

CAD to X3D Conversion with CAD Assembly Structure

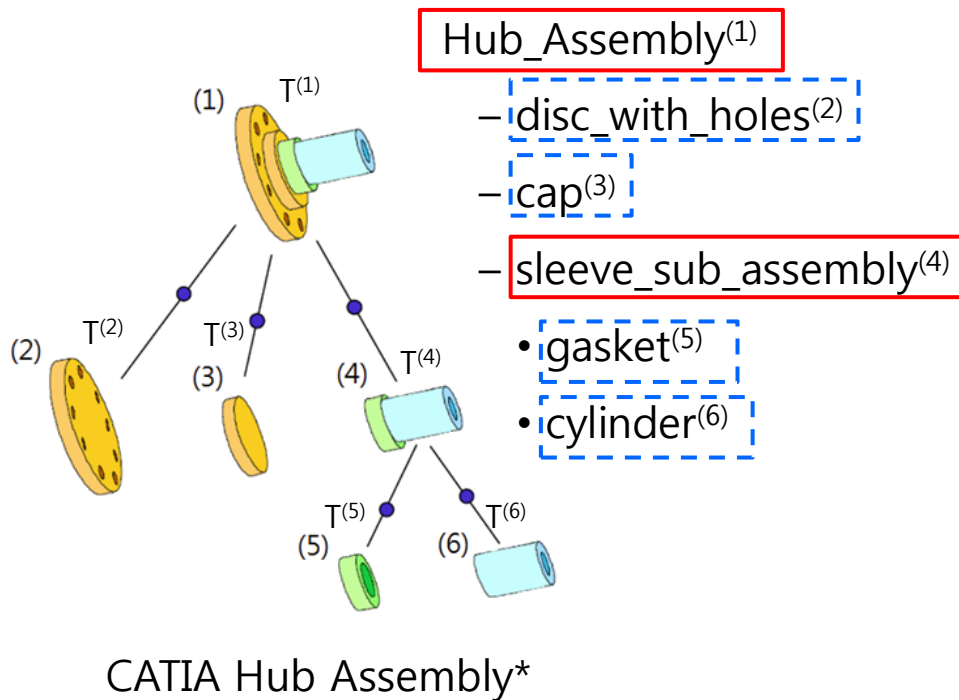
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CAD to X3D conversion with CAD assembly structure

- Conversion of a CATIA CAD assembly, "Hub".
 - Assembly structure information from assembly and sub-assembly
 - Geometry information from parts

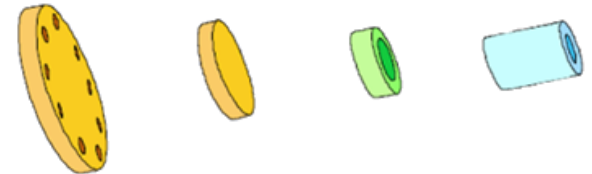


An assembly has

- a transform $[T^{(i)}]$ relative to its parent.
- a link to each child(part/sub-assembly).

