X3D Unit Specification Updates

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Units Specification

- ISO_IEC_19775_1_2008_WD3_Am1_2011_04_14
- PDAM in ISO progress

- UNIT statement
  - Defined in Core component
  - UNIT statements may only be contained in X3D worlds created for X3D version 3.3 or later
- Definition of UNIT statement
  - UNIT <category> <name> <conversion_factor>

Standard Units

Category	Initial base unit
angle	radian
force	newton
length	metre
mass	kilogram

Derived Units

Category	Initial base unit
acceleration	length/second^2
angular_rate	angle/second
area	length^2
speed	length/second
volume	length^3

Schema Extension for Units

```
<xs:element name="head">
  <xs:complexType>
    <xs:complexContent>
      <xs:extension base="SceneGraphStructureNodeType">
        <xs:sequence>
          <xs:element ref="component" minOccurs="0" maxOccurs="unbounded"/>
          <xs:element ref="unit" minOccurs="0" maxOccurs="unbounded"/>
          <xs:element ref="meta" minOccurs="0" maxOccurs="unbounded"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
</xs:element>
```

```xml
<xs:element name="unit">
  <xs:annotation>
    <xs:appinfo/>
    <xs:documentation source="http://www.web3d.org/specifications/ISO-IEC-
    19776.../Part01/core.html#UNITStatement"/>
  </xs:annotation>
  <xs:complexType mixed="false">
    <xs:complexContent mixed="false">
      <xs:extension base="SceneGraphStructureNodeType">
        <xs:attribute name="category" type="UnitCategoryType" use="required"/>
        <xs:attribute name="name" type="UnitNameType" use="required"/>
        <xs:attribute name="conversion_factor" type="SFDouble" use="optional" default="1"/>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
</xs:element>
```

```xml
<xs:simpleType name="UnitCategoryType">
 <xs:annotation>
  <xs:documentation>defines a type of unit category as a union of standard unit category and
    derived unit category</xs:documentation>
 </xs:annotation>
 <xsd:union memberTypes="StandardUnitCategoryType DerivedUnitCategoryType/>
