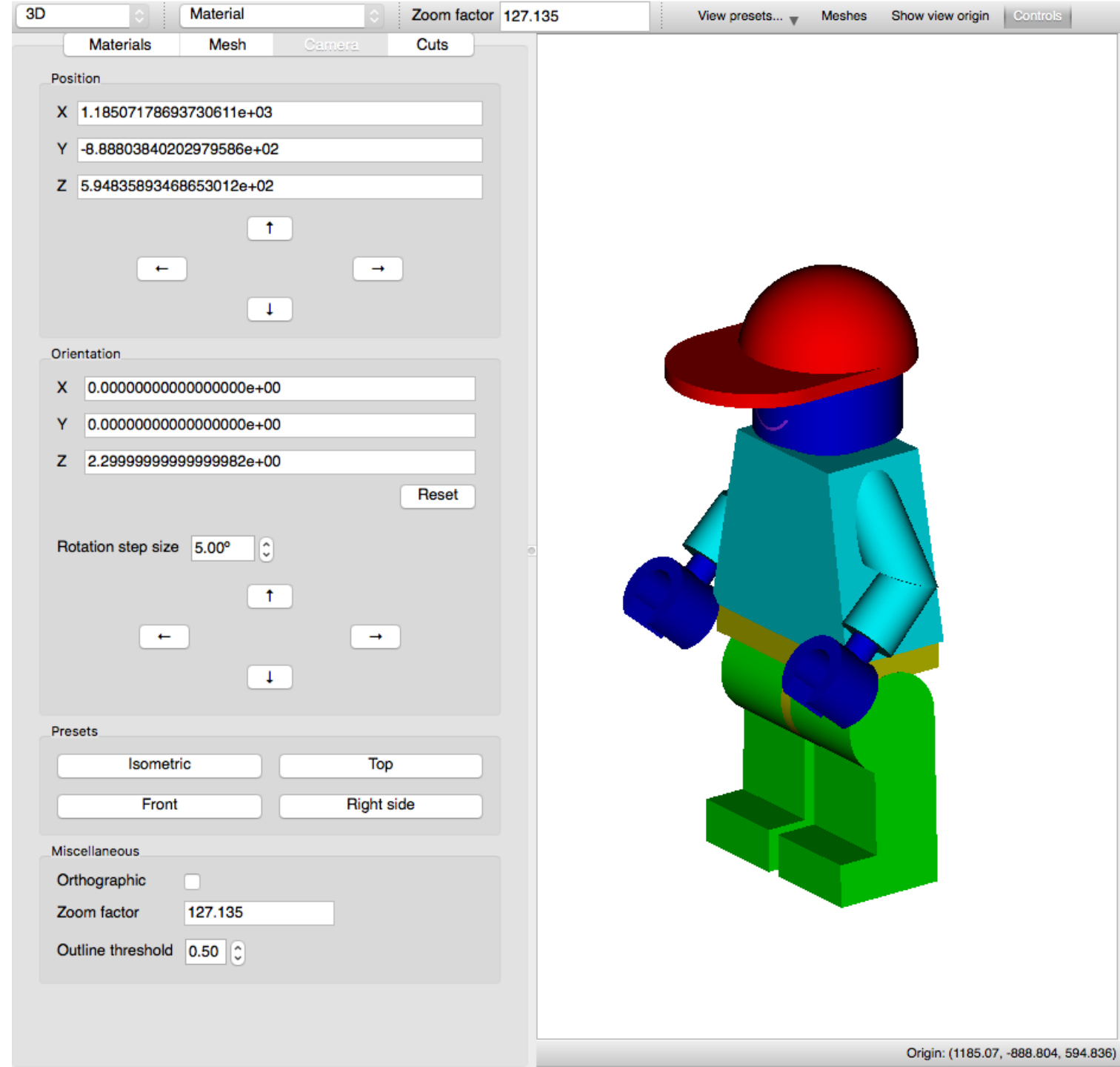# 3D Visualization In Fulcrum

Rob Lefebvre, Seth Johnson, Adam Thompson, Tom Evans, William (BJ) Marshall, Brad Rearden
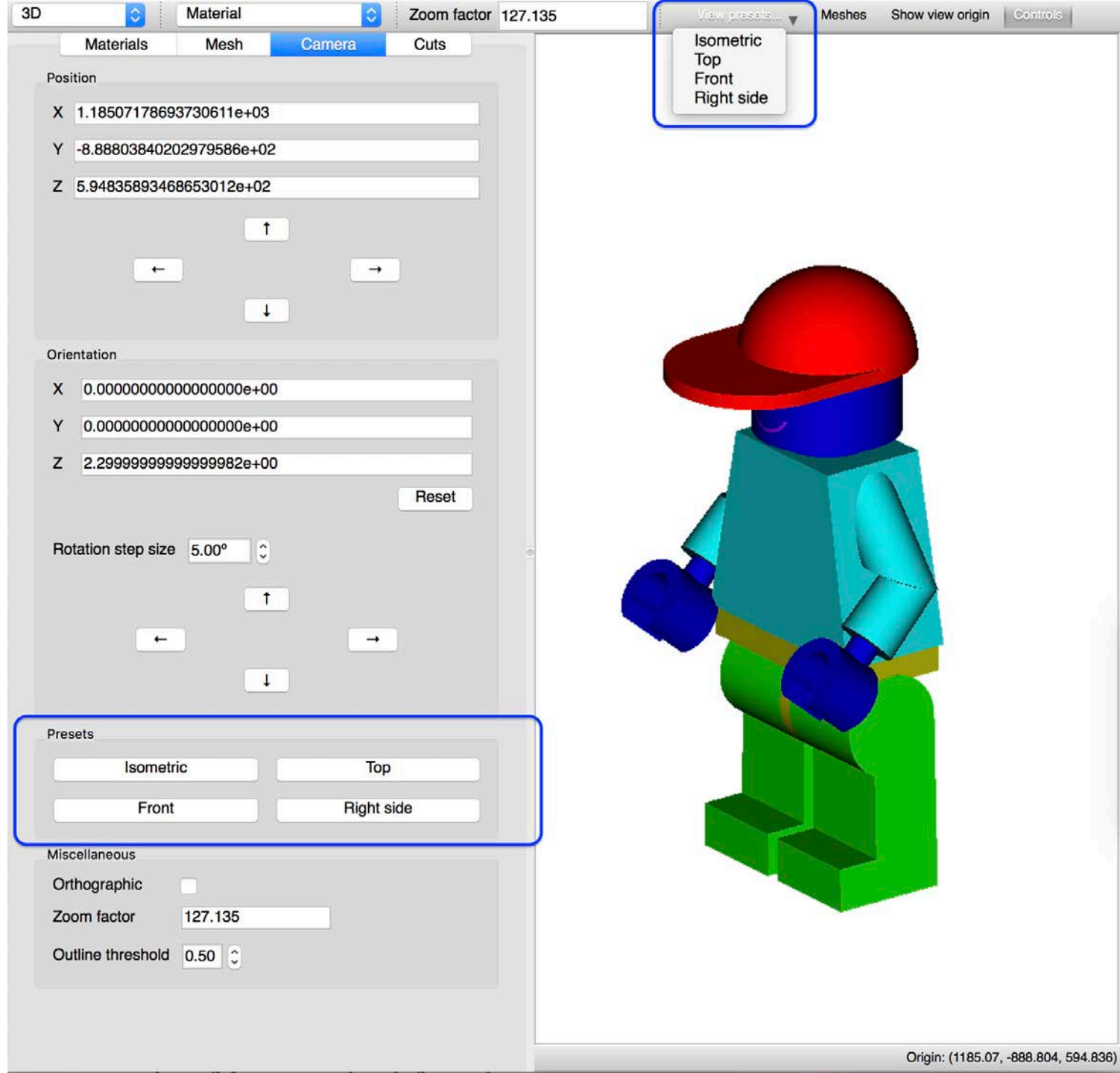
Overview

- **Camera**
  - Presets
  - Panning
  - Zooming
  - Rotation

- **Rendering modes**

- **Display metadata**

- **Material controls**
  - Filter material table

- **Geometry Cuts**

Camera presets

- **Top**: camera is in +Z looking into –Z

- **Front**: camera is in –Y looking into +Y

- **Right side**: camera is in +X looking into –X
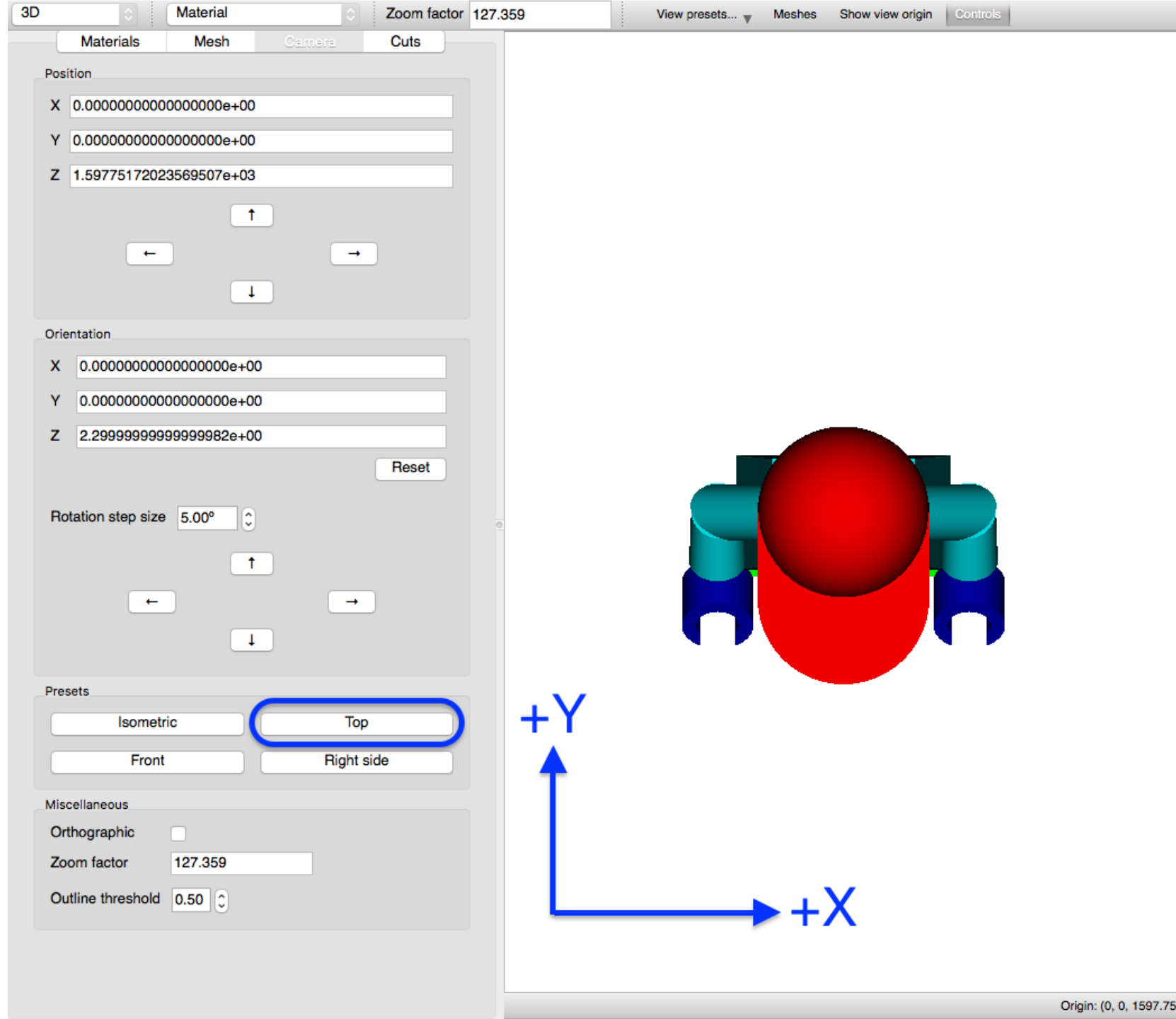
- **Isometric**: camera is above and in front

