STEAMVR™
Tracking Training

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Tracking Training

Extracting Sensor Data from 3D CAD

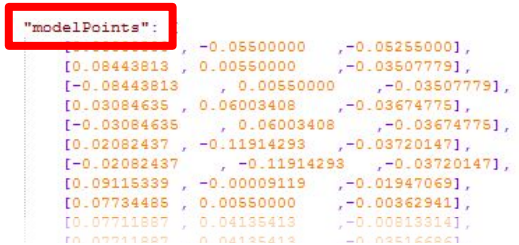
VALVE

Introduction

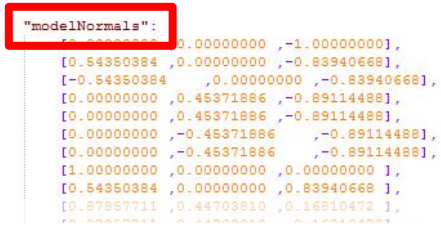
- Creating a JSON file is an important part of the sensor placement process
- Manual creation of JSON files
  - Good for prototyping
  - Easy to use when the number of sensors is small
  - Time consuming
  - Error prone
- Automated creation of JSON files
  - Eliminates most human error
  - Fast
  - Difficult to work with universal file types (STEP, X_T, IGES, etc)
  - Program likely needs to be written for each CAD package

Creating a JSON for hmd_designer

- Location of sensor centroid
  - x, y, and z parameters determine position
  - Expressed in meters



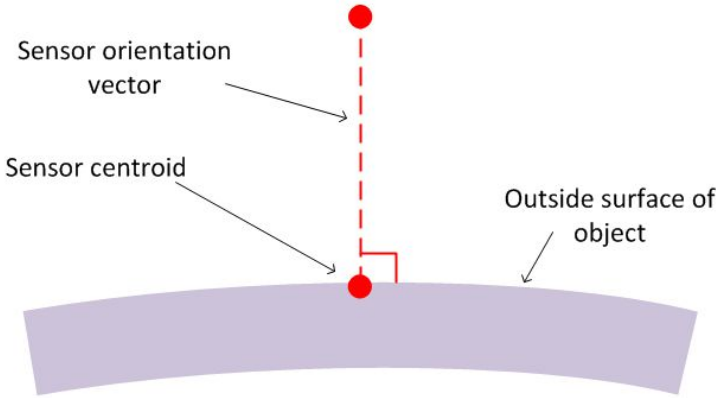
- Sensor orientation
  - Vector that has a direction indicating the center of the sensor viewing area
  - Unit vector with length of 1



- Channel map not required. Can be added though if specific sensor identifiers are desired.

Manual Extraction from 3D CAD

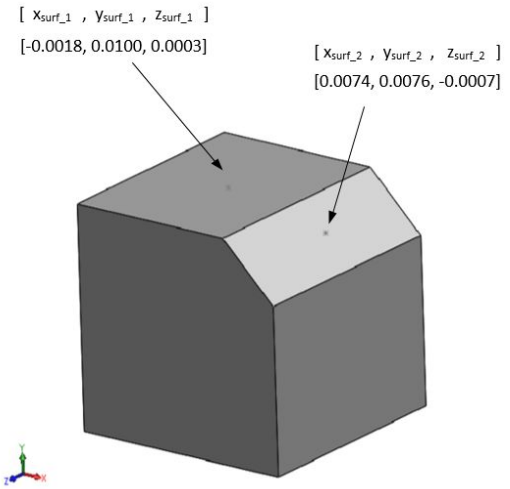
- Indicate the location of the sensor centroid
  - Need to be able to measure the absolute position of the centroid relative to the origin
  - A point usually works well
  - Usually on outside surface of part
- Indicate the direction the sensors are facing
  - Extend a line from the sensor centroid point in the desired direction
  - Line is usually perpendicular to the surface
  - Length of line not important



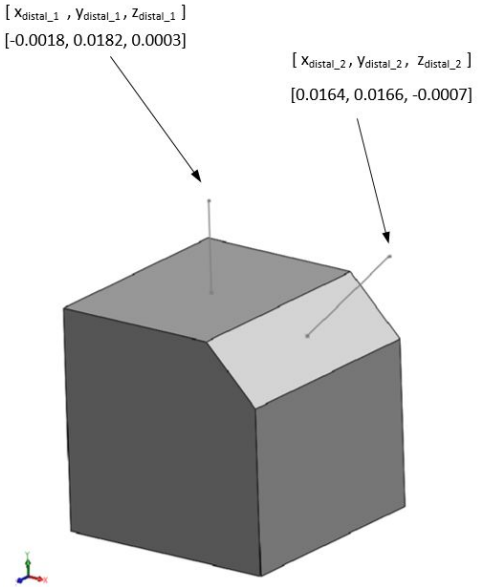
Manual Extraction from 3D CAD

- Measure the absolute positions

Sensor centroids



End of sensor orientation line



Manual Extraction from 3D CAD

- Calculate the normalized vector components for the orientation line

$$x_{normal} = \frac{x_{distal} - x_{surf}}{\sqrt{(x_{distal} - x_{surf})^2 + (y_{distal} - y_{surf})^2 + (z_{distal} - z_{surf})^2}}$$

$$y_{normal} = \frac{y_{distal} - y_{surf}}{\sqrt{(x_{distal} - x_{surf})^2 + (y_{distal} - y_{surf})^2 + (z_{distal} - z_{surf})^2}}$$

$$z_{normal} = \frac{z_{distal} - z_{surf}}{\sqrt{(x_{distal} - x_{surf})^2 + (y_{distal} - y_{surf})^2 + (z_{distal} - z_{surf})^2}}$$