</xs:simpleType>

<xs:simpleType name="UnitNameType">
 <xs:annotation>
  <xs:documentation>defines a type of unit name as a union of standard unit name and derived
    unit name</xs:documentation>
 </xs:annotation>
 <xsd:union memberTypes="StandardUnitNameType DerivedUnitNameType/>
</xs:simpleType>
```

```xml
<xs:simpleType name="StandardUnitCategoryType">
 <xs:annotation>
  <xs:documentation>defines a type of standard unit category</xs:documentation>
 </xs:annotation>
 <xs:restriction base="SFString">
  <xs:enumeration value="angle"/>
  <xs:enumeration value="force"/>
  <xs:enumeration value="length"/>
  <xs:enumeration value="mass"/>
 </xs:restriction>
</xs:simpleType>
 <xs:simpleType name="DerivedUnitCategoryType">
 <xs:annotation>
  <xs:documentation>defines a type of derived unit category</xs:documentation>
 </xs:annotation>
 <xs:restriction base="SFString">
  <xs:enumeration value="acceleration"/>
  <xs:enumeration value="angular_rate"/>
  <xs:enumeration value="area"/>
  <xs:enumeration value="speed"/>
  <xs:enumeration value="volume"/>
 </xs:restriction>
</xs:simpleType>
```

```xml
<xs:simpleType name="StandardUnitNameType">
 <xs:annotation>
   <xs:documentation>defines a type of standard unit name</xs:documentation>
 </xs:annotation>
 <xs:restriction base="SFString">
  <xs:enumeration value="radian"/>
  <xs:enumeration value="newton"/>
  <xs:enumeration value="metre"/>
  <xs:enumeration value="kilogram"/>
 </xs:restriction>
</xs:simpleType>

<xs:simpleType name="DerivedUnitNameType">
 <xs:annotation>
   <xs:documentation>defines a type of derived unit name</xs:documentation>
 </xs:annotation>
 <xs:restriction base="SFString">
  <xs:enumeration value="metre/second2"/>
  <xs:enumeration value="radian/second"/>
  <xs:enumeration value="metre2"/>
  <xs:enumeration value="metre/second"/>
  <xs:enumeration value="metre3"/>
 </xs:restriction>
</xs:simpleType>
```
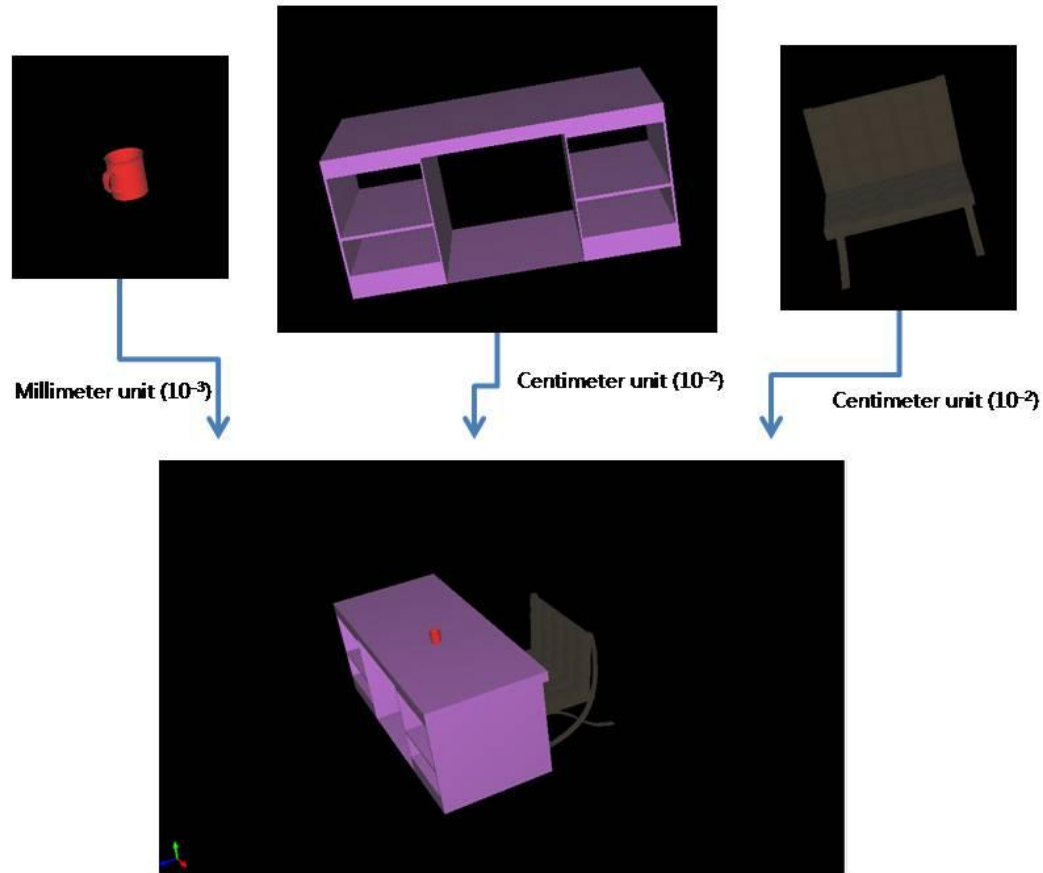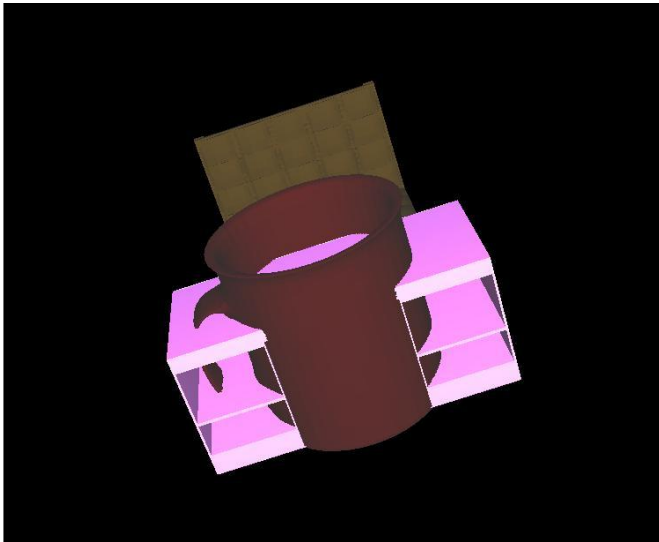
X3D v3.3 XML Schema and DTD