Camera presets:

- **Top**: camera is in +Z looking into −Z

- Front: camera is in −Y looking into +Y

- Right side: camera is in +X looking into −X

- Isometric: camera is above and in front

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Camera presets:

- Top: camera is in +Z looking into –Z

- **<u>Front</u>**: camera is in –Y looking into +Y

- Right side: camera is in +X looking into –X

- Isometric: camera is above and in front

Camera presets:

- Top: camera is in +Z looking into –Z

- Front: camera is in –Y looking into +Y

- **Right side**: camera is in +X looking into –X

- Isometric: camera is above and in front

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Camera presets:

- Top: camera is in +Z looking into –Z

- Front: camera is in –Y looking into +Y

- Right side: camera is in +X looking into –X

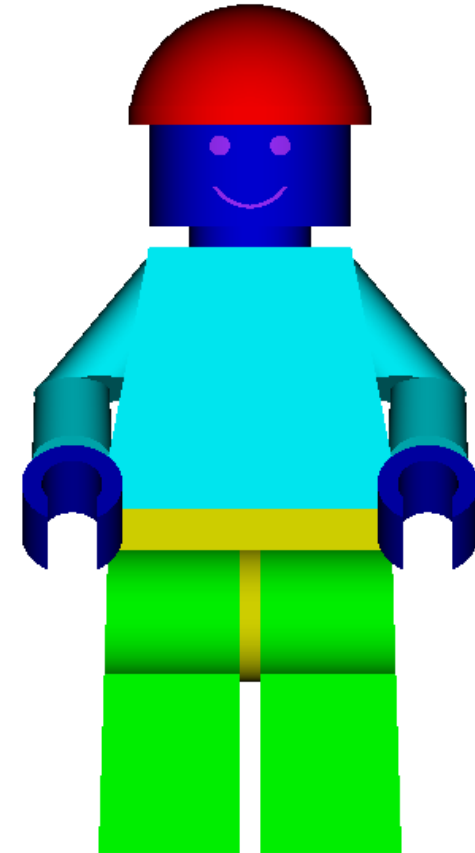- **Isometric**: camera is above and in front

Camera Panning

- **Position** fields allow absolute camera positioning

- **Up** arrow moves model up by moving camera down

- **Down** arrow moves model down by moving camera up

- **Left** arrow moves model left by moving camera right

- **Right** arrow moves model right by moving camera left

- **Double-click** at a point pans to re-center at click point

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Camera Panning:

- **Up** arrow moves model up by moving camera down

- Down arrow moves model down by moving camera up

- Left arrow moves model left by moving camera right

- Right arrow moves model right by moving camera left
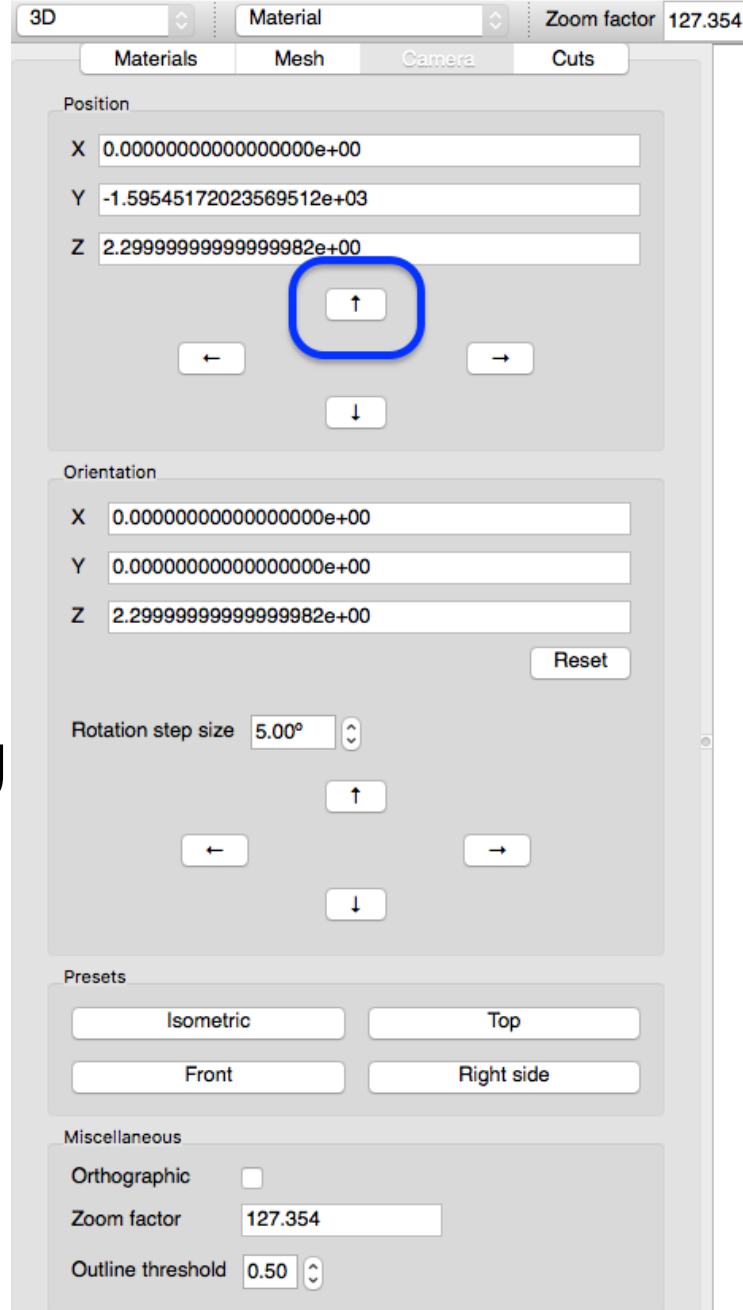
- Double-click at a point pans to re-center at click point
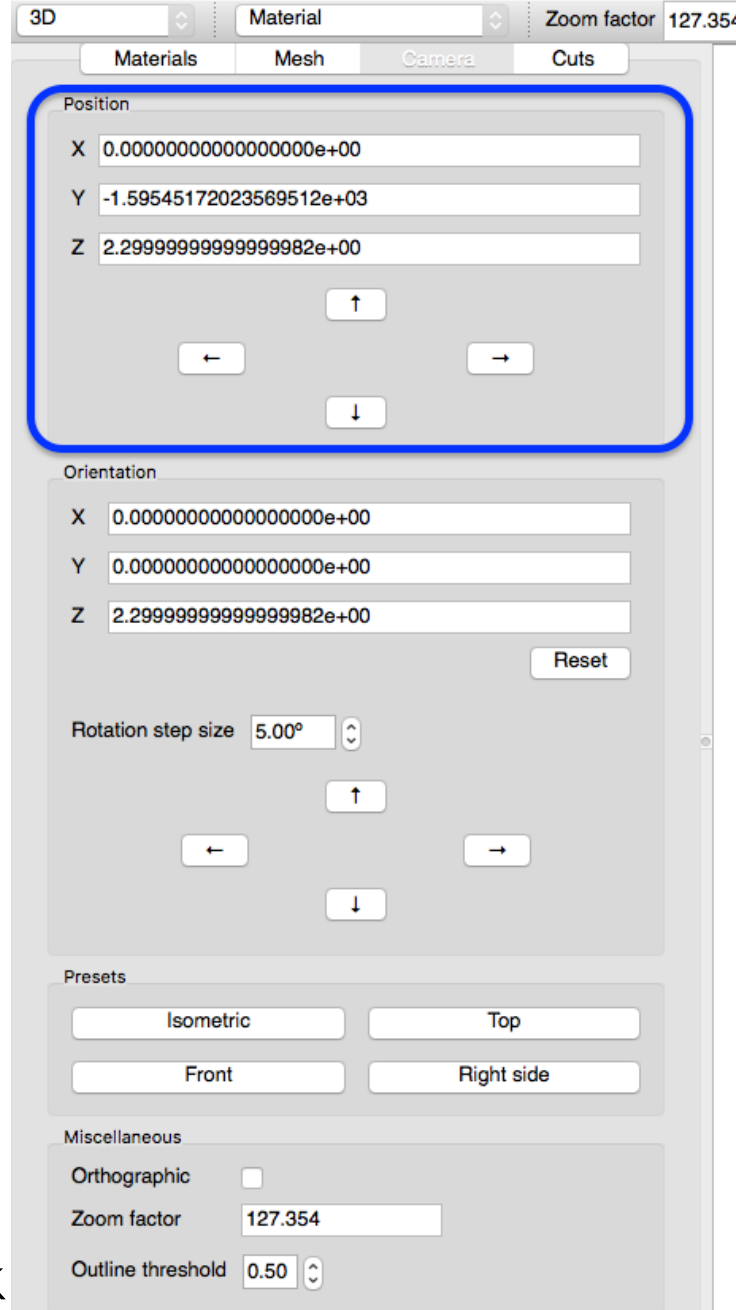
Shift+Mouse Drag to new location

