LISE ARIS 3D-Envelope: Panel Development

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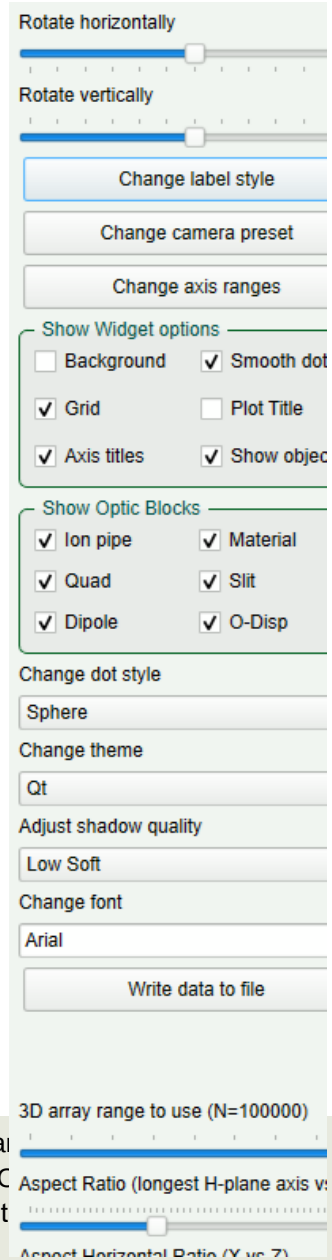
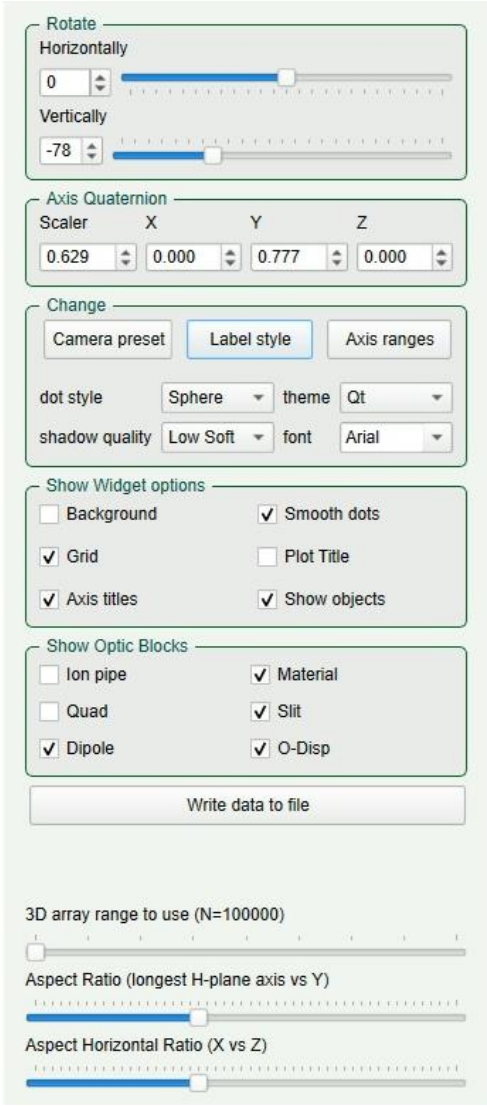
Panel Optimization