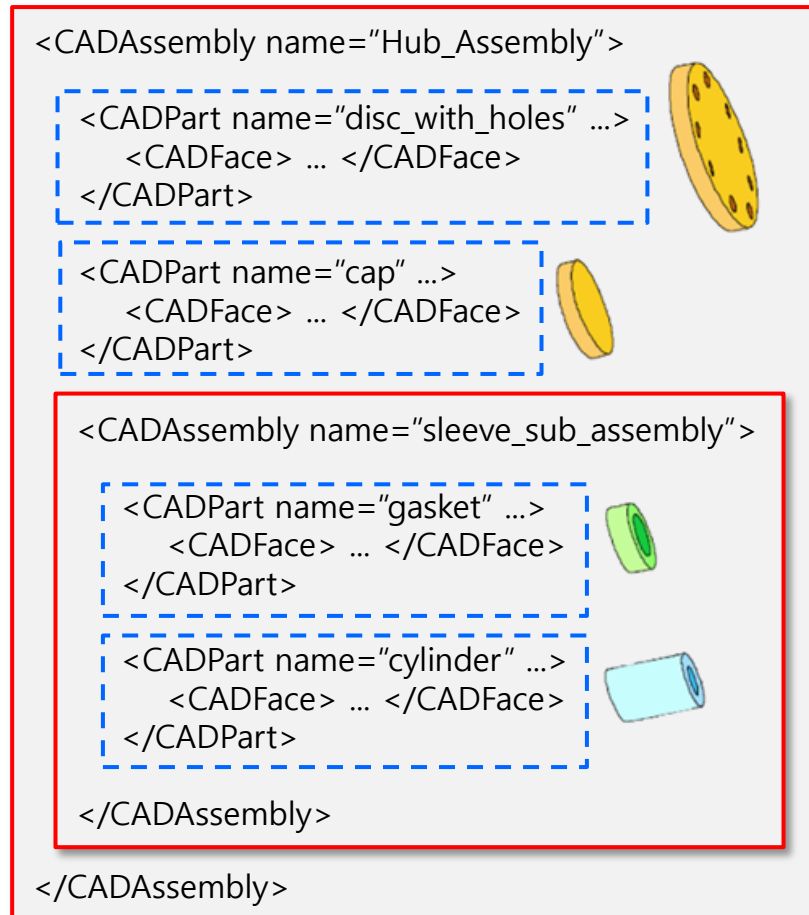
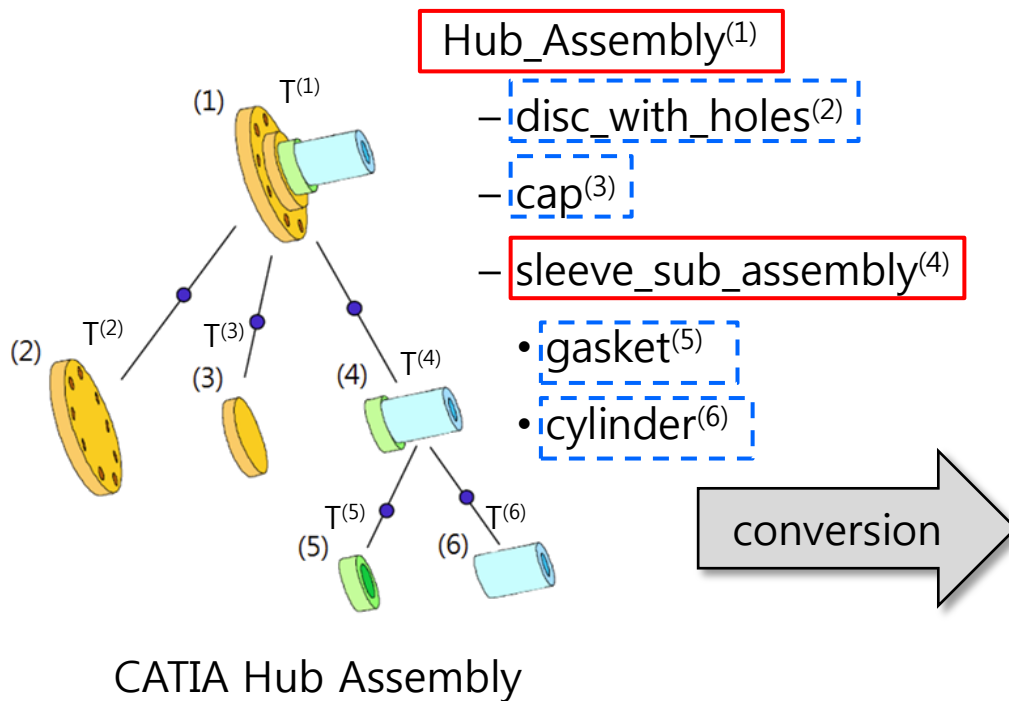
A part have

- a transform $[T^{(i)}]$ relative to its parent.
- geometry information.



Representing CAD assembly structure in X3D

- Representing Hub assembly with CAD geometry component
 - Assembly structure => **CADAssembly, CADPart**
 - Geometry => **CADPart, CADFace**



CAD geometry component

- CADAssembly

```
CADAssembly : X3DGroupingNode, X3DProductStructureChildNode {  
  MFNode [in] addChildren  
  MFNode [in] removeChildren  
  MFNode [in,out] children [] [X3DProductStructureChildNode, X3DGroupingNode]  
  SFNode [in,out] metadata NULL [X3DMetadataObject]  
  SFString [in,out] name ""  
  SFVec3f [] bboxCenter 0 0 0 (-∞, ∞)  
  SFVec3f [] bboxSize -1 -1 -1 [0, ∞) or -1 -1 -1  
}
```

- Each of children will be either a sub-assembly or a part. (CADAssembly or CADPart).