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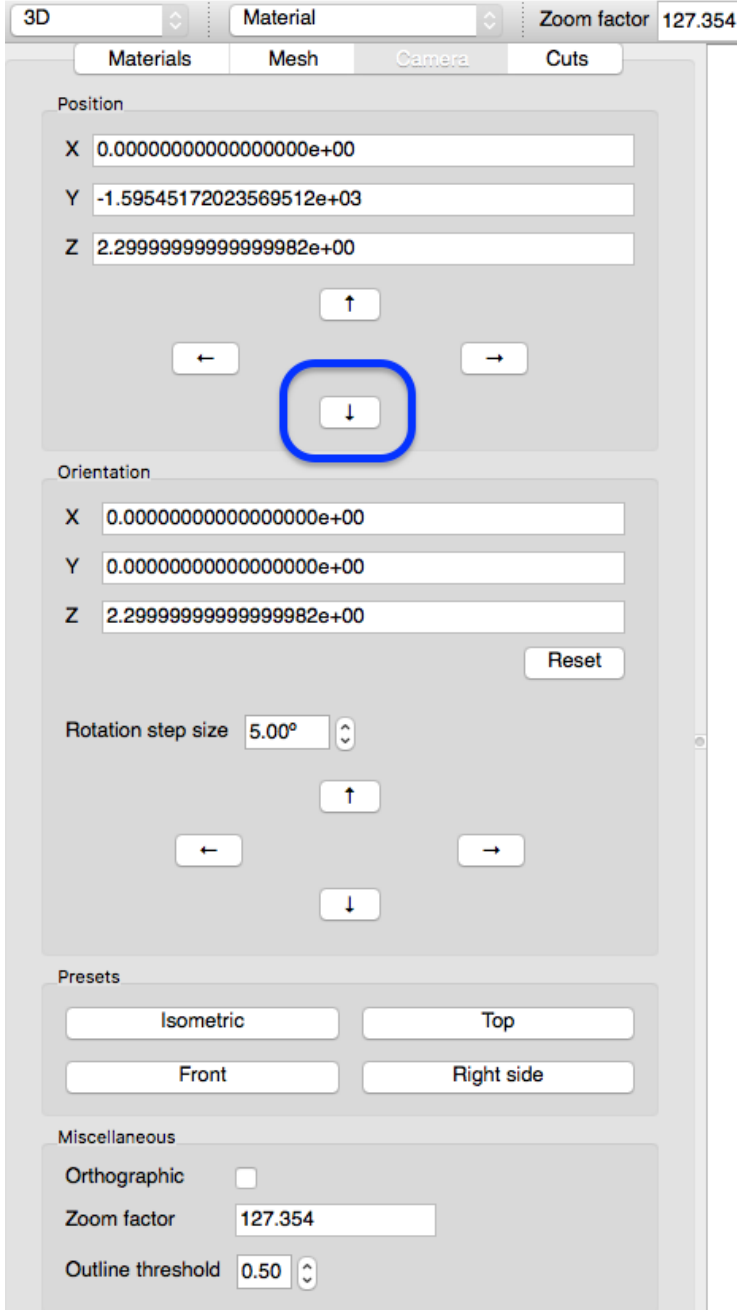
Camera Panning:

- Up arrow moves model up by moving camera down

- **<u>Down</u>** arrow moves model down by moving camera up

- Left arrow moves model left by moving camera right

- Right arrow moves model right by moving camera left

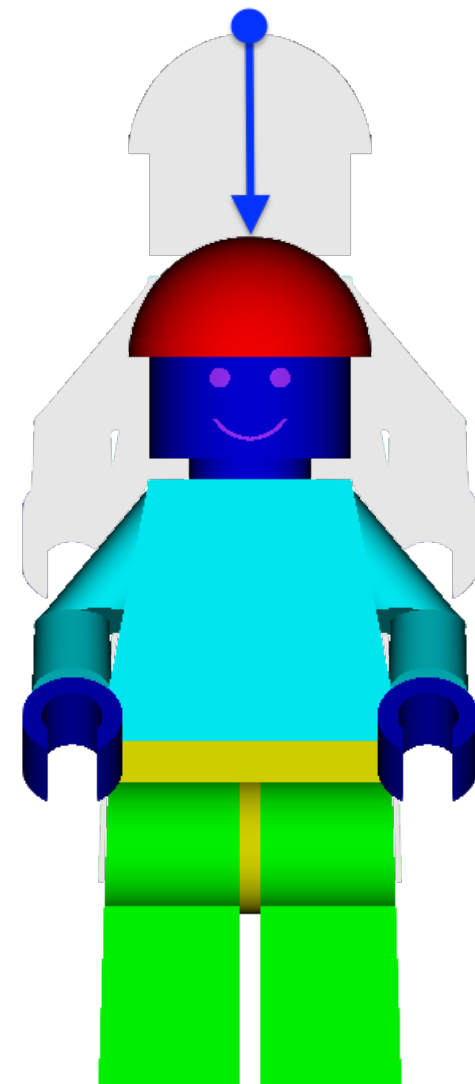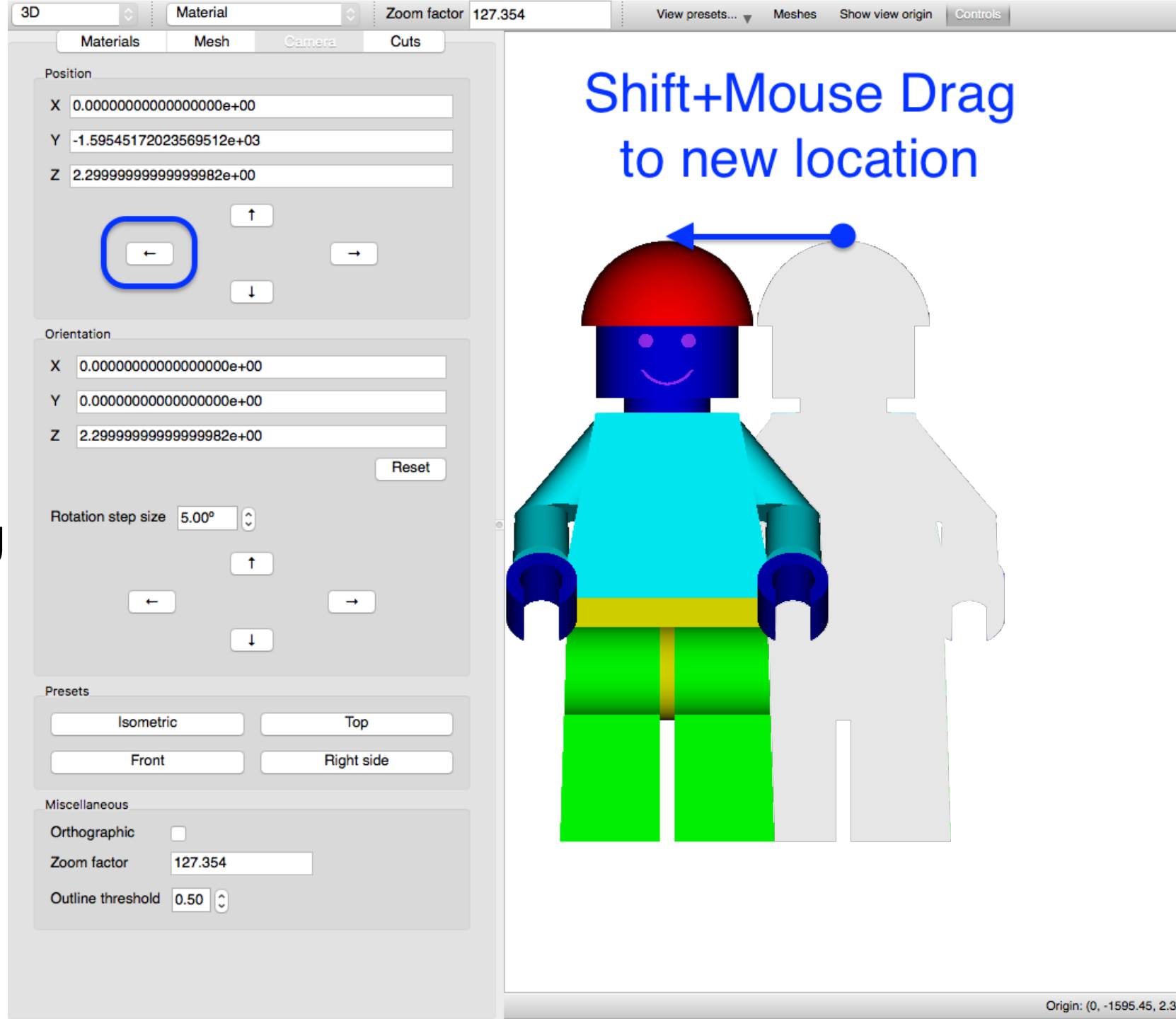- Double-click at a point pans to re-center at click point
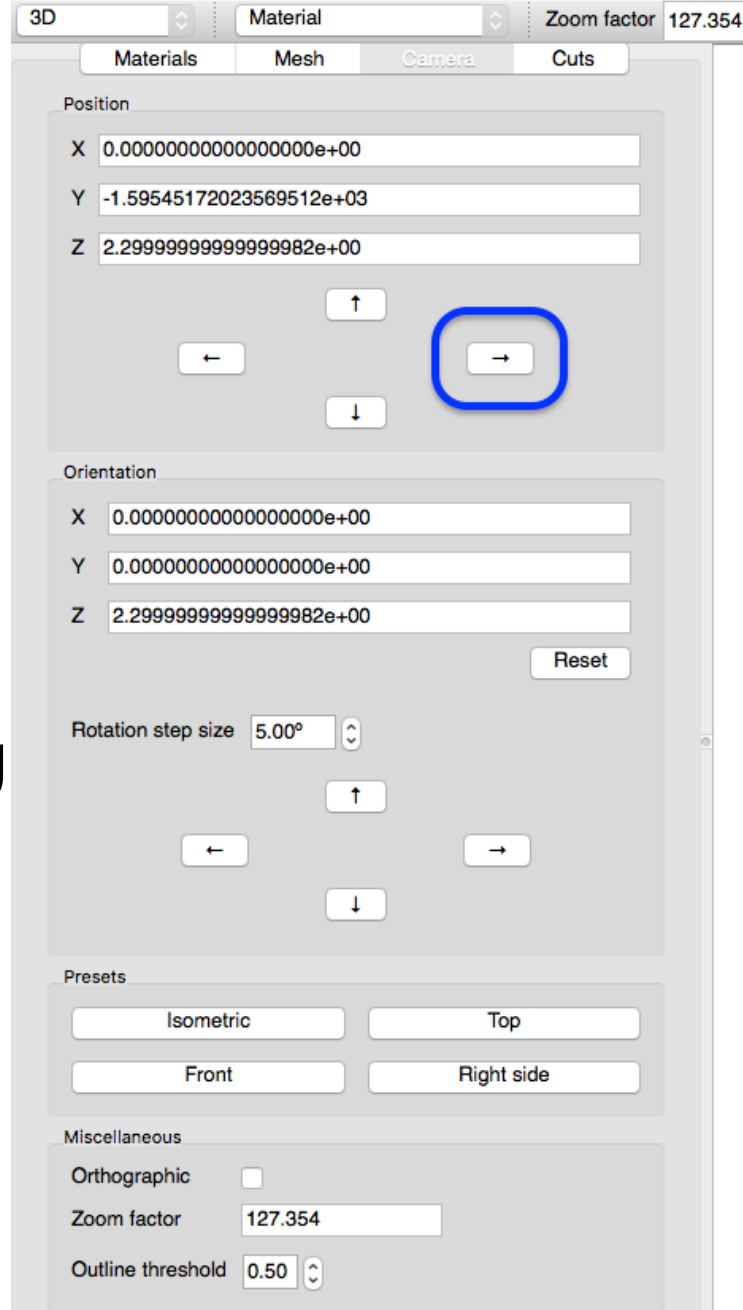
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Camera Panning:

- Up arrow moves model up by moving camera down

- Down arrow moves model down by moving camera up

- **Left** arrow moves model left by moving camera right

- Right arrow moves model right by moving camera left

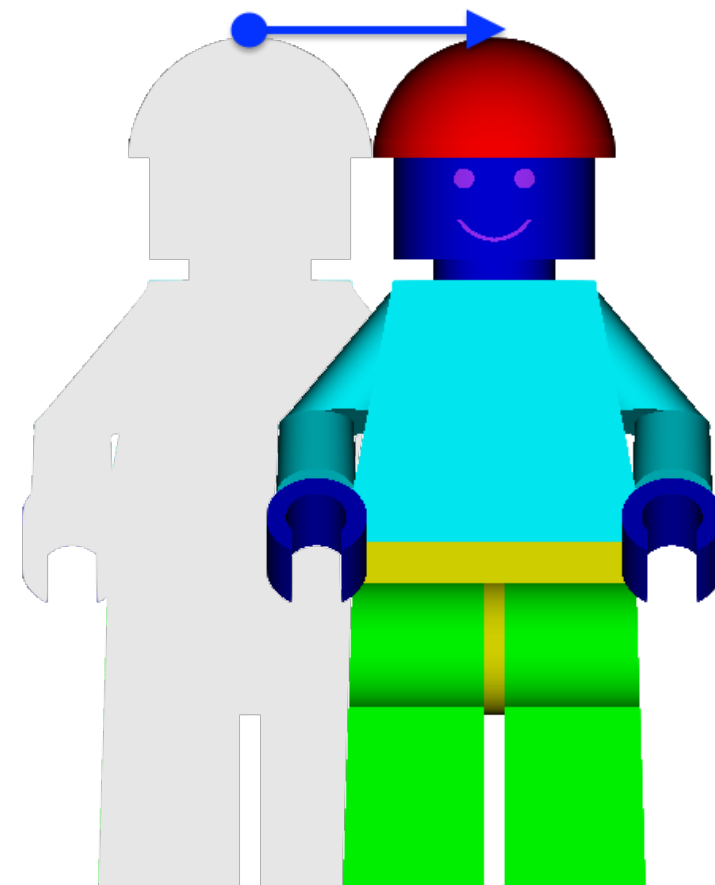- Double-click at a point pans to re-center at click point

Camera Panning:

- Up arrow moves model up by moving camera down

- Down arrow moves model down by moving camera up

- Left arrow moves model left by moving camera right

- **<u>Right</u>** arrow moves model right by moving camera left

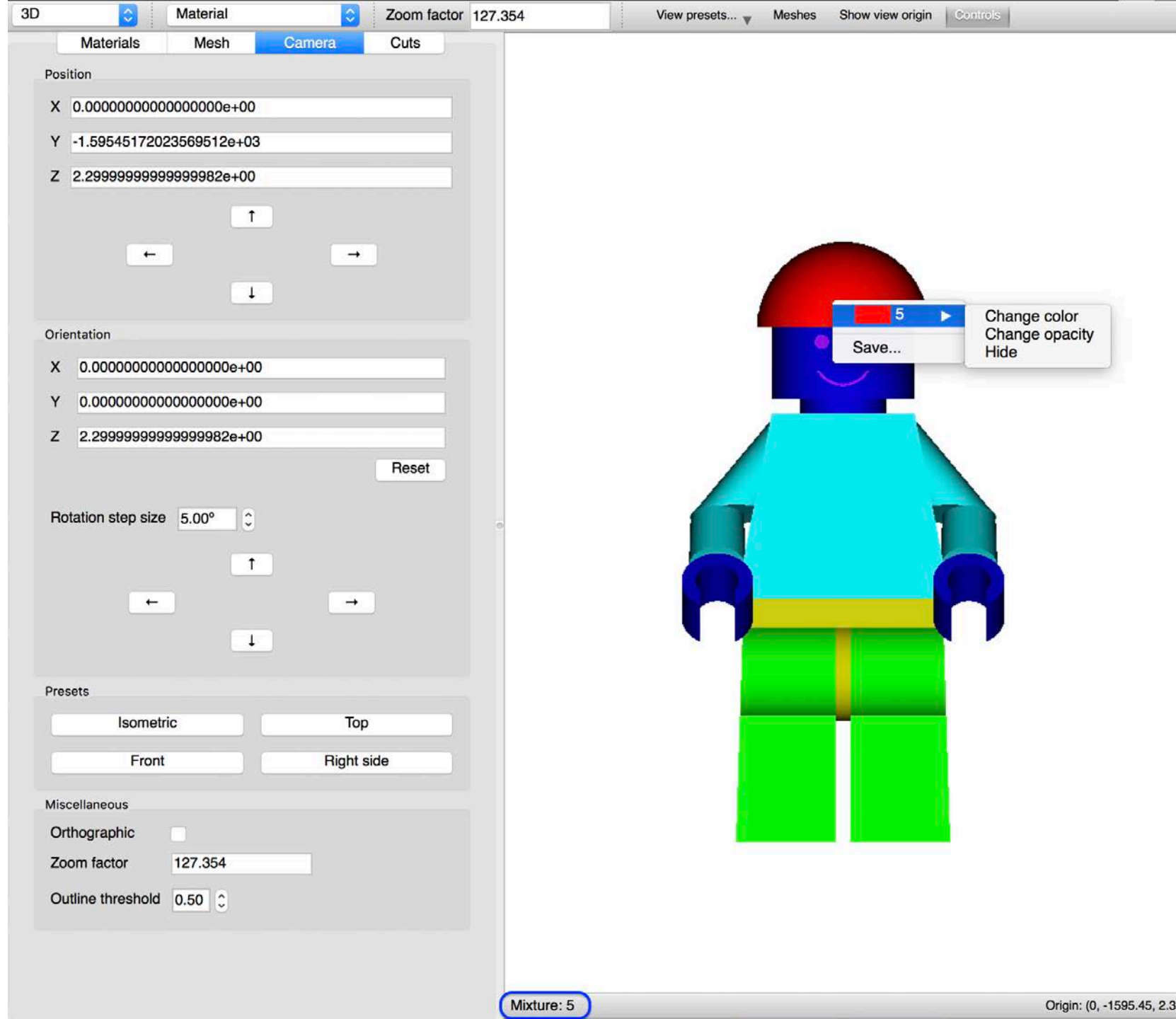- Double-click at a point pans to re-center at click point
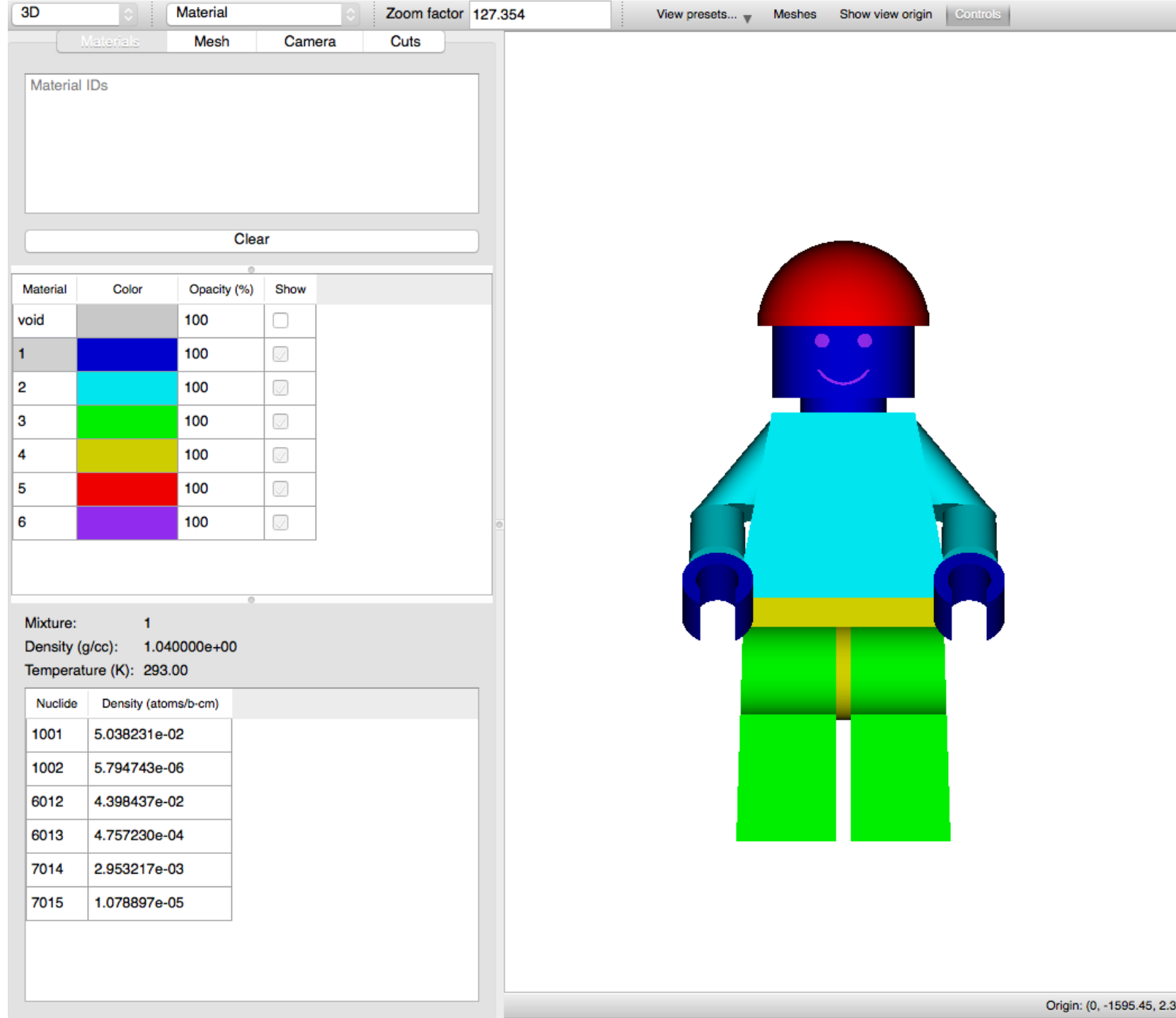
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Display metadata

- Mousing-over pixels reports the material under the cursor

- The user can also right-click on a pixel with material information and control
  - **visibility**,
  - **opacity**,
  - and **color**
  - for **one or more** materials under the given pixel.