Previous design

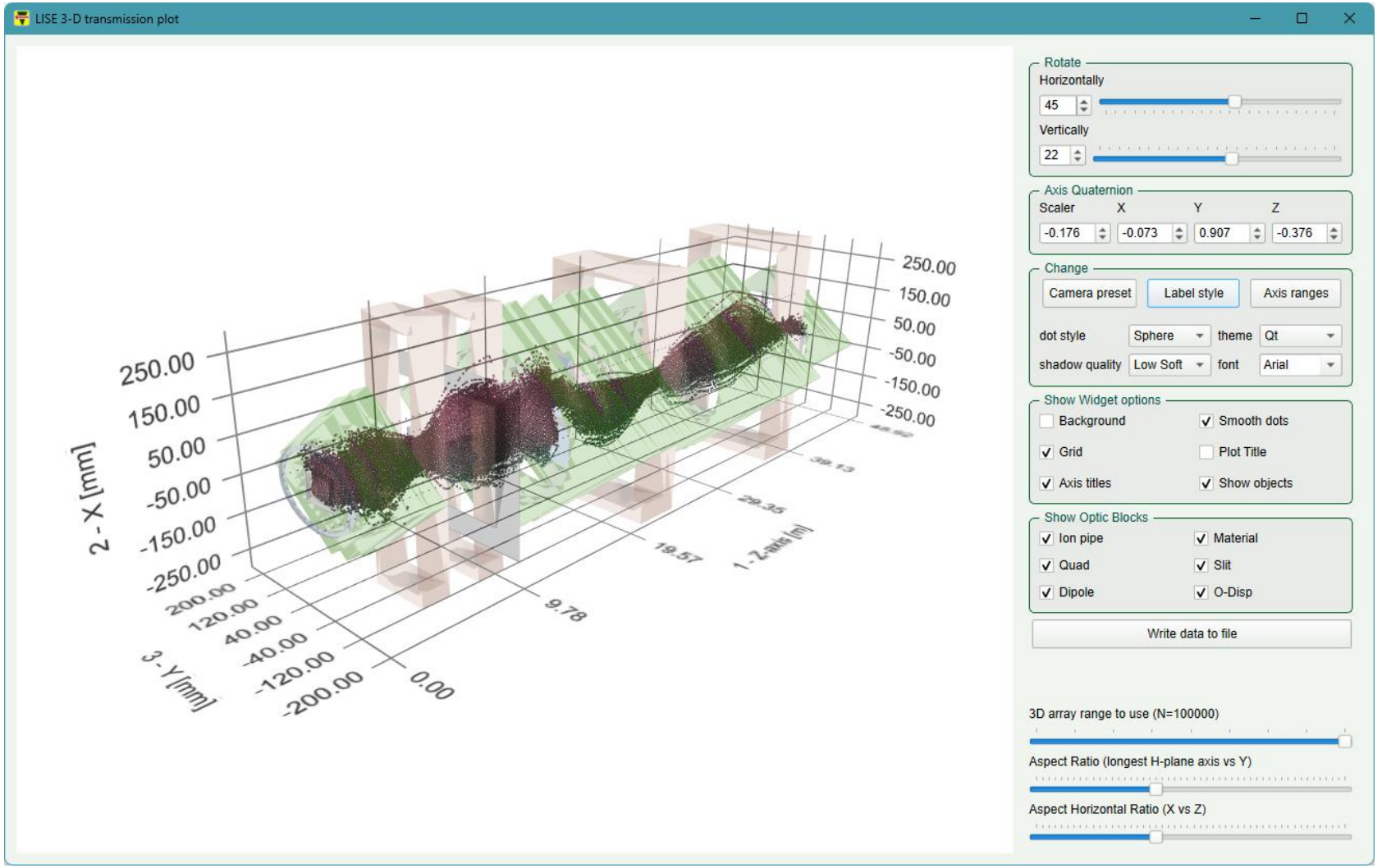


Optimized design with additional features

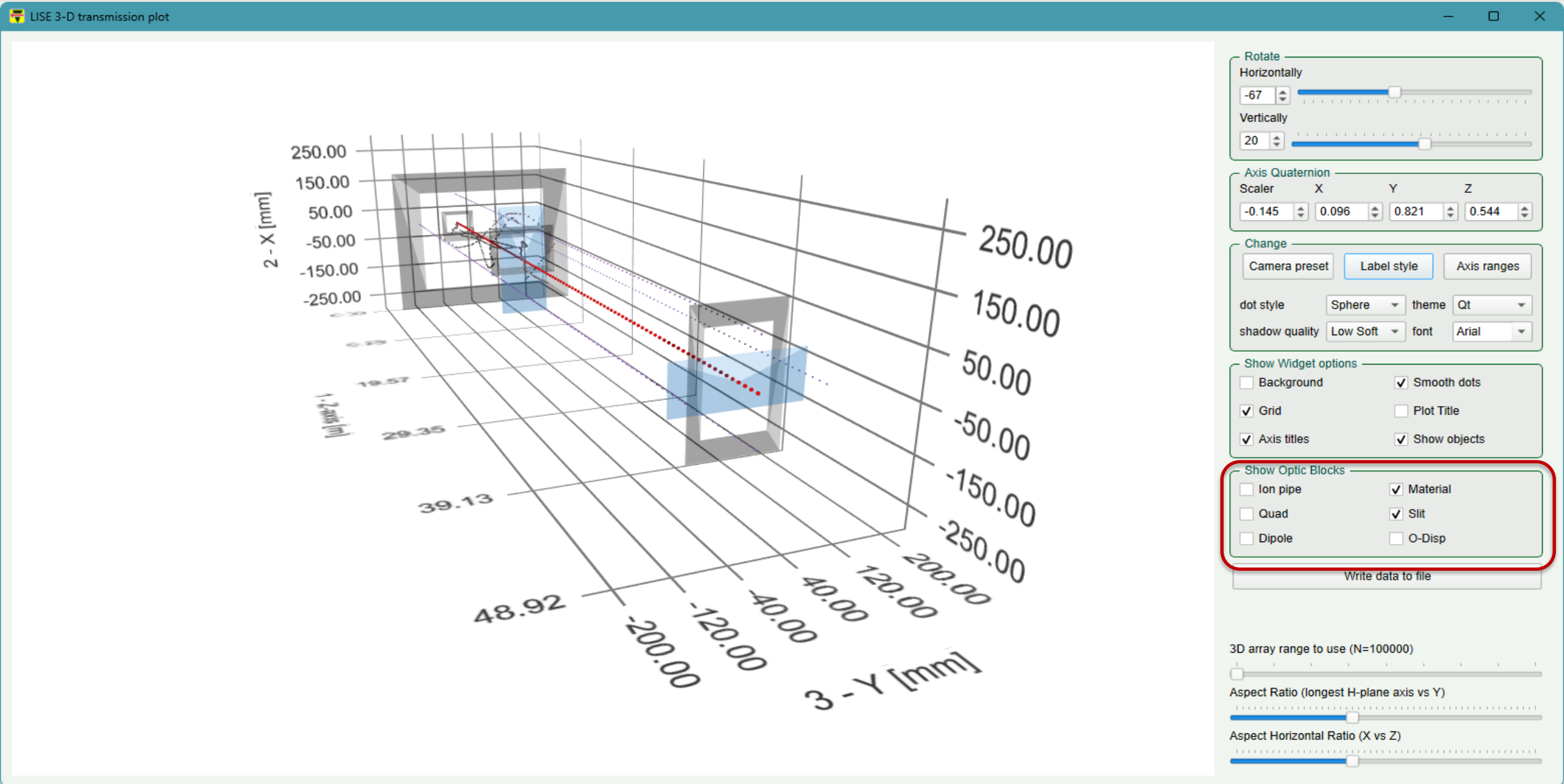


New Features

- Panning of the graph using the left mouse button
- Value input to adjust the angle of the graph, as well as arrows to increment.
- Axis Quaternion input boxes implemented to specify 3D rotation using quaternions.