CAD geometry component

- CADPart and CADFace

```
CADPart : X3DGroupingNode, X3DProductStructureChildNode {
  MFNode      [in]      addChildren
  MFNode      [in]      removeChildren
  SFVec3f     [in,out]  center          0 0 0      (-∞,∞)
  MFNode      [in,out]  children        []          [CADFace]
  SFNode      [in,out]  metadata        NULL       [X3DMetadataObject]
  SFString    [in,out]  name            ""
  SFRotation  [in,out]  rotation        0 0 1 0   [-1,1] or (-∞,∞)
  SFVec3f     [in,out]  scale           1 1 1     (0,∞)
  SFRotation  [in,out]  scaleOrientation 0 0 1 0   [-1,1] or (-∞,∞)
  SFVec3f     [in,out]  translation     0 0 0     (-∞,∞)
  SFVec3f     []        bboxCenter      0 0 0     (-∞,∞)
  SFVec3f     []        bboxSize        -1 -1 -1  [0,∞) or -1 -1 -1
}
```

transform-related fields

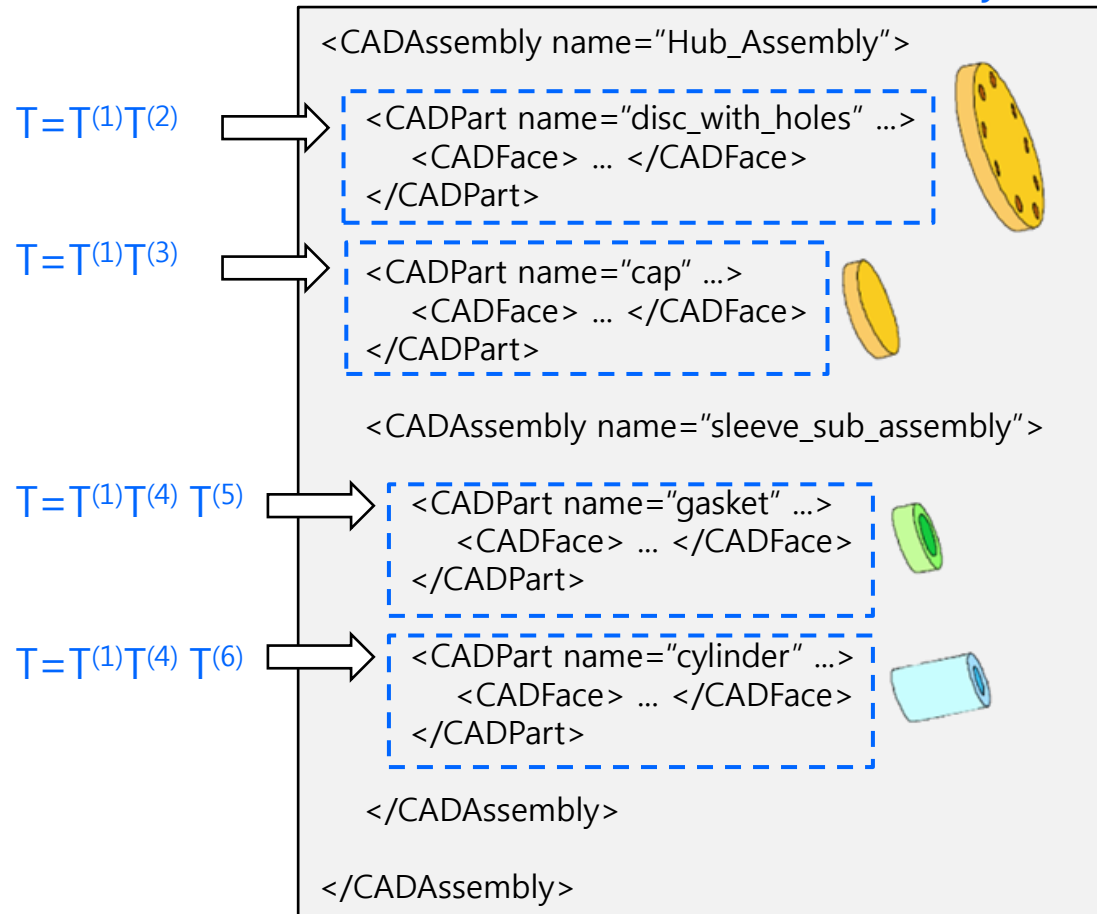
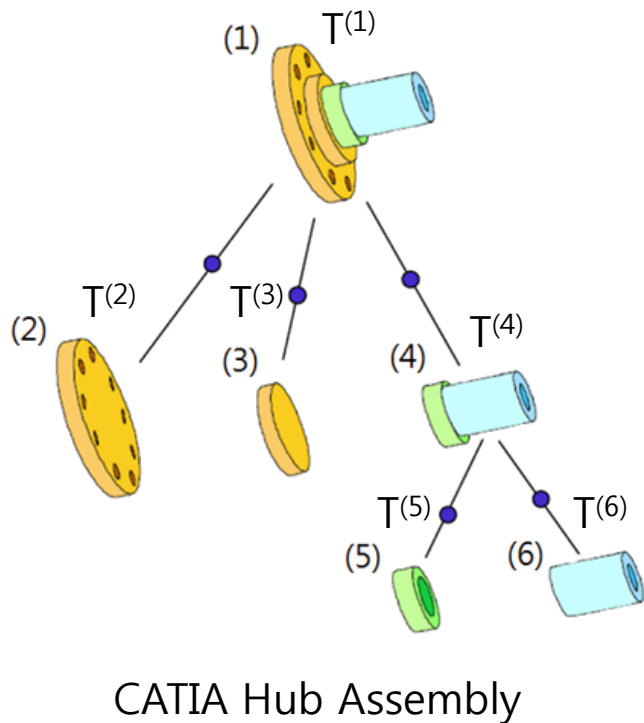
```
CADFace : X3DProductStructureChildNode, X3DBoundedObject {
  SFNode      [in,out]  metadata        NULL       [X3DMetadataObject]
  SFString    [in,out]  name            ""
  SFNode      [in,out]  shape           NULL       [X3DShapeNode, LOD]
  SFVec3f     []        bboxCenter      0 0 0     (-∞,∞)
  SFVec3f     []        bboxSize        -1 -1 -1  [0,∞) or -1 -1 -1
}
```