- http://www.web3d.org/specifications/contents.html
- http://x3d.svn.sourceforge.net/viewvc/x3d/www.web3d.org/specifications
- http://www.web3d.org/specifications/x3d-3.3.xsd
- http://www.web3d.org/specifications/x3d-3.3.dtd
- Documentation for each is also posted with each update, online at
  http://www.web3d.org/specifications/X3dSchemaDocumentation3.3.html
  http://www.web3d.org/specifications/X3dDoctypeDocumentation3.3.html
- Change logs are maintained at:
  http://www.web3d.org/specifications/x3d-schema-changelog.txt
  http://www.web3d.org/specifications/x3d-dtd-changelog.txt

- > X3D Schema update activity:
  > 19 July 2011, brutzman
  > - added unit statement (similar to component statement) and MetadataBoolean

Length Unit X3D Example (1)

Millimeter unit (10^{-3})

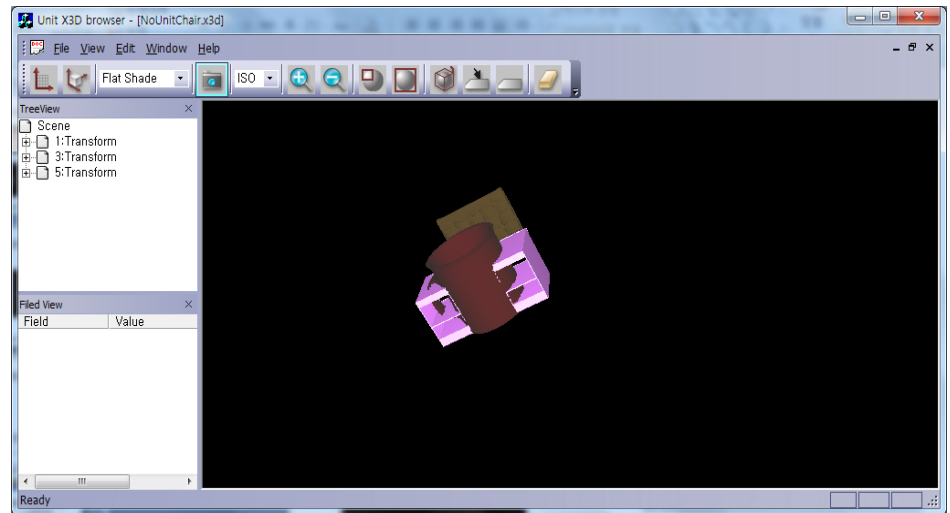Centimeter unit (10^{-2})

Centimeter unit (10^{-2})

Length Unit X3D Example (2)

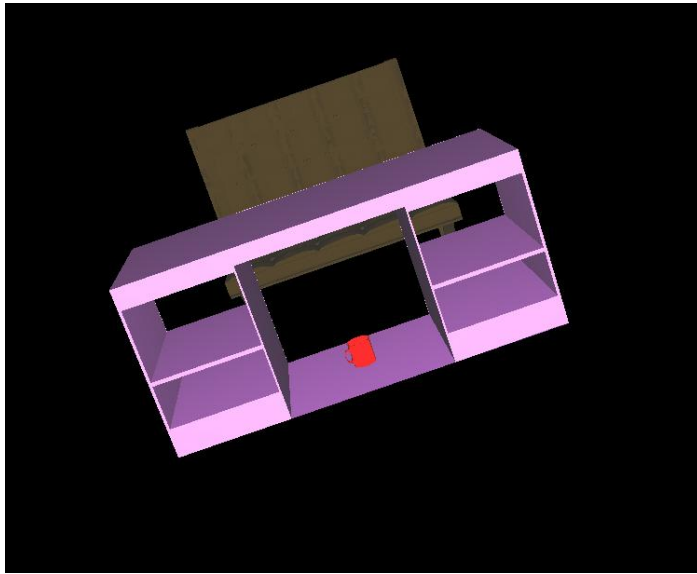Before length units specification

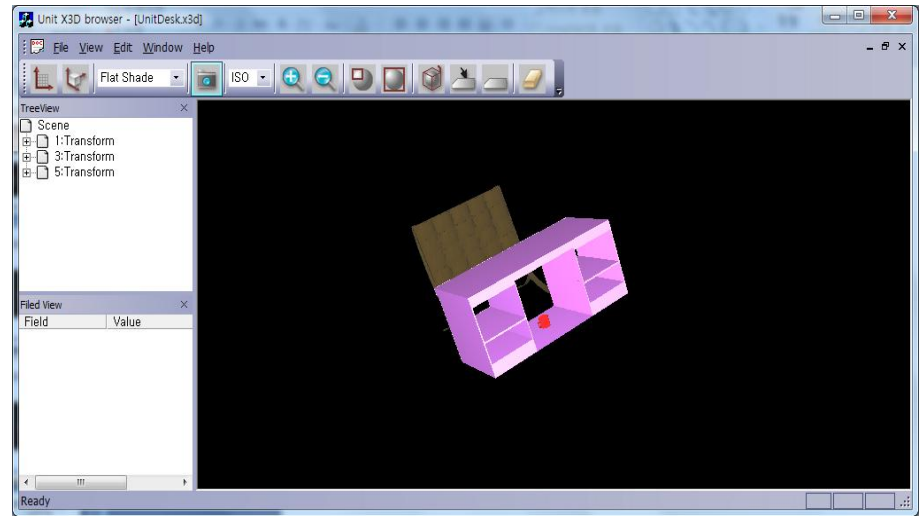Unit browser using no unit specification

Length Unit X3D Example (2)