- Angle of the graph updates the panel values and sliders in real time.
- Synchronization of manual rotation controls and quaternion-based camera orientation.

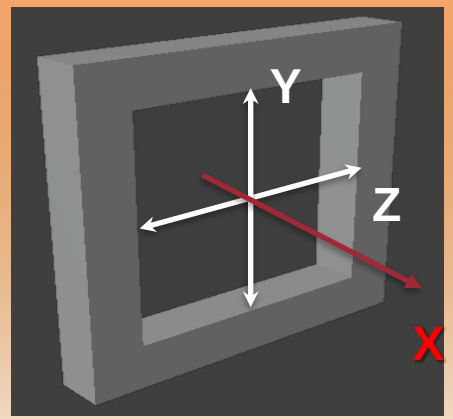


Plotting selected optic blocks



3D Separator Blocks Update (1)

Slit

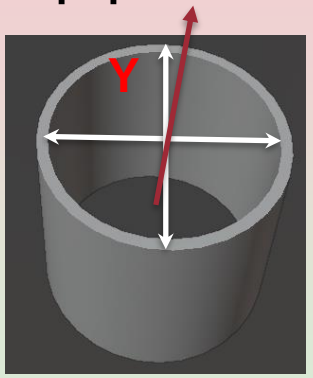


NEW
Length (thick) X = 0.02 m
Inner size Y & Z = 0.10 m
Outer size Y & Z = 0.14 m