- The CADFace node holds the geometry representing a face of a part.
- The shape field contains the Shape node providing the geometry and appearance for the face or an LOD node containing different detail levels of the shape.

Representing CAD assembly structure in X3D

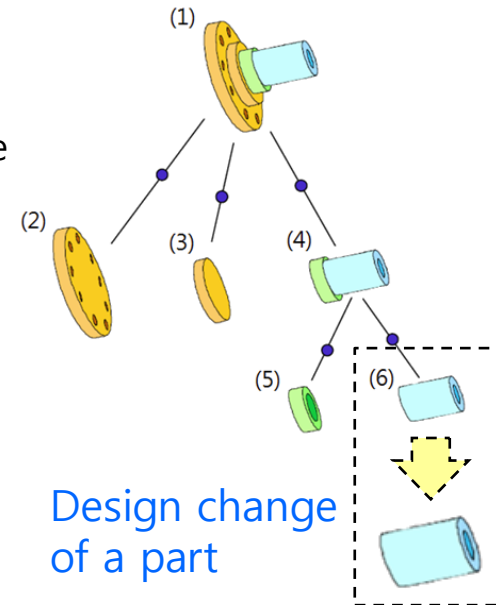
- Representing Hub assembly with CAD geometry component
 - One X3D file for a CAD data.
 - Transform node is provided only in CADPart node.

Hub_Assembly.x3d



Shortcomings of CAD geometry component

- Little practical value of CAD geometry component
 - Low efficiency in updating partial change of design.
 - If a part's design in a CAD assembly is changed, it's not easy to locally apply the partial change of the CAD assembly to the corresponding X3D CAD geometry component, since it has to be converted to a single X3D file.
 - Lacking in reusability
 - A part represented as a CADPart node in an assembly is generally nonreusable, because it is physically written as a section in an X3D file, and its transform data is not relative to its parent node but to the root node of the assembly.