After length units specification

Unit browser using unit specification

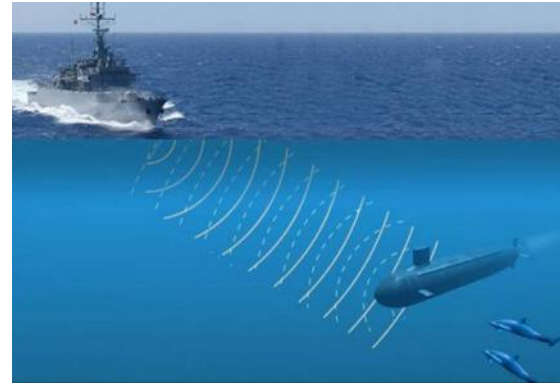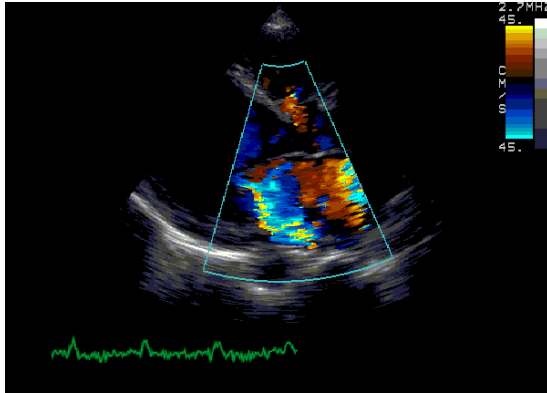# Other Units and Examples (1)

- Area

Other Units and Examples (2)

- Volume

Other Units and Examples (3)

- Sound

Conclusions

- Schema extension for units specification

- Other units consideration
  - SI base units
    - Sound: necessary for medical, and e-learning scientific data representation
    - Luminous intensity, electric current, temperature: necessary for e-learning scientific data representation

- Unit X3D Viewer Program
  - a distribution version: MS Windows

X3D 3.3 Schema for Units (1)

```
<xs:simpleType name="unitCategories">
<xs:annotation>
<xs:appinfo>unitValues are allowed enumeration values for standard and derived units for the
    UNIT statement.</xs:appinfo>
 <xs:documentation
    source="http://igraphics.com/Standards/ISO_IEC_19775_1_2_PDAM1_Candidate_2011_05_
    12/Part01/concepts.html#t-Standardunits" />
 </xs:annotation>
 <xs:restriction base="xs:token">
 <xs:enumeration value="angle" />
 <xs:enumeration value="force" />
 <xs:enumeration value="length" />
 <xs:enumeration value="mass" />
 <xs:enumeration value="acceleration" />
 <xs:enumeration value="angular_rate" />
 <xs:enumeration value="area" />
 <xs:enumeration value="speed" />
 <xs:enumeration value="volume" />
</xs:simpleType>
```

X3D 3.3 Schema for Units (2)

```
<xs:element name="unit">
<xs:annotation>
 <xs:appinfo />
 <xs:documentation
    source="http://igraphics.com/Standards/ISO_IEC_19775_1_2_PDAM1_Candidate_2011_05_
    12/Part01/components/core.html#UNITStatement" />
 </xs:annotation>
 <xs:complexType mixed="false">
 <xs:complexContent mixed="false">
 <xs:extension base="SceneGraphStructureNodeType">
 <xs:attribute name="category" type="unitCategories" use="required" />
 <xs:attribute name="name" type="xs:NMTOKEN" use="required" />
 <xs:attribute name="conversionFactor" use="required">
 <xs:simpleType>
 <xs:restriction base="SFDouble">
 <xs:minExclusive value="0" />
</xs:restriction>
</xs:simpleType>
</xs:attribute>
```

```
</xs:extension>
</xs:complexContent>
</xs:complexType>
</xs:element>


<xs:element name="head">
<xs:complexType>
<xs:complexContent>
<xs:extension base="SceneGraphStructureNodeType">
<xs:sequence>
<xs:element ref="component" minOccurs="0" maxOccurs="unbounded" />
<xs:element ref="unit" minOccurs="0" maxOccurs="unbounded" />
<xs:element ref="meta" minOccurs="0" maxOccurs="unbounded" />
</xs:sequence>
</xs:extension>
</xs:complexContent>
</xs:complexType>
</xs:element>
```