Materials Controls

- A table containing the full listing of known materials in the model.

- Table allows controlling
  - **visibility**,
  - **opacity**,
  - and **color**
  - for **all** material in the model.

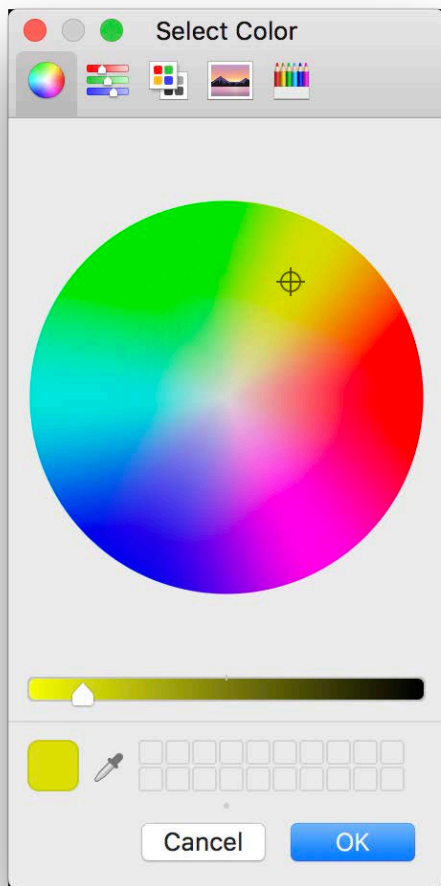- Mixture information changes as a function of selected material

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Materials Controls: Color

Materials Controls: Visibility

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Materials Controls: Visibility

Materials Controls: Opacity
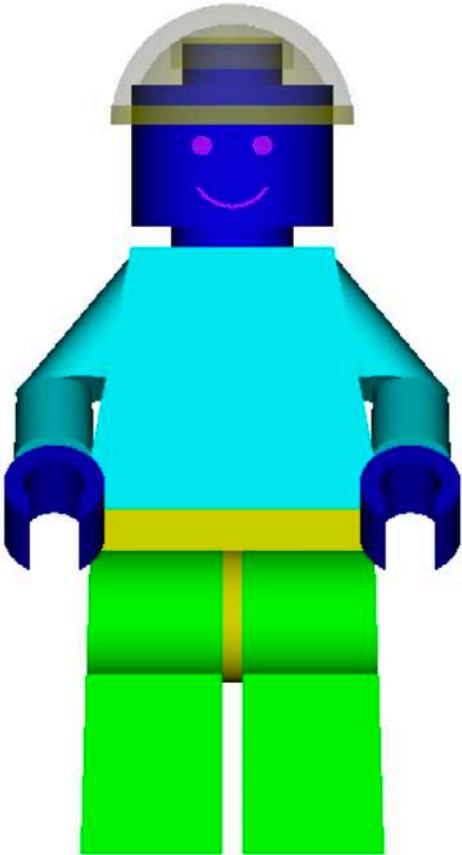
Material Filter

- Users can type material identifiers (numbers) to filter material table rows.

- Same filtering capability conducted by right-clicking a pixel with multiple materials and selecting **'Manage'**
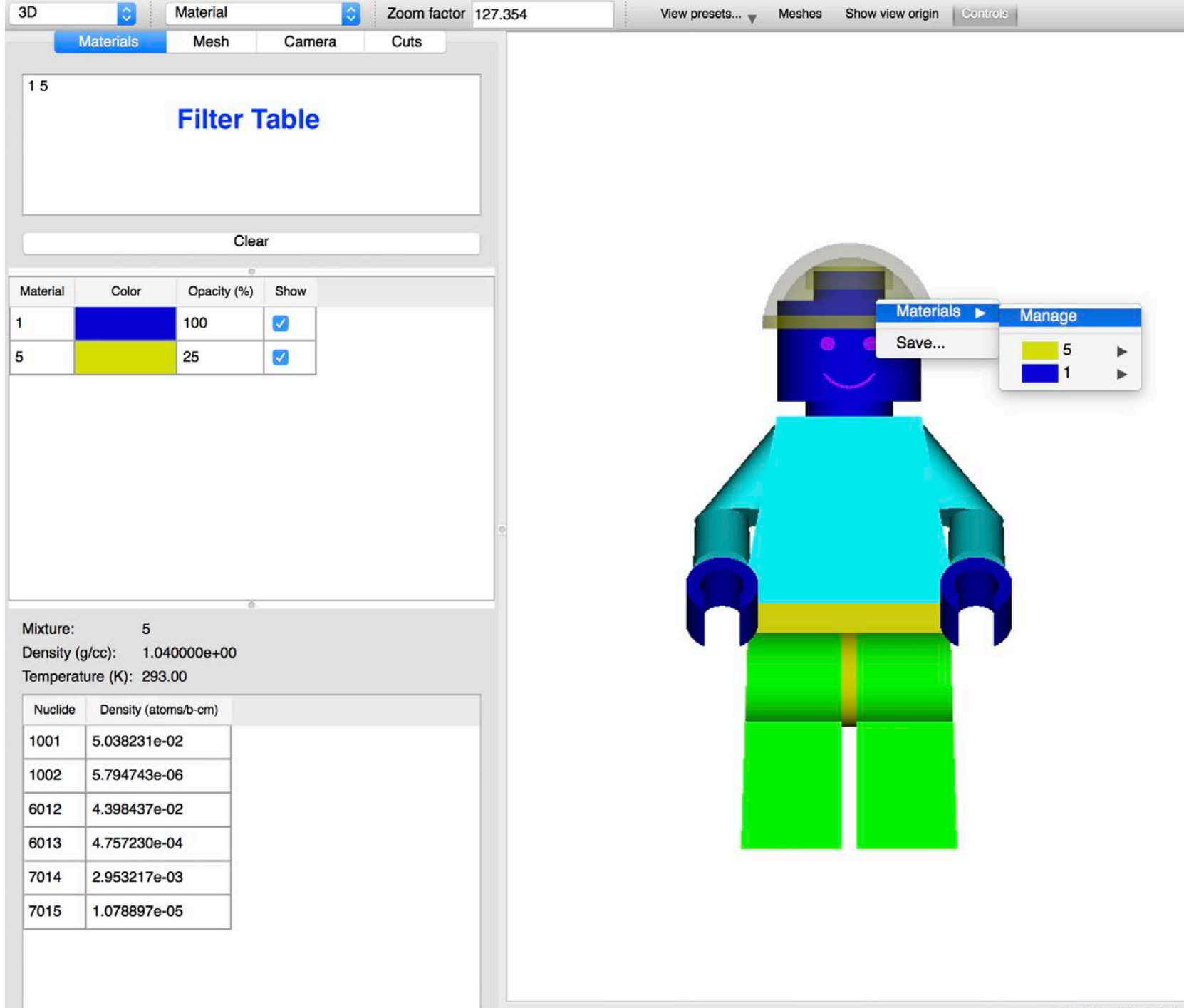
Zooming

- Rectangle (or lasso) zoom is implemented just as it is in the 2D view

  - Click upper-left and drag to lower-right

- Quick zoom is implemented via a **Zoom factor** text field, allowing the user to enter a zoom (multiplication) factor.

  - **Show view origin** can assist in zoom factor focus
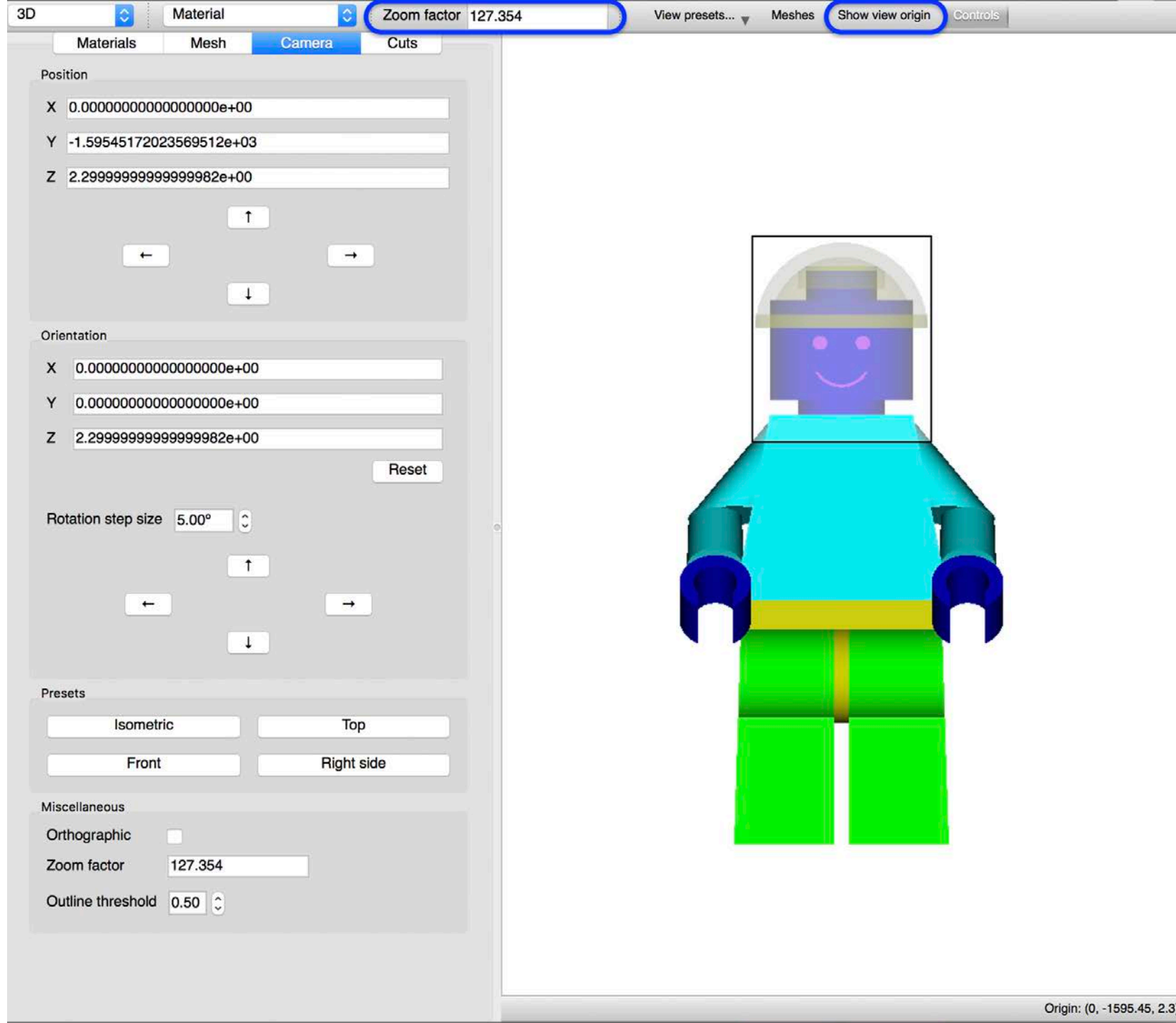
Zooming

- Rectangle (or lasso) zoom is implemented just as it is in the 2D view

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- Quick zoom is implemented via a **Zoom factor** text field, allowing the user to enter a zoom (multiplication) factor.

