembly_proto.x3d -----
```

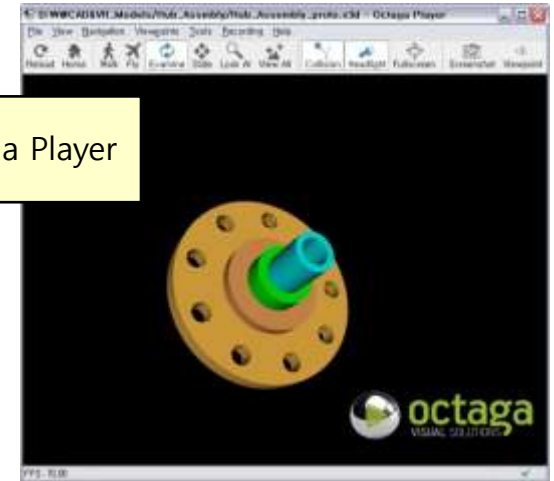
BS Contact
VRML/X3D



Instant Reality



Octaga Player

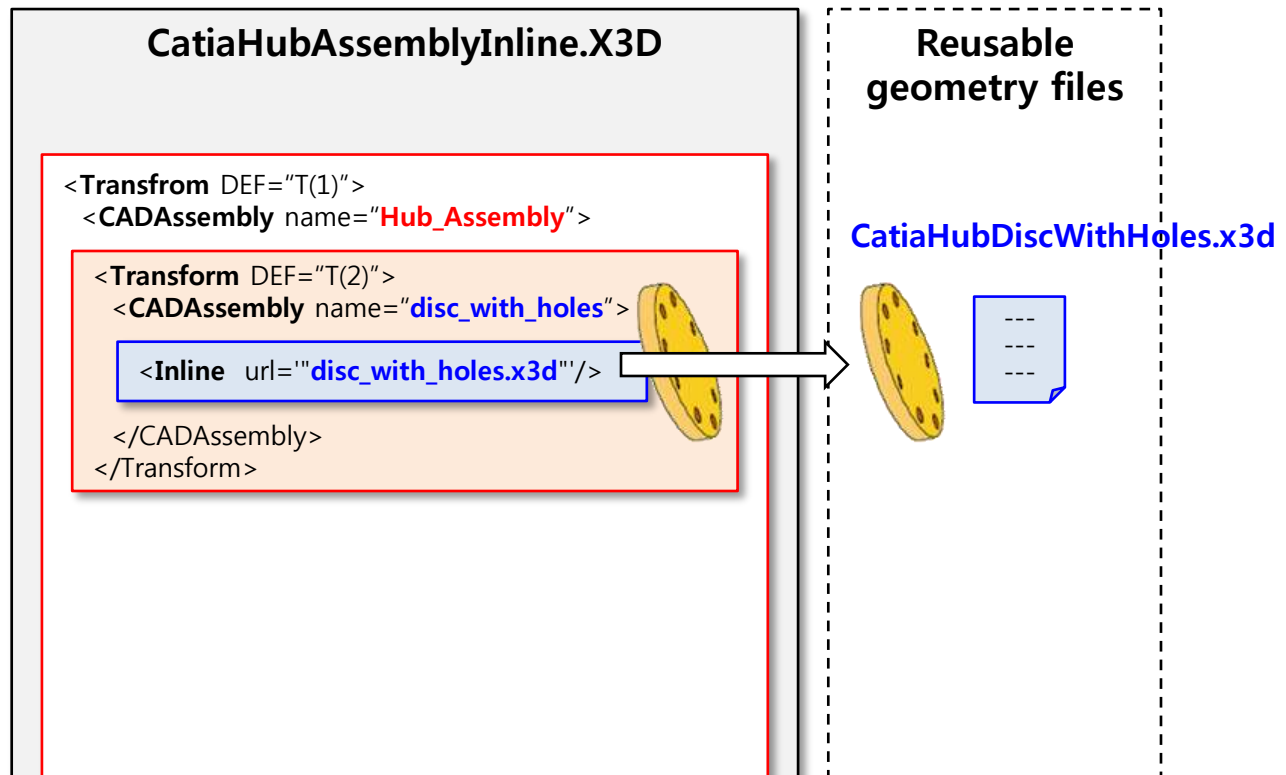


Suggestions

- External referencing of geometry files

A. Prototype with Inline

B. Inline



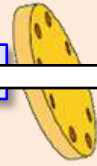
CatiaHubAssemblyInline.X3D

```
<Transform DEF="T(1)">  
<CADAssembly name="Hub_Assembly">
```

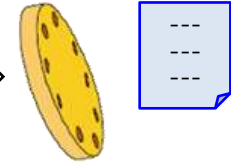
```
<Transform DEF="T(2)">  
<CADAssembly name="disc_with_holes">
```

```
<Inline url="disc_with_holes.x3d"/>
```

```
</CADAssembly>  
</Transform>
```



CatiaHubDiscWithHoles.x3d



```
<Transform DEF="T(3)">  
<CADAssembly name="cap">
```

```
<Inline url="cap.x3d"/>
```

```
</CADAssembly>  
</Transform>
```



CatiaHubCap.x3d



```
<Transform DEF="T(4)">  
<CADAssembly name="sleeve_sub_assembly">
```

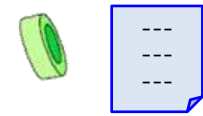
```
<Transform DEF="T(5)">  
<CADAssembly name="gasket">
```

```
<Inline url="gasket.x3d"/>
```

```
</CADAssembly>  
</Transform>
```



CatiaHubGasket.x3d



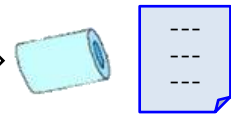
```
<Transform DEF="T(6)">  
<CADAssembly name="cylinder">
```

```
<Inline url="cylinder.x3d"/>
```

```
</CADAssembly>  
</Transform>
```

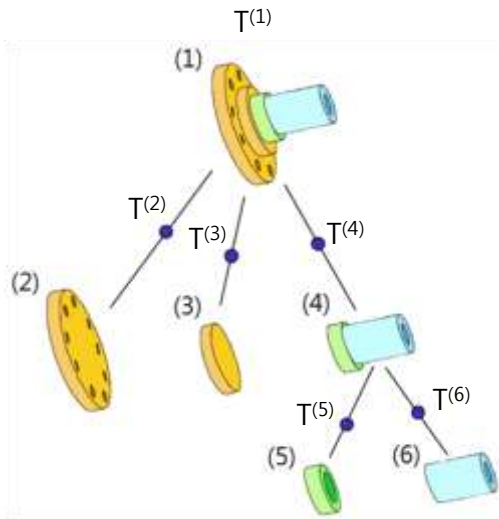


CatiaHubCylinder.x3d



```
</CADAssembly>  
</Transform>
```

```
</CADAssembly>  
</Transform>
```



Reusable geometry files

Heavyweight CAD Data

- **Size (CATIA) : 1,154 MB**
- **# of files : 4054**



```
stl
igs
model
stp
3dmap
3dxml
cgr
hcg
vps
wrl
```

Format	# of files	Size(MB)
3DXML	1	136
HOOPS	1	105
VRML	1	1,136
IGES	1	1,934
STEP	1	1,287
VRML's	3890	491
VRML's (reduced)	3890	427
X3D's	3890	455
X3DB's	3890	65

Thank you!

Hyokwang Lee
adpc9@partdb.com
<http://www.partdb.com>