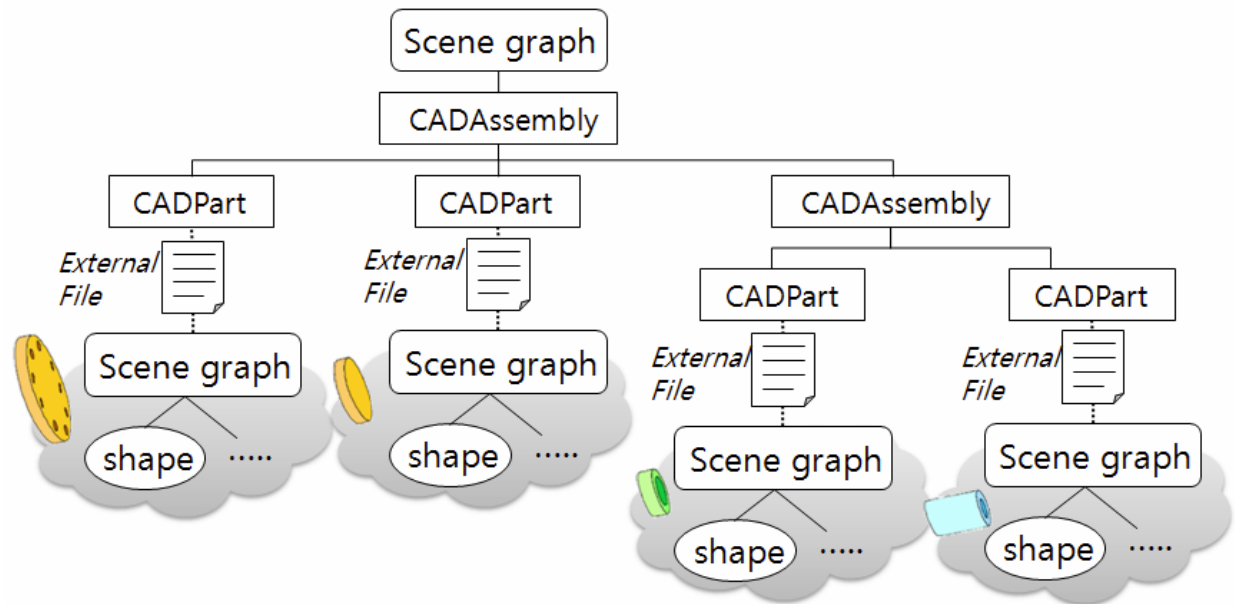
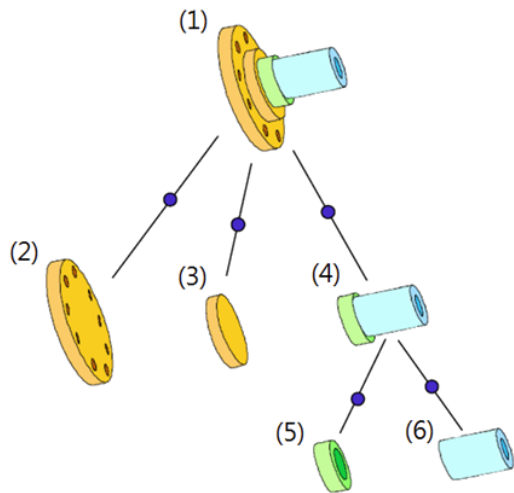


Suggestions

- Providing transform-related fields in CADAssembly
- External file referencing for geometry data

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Assembly structure represented with the suggested method*

* Guimok Cho, "Translation of 3D CAD Data to X3D Dataset Maintaining Product Structure for Web-based Visualization", Master Thesis, Chungnam National Univ., Feb. 2011.

Suggestions

- Providing transform-related fields in CADAssembly

```
CADAssembly : X3DGroupingNode, X3DProductStructureChildNode {  
  MFNode      [in]      addChildren  
  MFNode      [in]      removeChildren  
  MFNode      [in,out]  children      []      [X3DProductStructureChildNode, X3DGroupingNode]  
  SFNode      [in,out]  metadata      NULL    [X3DMetadataObject]  
  SFString    [in,out]  name " "  
  SFRotation  [in,out]  rotation      0 0 1 0 [-1,1] or (-∞,∞)  
  SFVec3f     [in,out]  scale          1 1 1   (0,∞)  
  SFRotation  [in,out]  scaleOrientation 0 0 1 0 [-1,1] or (-∞,∞)  
  SFVec3f     [in,out]  translation    0 0 0   (-∞,∞)  
  SFVec3f     []        bboxCenter     0 0 0   (-∞,∞)  
  SFVec3f     []        bboxSize       -1 -1 -1 [0,∞) or -1 -1 -1  
}
```