Old

Dimensions:	
X	0.02 m
Y	0.14 m
Z	0.14 m

Ion pipe X

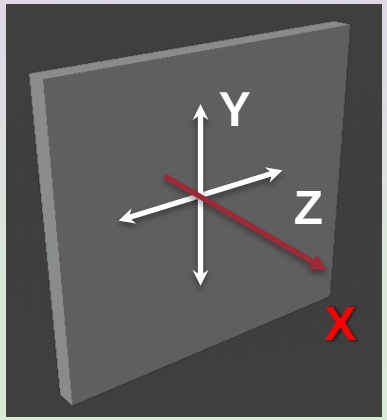


NEW
X – length : 0.2 m,
Y & Z Inner diameter 0.1 m
Y & Z Outer diameter 0.11 m

Old

Dimensions:	
X	0.11 m
Y	0.11 m
Z	0.1 m

Material



NEW
X length : 0.01 m,
Y size: 0.1 m
Z size : 0.1 m

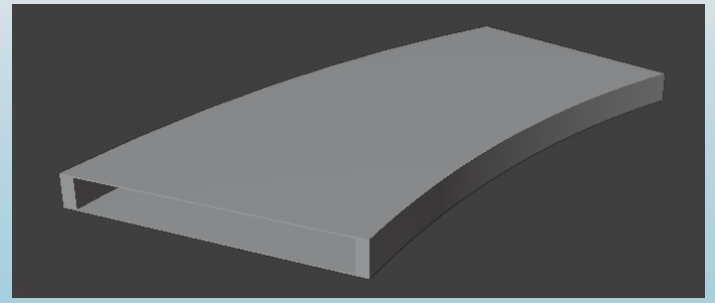
Old

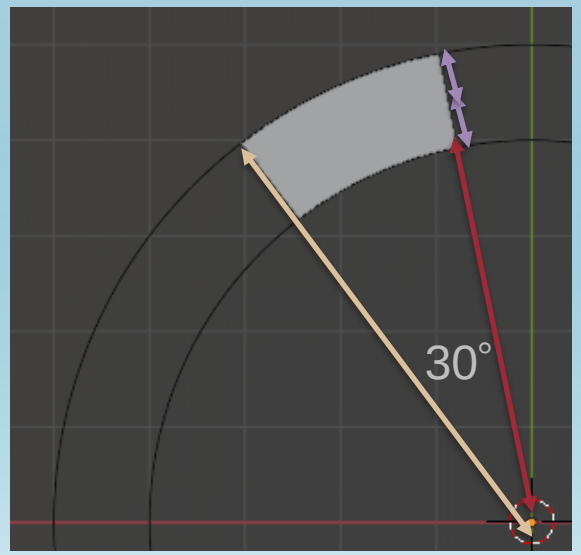
Dimensions:	
X	0.075 m
Y	0.075 m
Z	0.005 m

X is always the central axis for ALL blocks

3D Separator Blocks Update (2)

Dipole

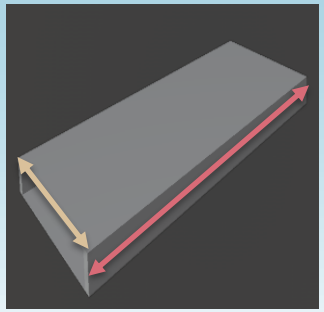


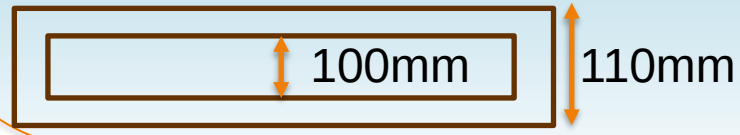


500 mm

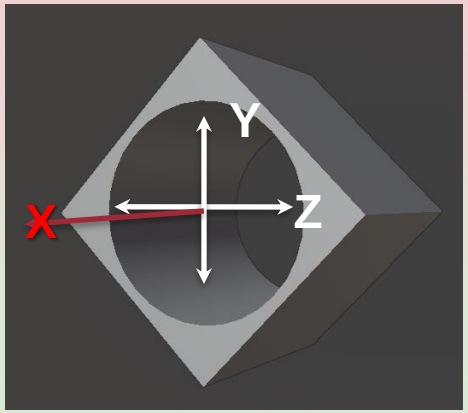
Rmax 5000mm

Rmin 4000mm





Quadrupole

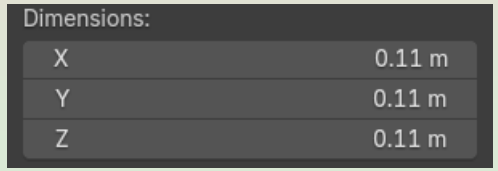


NEW

X length : 0.1 m,

Y-Z inner radius : 0.05 m

Old Inner radius 50mm



X is always the central axis for ALL blocks

Qt Quaternion & Camera

Qt Quaternion Overview

Definition

A quaternnion is a 4D construct for representing 3D rotations:

$$q = w + xi + yj, zk$$

- Quaternnion (float scalar, float *x*, float y, float, z)
- *w* serar = °: real part (w)
- *x, y, ty.* amatmiarry/vector *t*: par)