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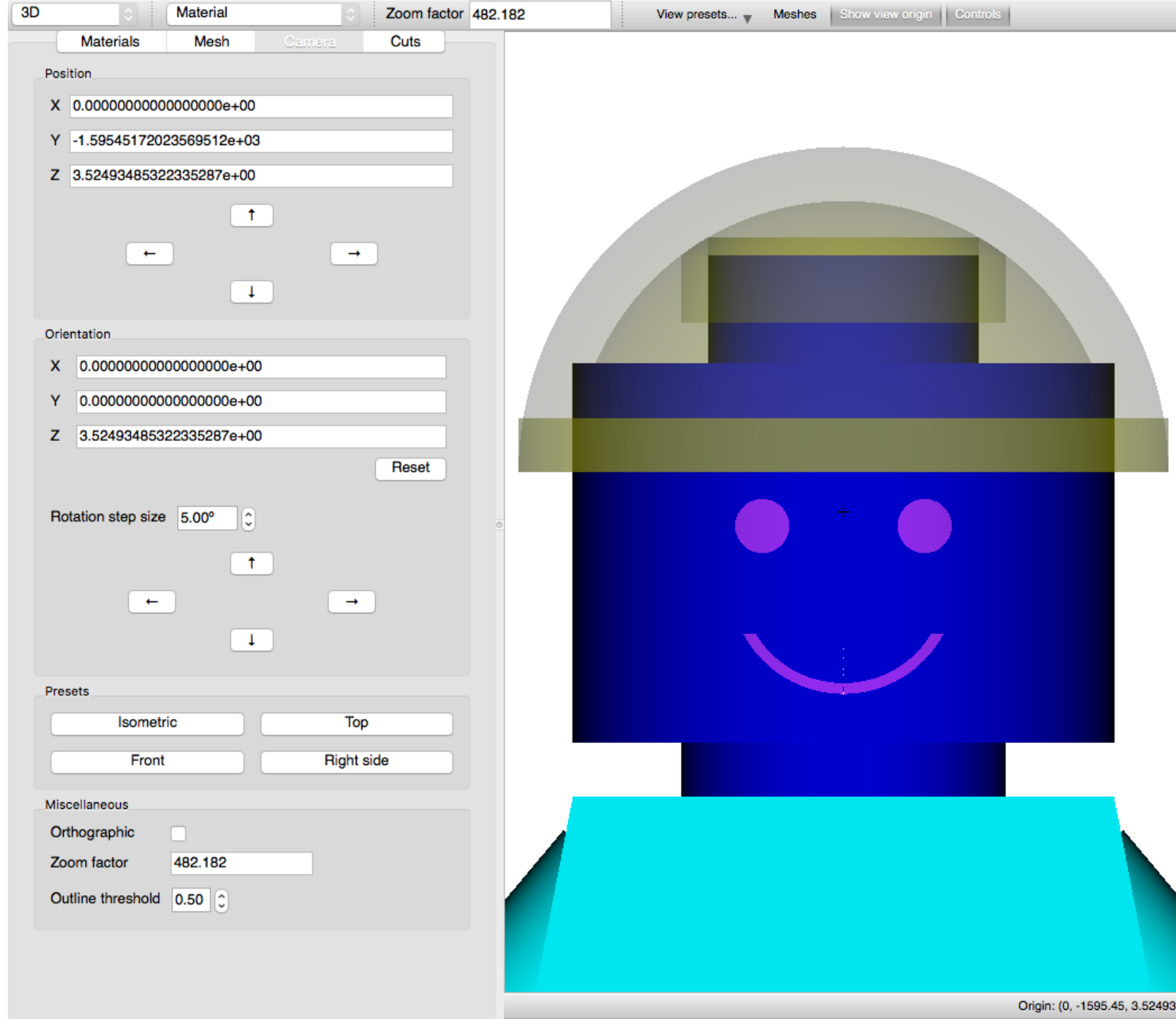
Camera Rotation

- **Rotation step size** input field allows specifying explicit rotation.

- Up arrow rotates model up by rotating camera down

- Down arrow rotates model down by rotating camera up

- Left arrow rotates model left by rotating camera right

- Right arrow rotates model right by rotating camera left

- Arbitrary rotation is achieved by **Alt+click-and-drag**

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Camera Rotation: Up

- **Rotation step size** input field allows specifying explicit rotation.

- **Up arrow rotates model up** by rotating camera down

- Down arrow rotates model down by rotating camera up

- Left arrow rotates model left by rotating camera right

- Right arrow rotates model right by rotating camera left

- Arbitrary rotation is achieved by **Alt+click-and-drag**

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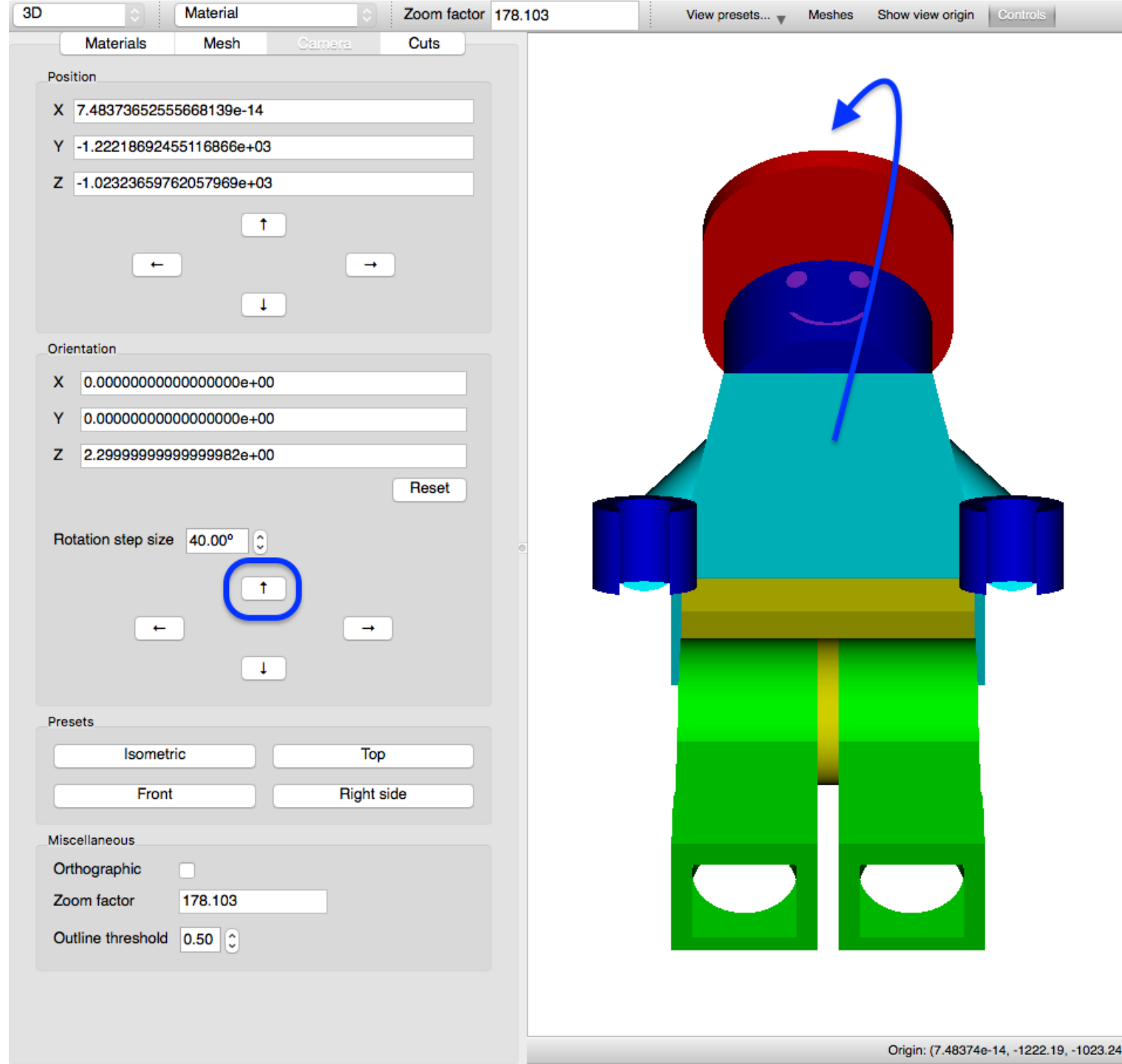
Camera Rotation: Down

- **Rotation step size** input field allows specifying explicit rotation.

- Up arrow rotates model up by rotating camera down

- **Down arrow rotates model down** by rotating camera up

- Left arrow rotates model left by rotating camera right

- Right arrow rotates model right by rotating camera left

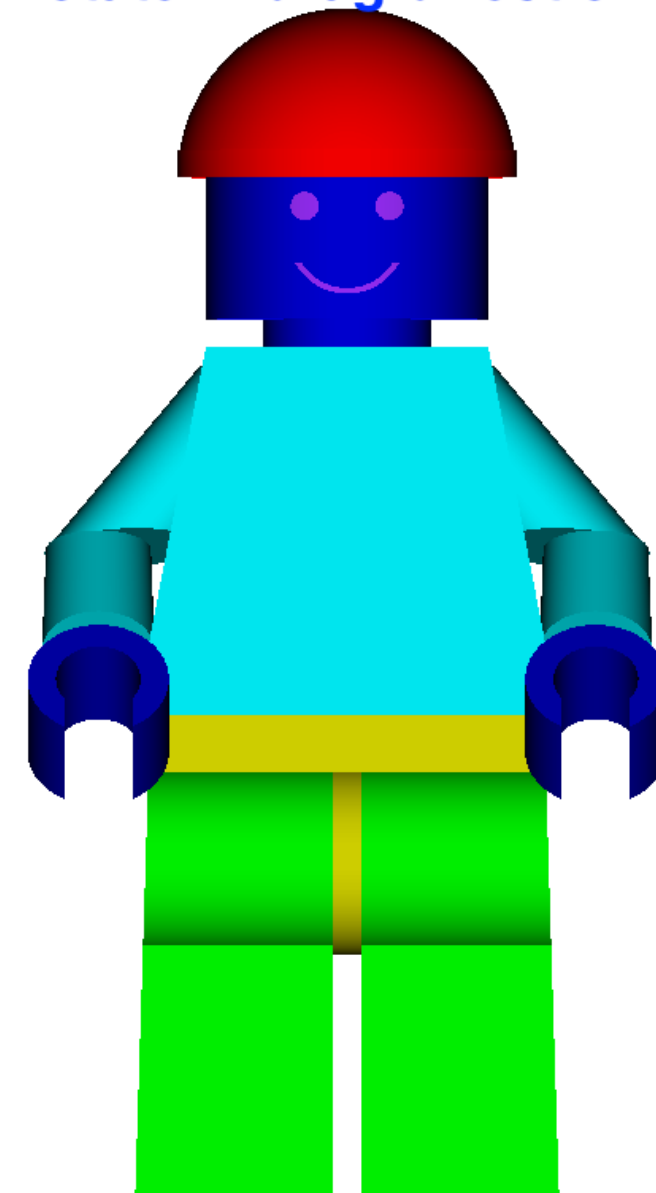- Arbitrary rotation is achieved by **Alt+click-and-drag**

Camera Rotation: Left

- **Rotation step size** input field allows specifying explicit rotation.