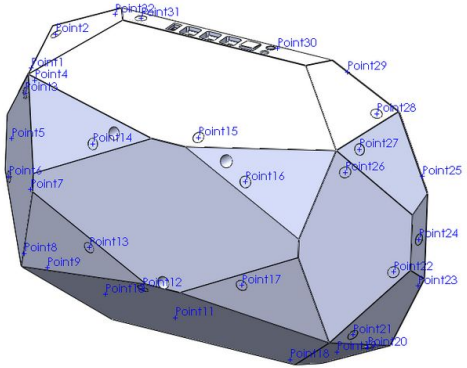
- Enter the centroid locations and normalized orientation vector components into JSON file

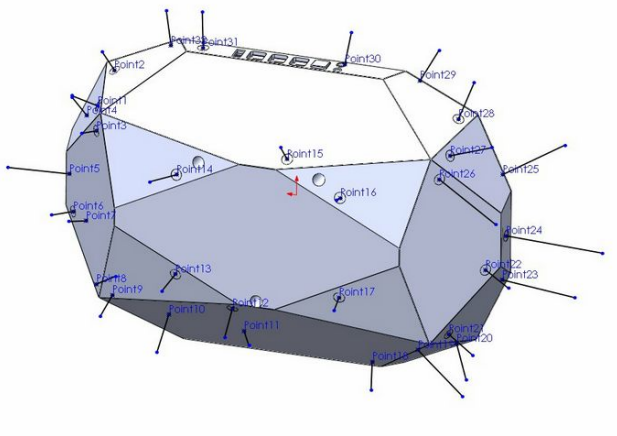
```
"modelPoints" : [
        [ xsurf_1, ysurf_1, zsurf_1 ],
        [ xsurf_2, ysurf_2, zsurf_2]
    ]
```

```
"modelNormals" : [
        [ xnormal_1, ynormal_1, znormal_1 ],
        [ xnormal_2, ynormal_2, znormal_2 ]
    ]
```

Automated Extraction from Solidworks

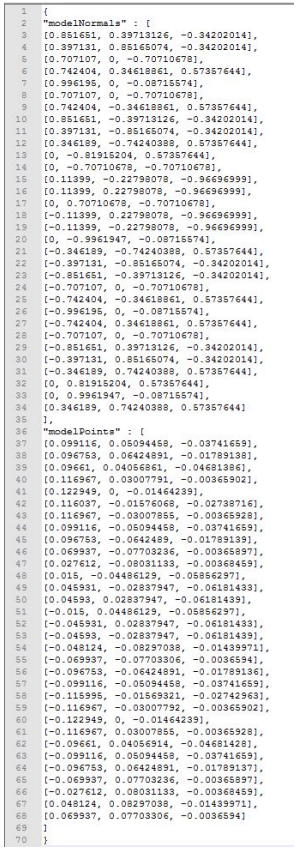
- Add macro to Solidworks
- Create a 3D Sketch
  - Indicate sensor centroid with sketch points
  - Indicate the sensor orientation with a sketch segment
  - Make the sketch segment normal to the face





Automated Extraction from Solidworks

- Save the Solidworks file
- Select 3D Sketch in the Feature Tree and run the macro
- A JSON file will be created with the same name as the Solidworks file and in the same directory



```
{
"modelNormals" : [
[0.851651, 0.39713126, -0.34202014],
[0.397131, 0.85165074, -0.34202014],
[0.707107, 0, -0.70710678],
[0.742404, 0.34618861, 0.57357644],
[0.996196, 0, -0.08715574],
[0.707107, 0, -0.70710678],
[0.742404, -0.34618861, 0.57357644],
[0.851651, -0.39713126, -0.34202014],
[0.397131, -0.85165074, -0.34202014],
[0.346189, -0.74240388, 0.57357644],
[0, -0.81915204, 0.57357644],
[0, -0.70710678, -0.70710678],
[0.11399, -0.22798078, -0.96696999],
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[0, -0.9961947, -0.08715574],
[-0.346189, -0.74240388, 0.57357644],
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[0, 0.81915204, 0.57357644],
[0, 0.9961947, -0.08715574],
[0.346189, 0.74240388, 0.57357644]
],
"modelPoints" : [
[0.099116, 0.05094458, -0.03741659],
[0.096753, 0.06424891, -0.01789138],
[0.09661, 0.04056861, -0.04681386],
[0.116967, 0.03007791, -0.00365902],
[0.122949, 0, -0.01464239],
[0.116037, -0.01576068, -0.02738716],
[0.116967, -0.03007855, -0.00365928],
[0.099116, -0.05094458, -0.03741659],
[0.096753, -0.0642489, -0.01789139],
[0.069937, -0.07703236, -0.00365897],
[0.027612, -0.08031133, -0.00368459],
[0.015, -0.04486129, -0.05856297],
[0.045931, -0.02837947, -0.06181433],
[0.04593, 0.02837947, -0.06181433],
[-0.015, 0.04486129, -0.05856297],
[-0.045931, 0.02837947, -0.06181433],
[-0.04593, -0.02837947, -0.06181439],
[-0.048124, -0.08297038, -0.01439971],
[-0.069937, -0.07703306, -0.0036594],
[-0.096753, -0.06424891, -0.01789136],
[-0.099116, -0.05094458, -0.03741659],
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[0.048124, 0.08297038, -0.01439971],
[0.069937, 0.07703306, -0.0036594]
]
}
```

JSON File Verification

- Open the JSON to verify it was built correctly
  - Confirm there is a modelNormals section
  - Confirm there is a modelPoints section
  - Make sure there are no null vectors in the modelNormals array
  - Make sure the number of elements in each array is the same
- Visualize in hmd_designer
  - Export 3D object as an STL file
  - Load STL and JSON into hmd_designer
  - Confirm the sensors are in the correct position
  - Make sure the green sensor face is oriented outwards