transform-related fields

Suggestions

- External file referencing for geometry data in CADPart or in CADFace

```
CADPart : X3DGroupingNode, X3DProductStructureChildNode {
  MFNode      [in]      addChildren
  MFNode      [in]      removeChildren
  SFVec3f     [in,out]  center          0 0 0    (-∞, ∞)
  MFNode      [in,out]  children        []        [CADFace, Inline]
  SFNode      [in,out]  metadata        NULL      [X3DMetadataObject]
  SFString    [in,out]  name            ""
  SFRotation  [in,out]  rotation        0 0 1 0  [-1,1] or (-∞, ∞)
  SFVec3f     [in,out]  scale            1 1 1    (0, ∞)
  SFRotation  [in,out]  scaleOrientation 0 0 1 0  [-1,1] or (-∞, ∞)
  SFVec3f     [in,out]  translation      0 0 0    (-∞, ∞)
  SFVec3f     []        bboxCenter      0 0 0    (-∞, ∞)
  SFVec3f     []        bboxSize        -1 -1 -1 [0, ∞) or -1 -1 -1
}
```

```
CADFace : X3DProductStructureChildNode, X3DBoundedObject {
  SFNode      [in,out]  metadata        NULL      [X3DMetadataObject]
  SFString    [in,out]  name            ""
  SFNode      [in,out]  shape           NULL      [X3DShapeNode, LOD, Inline]
  SFVec3f     []        bboxCenter      0 0 0    (-∞, ∞)
  SFVec3f     []        bboxSize        -1 -1 -1 [0, ∞) or -1 -1 -1
}
```

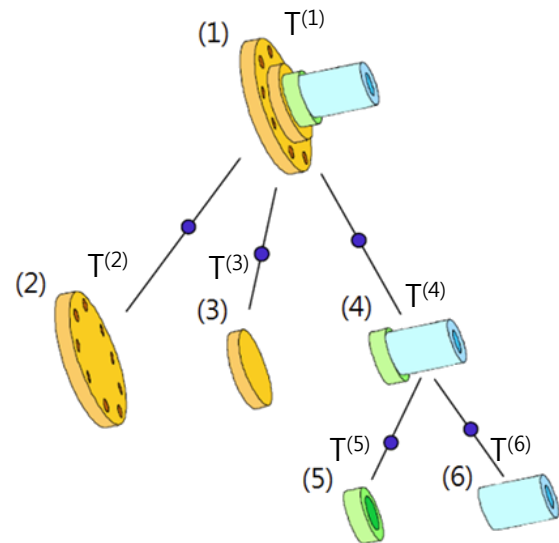
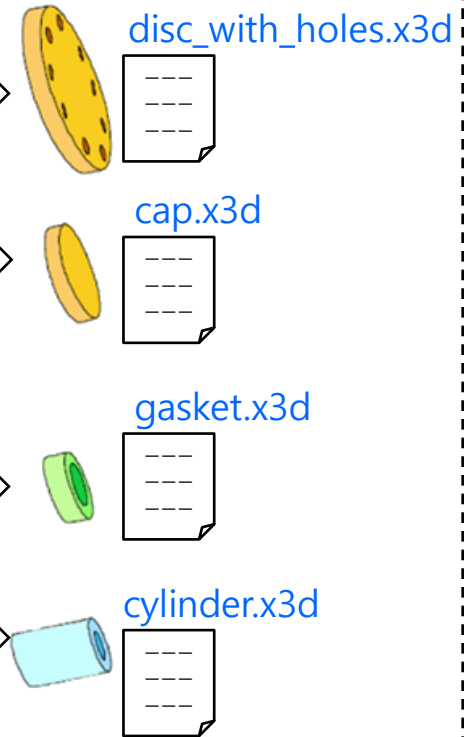
Suggestions

- External file referencing for geometry data

Hub_Assembly.x3d

```
<CADAssembly name="Hub_Assembly">  
  <CADPart name="disc_with_holes" ...>  
    <CADFace> ... </CADFace>  
  </CADPart>  
  <CADPart name="cap" ...>  
    <CADFace> ... </CADFace>  
  </CADPart>  
  <CADAssembly name="sleeve_sub_assembly">  
    <CADPart name="gasket" ...>  
      <CADFace> ... </CADFace>  
    </CADPart>  
    <CADPart name="cylinder" ...>  
      <CADFace> ... </CADFace>  
    </CADPart>  
  </CADAssembly>  
</CADAssembly>
```

Reusable geometry files



Thank you!

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<http://www.partdb.com>