- Up arrow rotates model up by rotating camera down

- Down arrow rotates model down by rotating camera up

- **Left arrow rotates model left** by rotating camera right

- Right arrow rotates model right by rotating camera left

- Arbitrary rotation is achieved by **Alt+click-and-drag**

Camera Rotation: Right

- **Rotation step size** input field allows specifying explicit rotation.
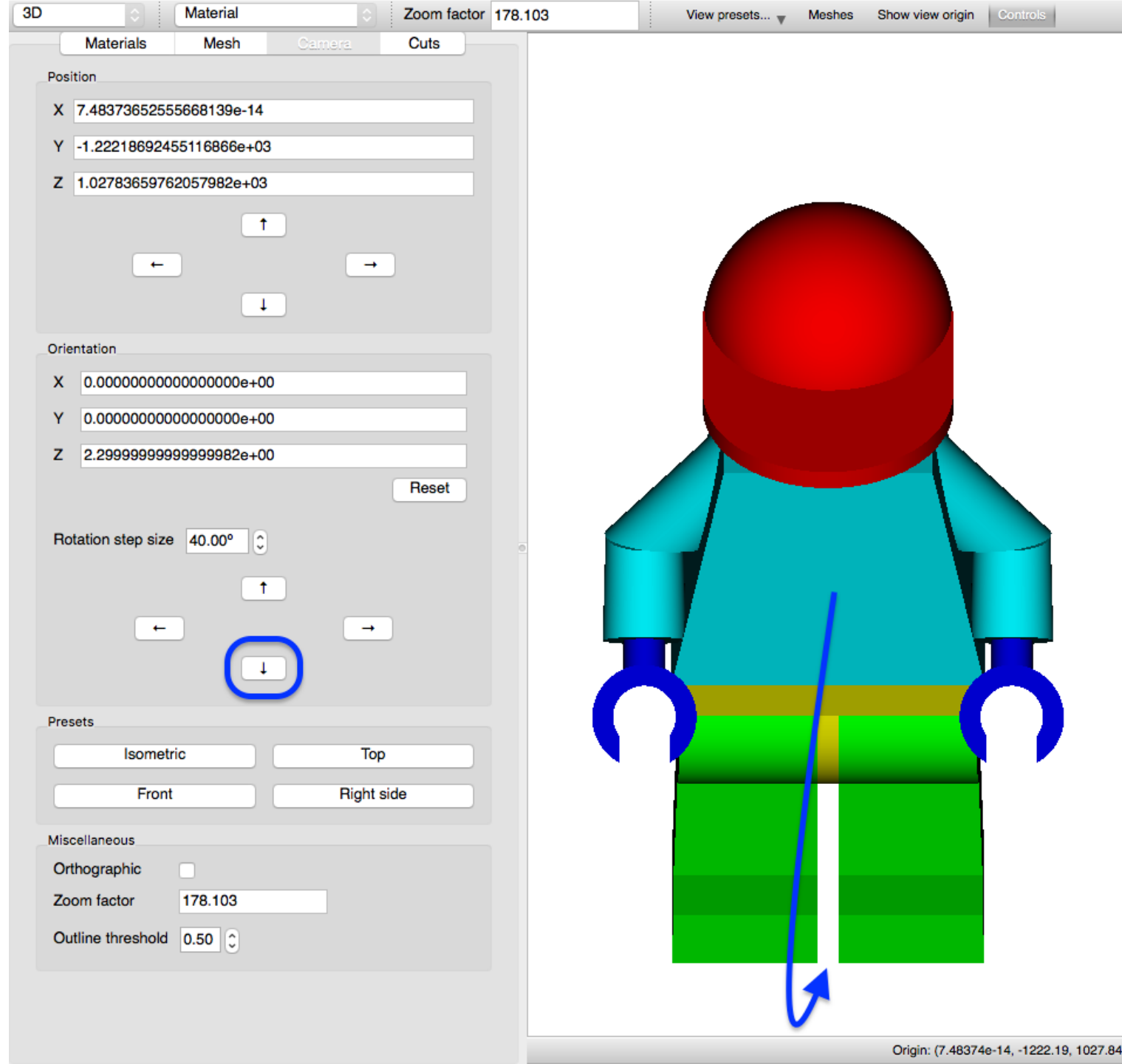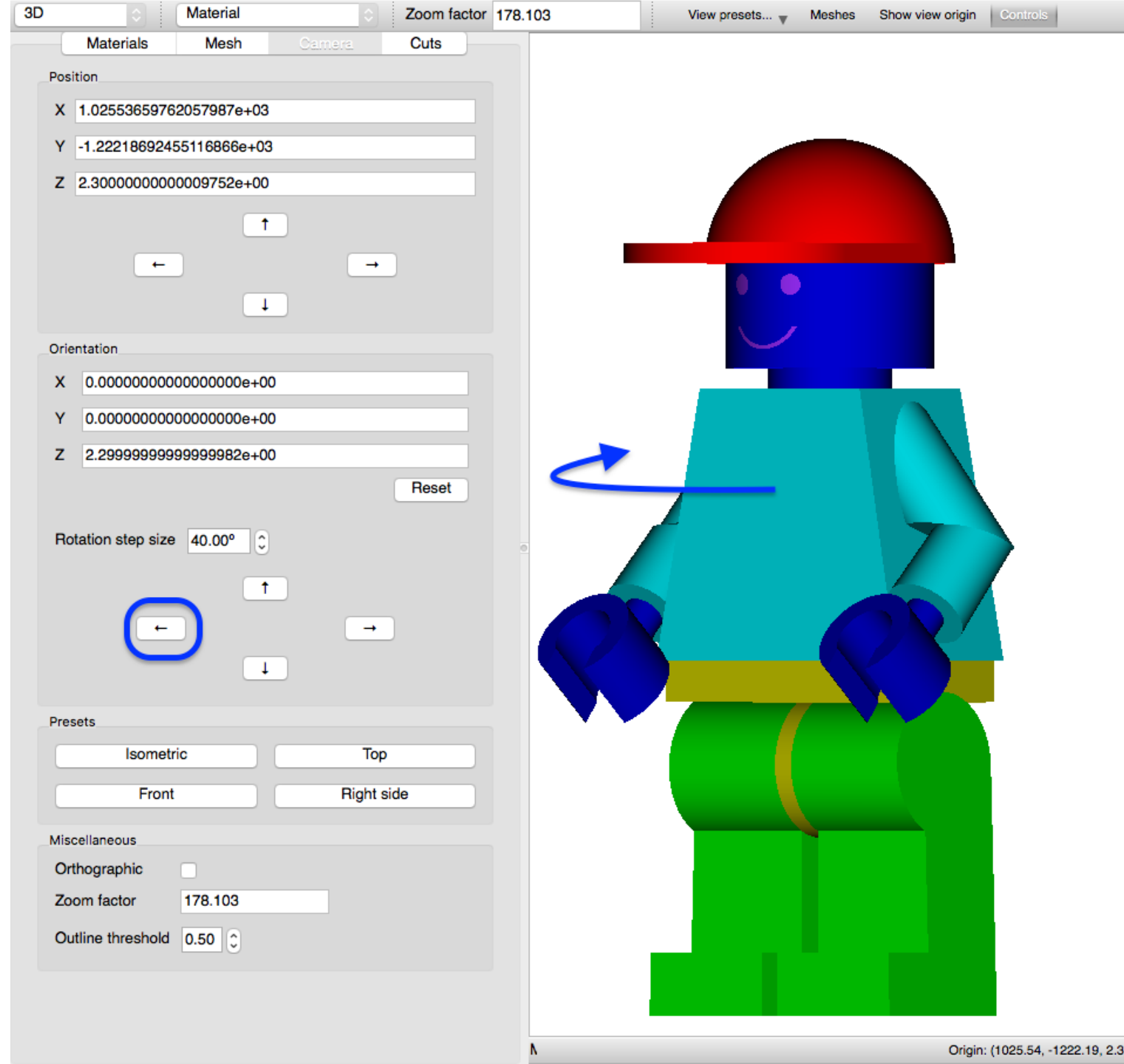
- Up arrow rotates model up by rotating camera down