Why Use QUaternrion?

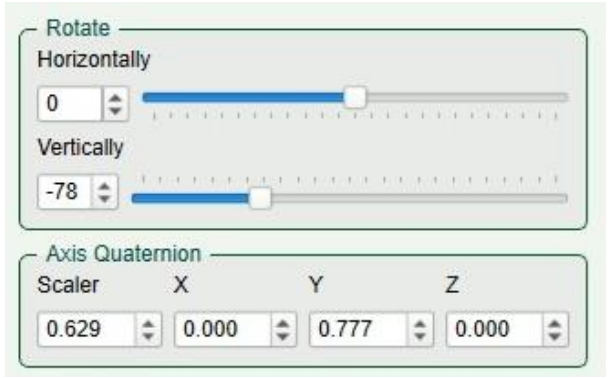
- Quaternnion();
- Quaternnion*x, w, x, y, z*);
- Quaternnion::fro*mAxisandAngle* (QVector3D axis, float angleDeg):
  Quaternnion::from*RotationMatrix* (QMatric3x3 matrix)

Essential Methods

Mcthod	Purpose
scalar()	Gcalar)
x(), y, z)	Get imaginarry part
normalized()	Rotate vector v using qoia
conjugated()	Reverse rotation
inverted()	Inverse of the rotation
slerp (q1, q2 .t)	Smooth interpolation bVv

Example

```
QQuaternnion q = Quaternnion::fromAxisAndAngleQVvectorD(0, 1, 0), 90);
QVector3D v = q.rotatedVectorQVvectorD(1, 0, 0));
/→ (0, 0, −1)
```



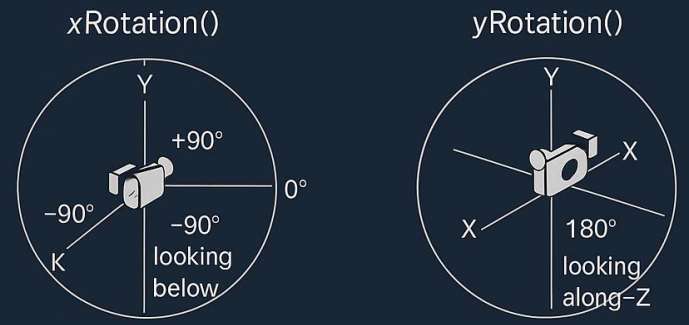
How to synchronize them in code?

Qt Camera: X & Y Rotations

Q3DCamera handles 3D viewing using two anges: Ax, YRotation()

Property	Meaning	Axis of Rotation
*x*Rotation()	Vertical tilt (elevation)	X
yRotation()	Horizontal pan (azimuth)	Y

Visual Meaning:



Example:

```
Q3DCamera *cam = myJDView->scene()->activeCamera()
```

Qt Quaternion & Camera: synchronization (1)

Quaternion

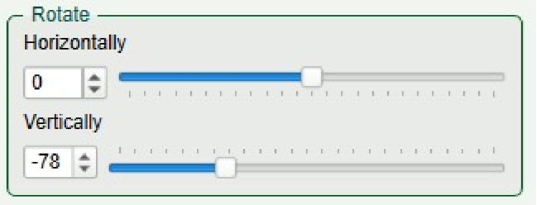

```
QObject::connect(spinS,  &QDoubleSpinBox::valueChanged, this, &TGraph3D::CmAngleRotations);
QObject::connect(spinX,  &QDoubleSpinBox::valueChanged, this, &TGraph3D::CmAngleRotations);
QObject::connect(spinY,  &QDoubleSpinBox::valueChanged, this, &TGraph3D::CmAngleRotations);
QObject::connect(spinZ,  &QDoubleSpinBox::valueChanged, this, &TGraph3D::CmAngleRotations);
```

Implementation of special variable :
flagPermitAngleChanged

```
void TGraph3D::CmAngleRotations(double )
{
  if(!flagPermitAngleChanged) return;

  modifier.get()->rotationAngles.setScalar(spinS->value());
  modifier.get()->rotationAngles.setX(spinX->value());
  modifier.get()->rotationAngles.setY(spinY->value());
  modifier.get()->rotationAngles.setZ(spinZ->value());

// Convert to forward (view direction) vector
QVector3D forward = -(modifier.get()->rotationAngles).rotatedVector(QVector3D(0, 0, 1));

// Normalize to be safe
forward.normalize();

// Compute spherical angles
float xRad = qAsin(forward.y()); // elevation
float yRad = qAtan2(forward.x(), forward.z()); // azimuth

float xRotationDeg = qRadiansToDegrees(xRad); // pitch
float yRotationDeg = qRadiansToDegrees(yRad); // yaw

if (yRotationDeg < 0)
    yRotationDeg += 360.0f;


  flagPermitAngleChanged = false;

Q3DCamera *cam = graph->scene()->activeCamera();
cam->setXRotation(xRotationDeg);
cam->setYRotation(yRotationDeg);

  flagPermitAngleChanged = true;
}
```

Qt Quaternion & Camera: synchronization (2)

Camera



SpinBox & Slider

```
QObject::connect(rotationSliderX, &QSlider::valueChanged, modifier.get(), &ScatterData::rotateX);
QObject::connect(rotationSpinX,  qOverload<int>(&QSpinBox::valueChanged), rotationSliderX, &QSlider::setValue);
QObject::connect(rotationSliderX, &QSlider::valueChanged, rotationSpinX, &QSpinBox::setValue);

QObject::connect(rotationSliderY, &QSlider::valueChanged, modifier.get(), &ScatterData::rotateY);
QObject::connect(rotationSpinY,  qOverload<int>(&QSpinBox::valueChanged), rotationSliderY, &QSlider::setValue);
QObject::connect(rotationSliderY, &QSlider::valueChanged, rotationSpinY, &QSpinBox::setValue);
```

Rotated by clicking mouse right button of image:

```
QObject::connect(modifier.get(), &ScatterData::rotateXchanged, rotationSliderX, &QSlider::setValue);
QObject::connect(modifier.get(), &ScatterData::rotateYchanged, rotationSliderY, &QSlider::setValue);
```

Implementation of special variable : **flagRotate**

```
void ScatterData::rotateX(int rotation)
{
  Q3DCamera *camera = m_graph->scene()->activeCamera();

  m_xRotation = rotation;
  if(flagRotate <=0 )
    camera->setCameraPosition(m_xRotation, m_yRotation);
  else flagRotate--;

  calculateCamRotation();
}
//WWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW
void ScatterData::rotateY(int rotation)
{
  m_yRotation = rotation;
   if(flagRotate==0)
       m_graph->scene()->activeCamera()->setCameraPosition(m_xRotation, m_yRotation);
   else flagRotate--;

   calculateCamRotation();
}
```

```
void ScatterData::calculateCamRotation()
{
  // Convert to radians
  float xRad = qDegreesToRadians(m_xRotation);
  float yRad = qDegreesToRadians(m_yRotation);

  // Forward vector (from camera to target)
  QVector3D forward(
      qCos(xRad) * qSin(yRad),
      qSin(xRad),
      qCos(xRad) * qCos(yRad)
  );

  // Right vector (camera's local X axis)
  QVector3D up(0.0f, 1.0f, 0.0f);  // World up
  QVector3D right = QVector3D::crossProduct(forward, up).normalized();

  // Recomputed up (camera's local Y axis)
  QVector3D cameraUp = QVector3D::crossProduct(right, forward).normalized();

  // Optionally: flip forward for OpenGL-like direction
  QVector3D cameraZ = -forward.normalized();

  QMatrix3x3 rotMatrix;
  setColumn(rotMatrix, 0, right);      // X axis
  setColumn(rotMatrix, 1, cameraUp);   // Y axis
  setColumn(rotMatrix, 2, cameraZ);    // Z axis

  rotationAngles = QQuaternion::fromRotationMatrix(rotMatrix);
  emit dataAngleChanged(rotationAngles);
}
```

Final Animation Page