- Down arrow rotates model down by rotating camera up

- Left arrow rotates model left by rotating camera right

- **Right arrow rotates model right** by rotating camera left

- Arbitrary rotation is achieved by **Alt+click-and-drag**
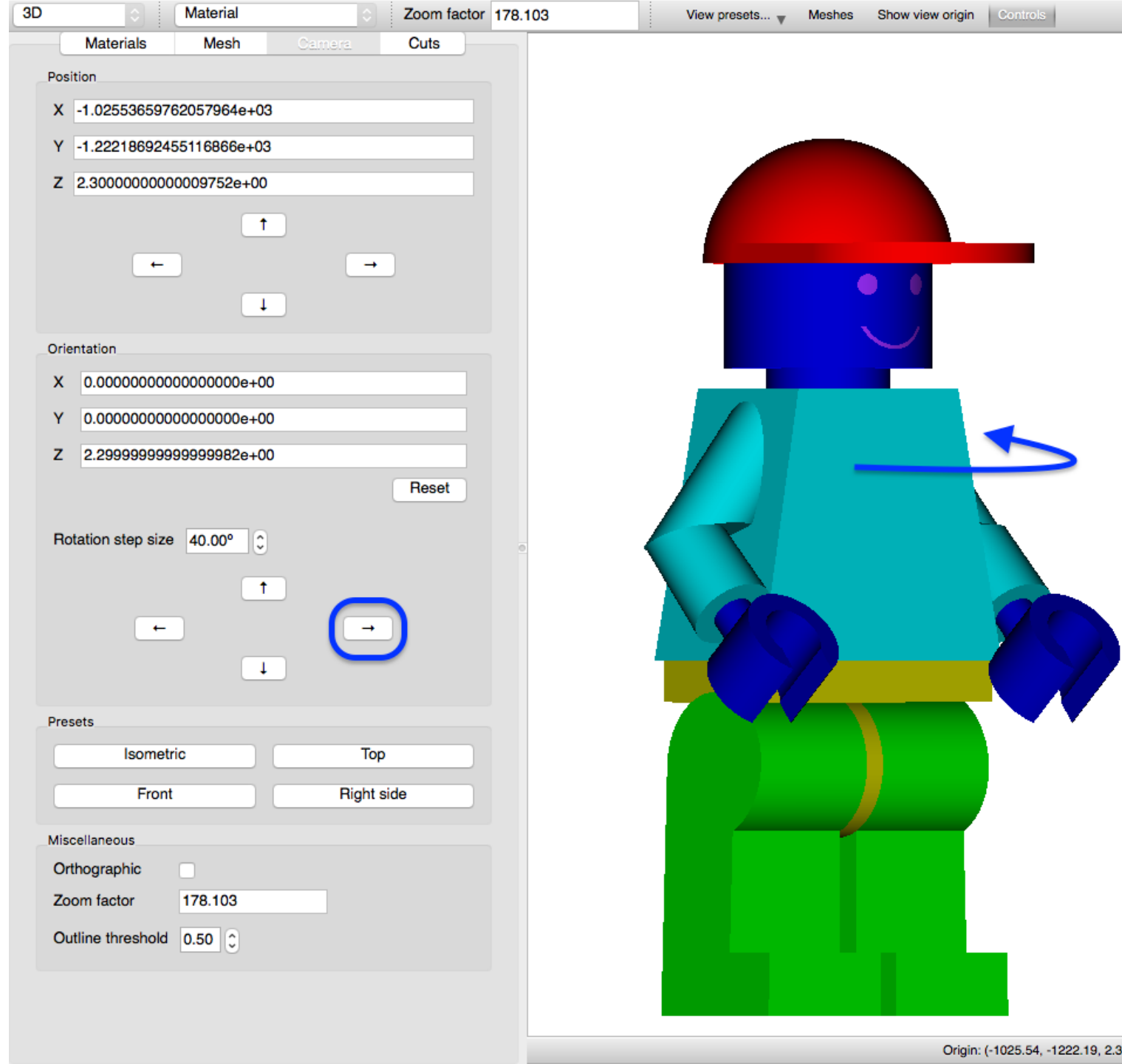
Rendering modes

- **Material** renders only material colors, shaded according to surface normal

- **Material+Outline** renders same as **Material** with the addition of black outlines at boundaries

- **Outline** renders only material boundaries using Material colors

- Mesh data **Overlay** and **Overlay+boundaries** capabilities are slated for phase 2 development.

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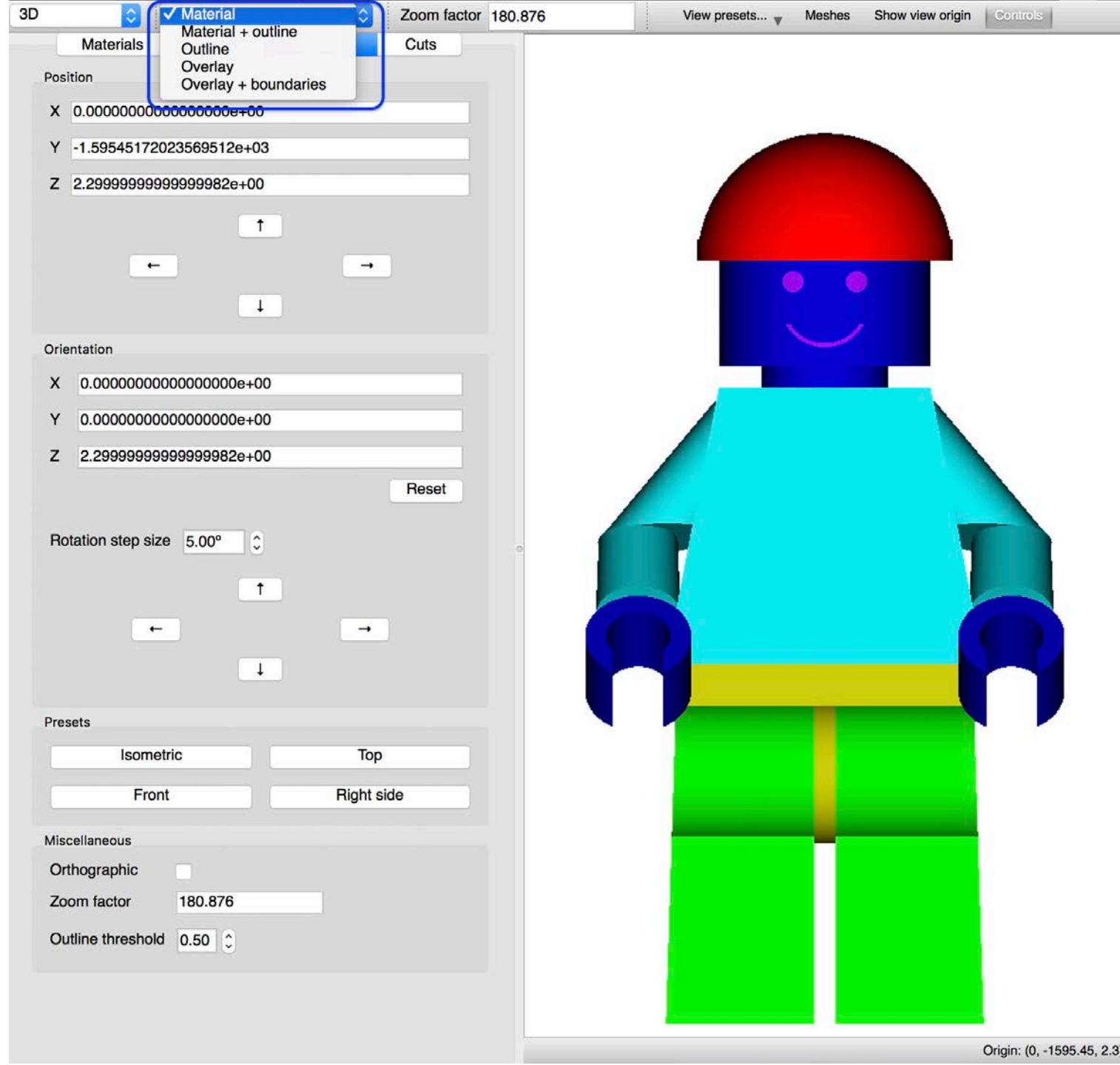
Rendering modes: Material + outline

- renders same as **Material** with the addition of black outlines at boundaries

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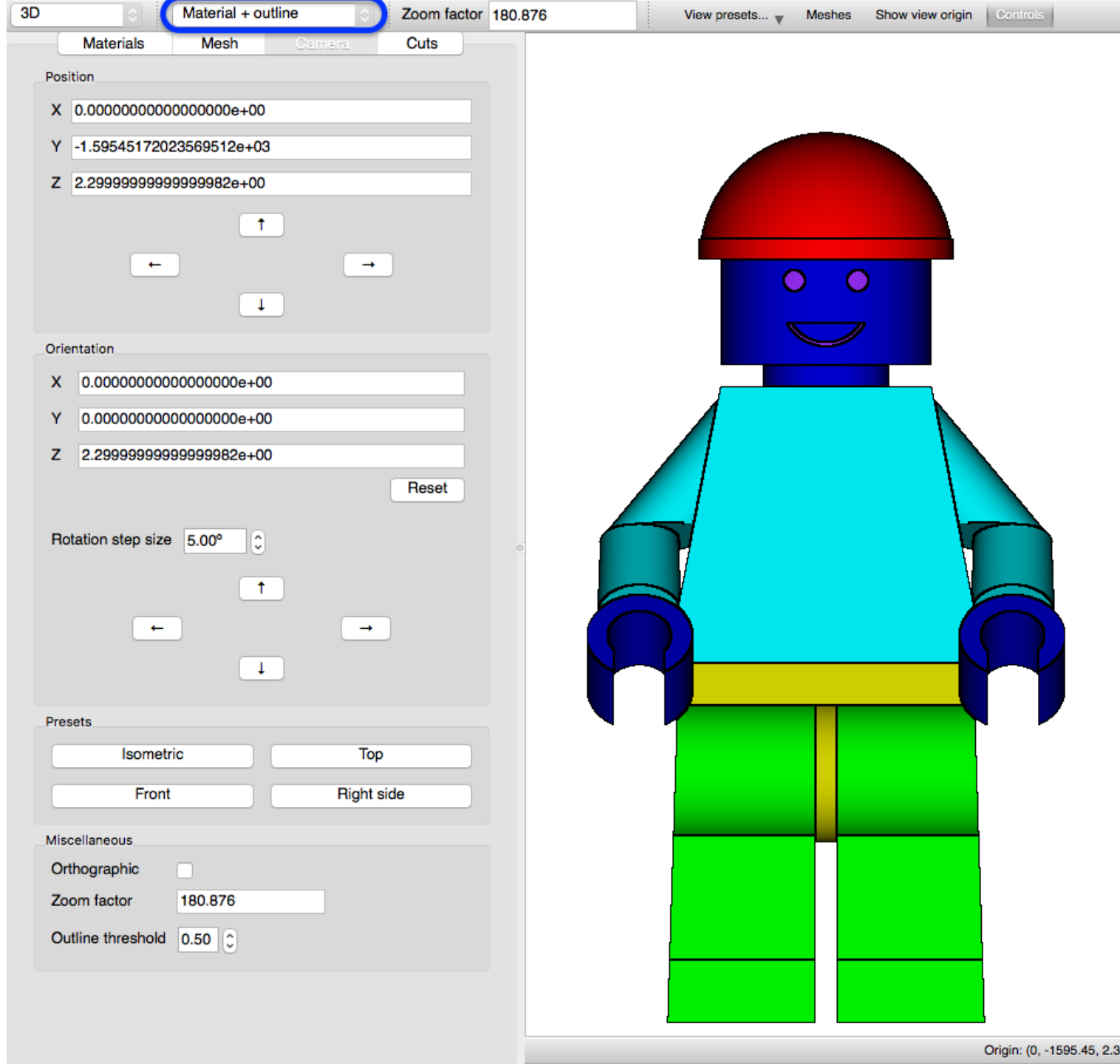
Rendering modes: Outline

- renders only material boundaries using Material colors
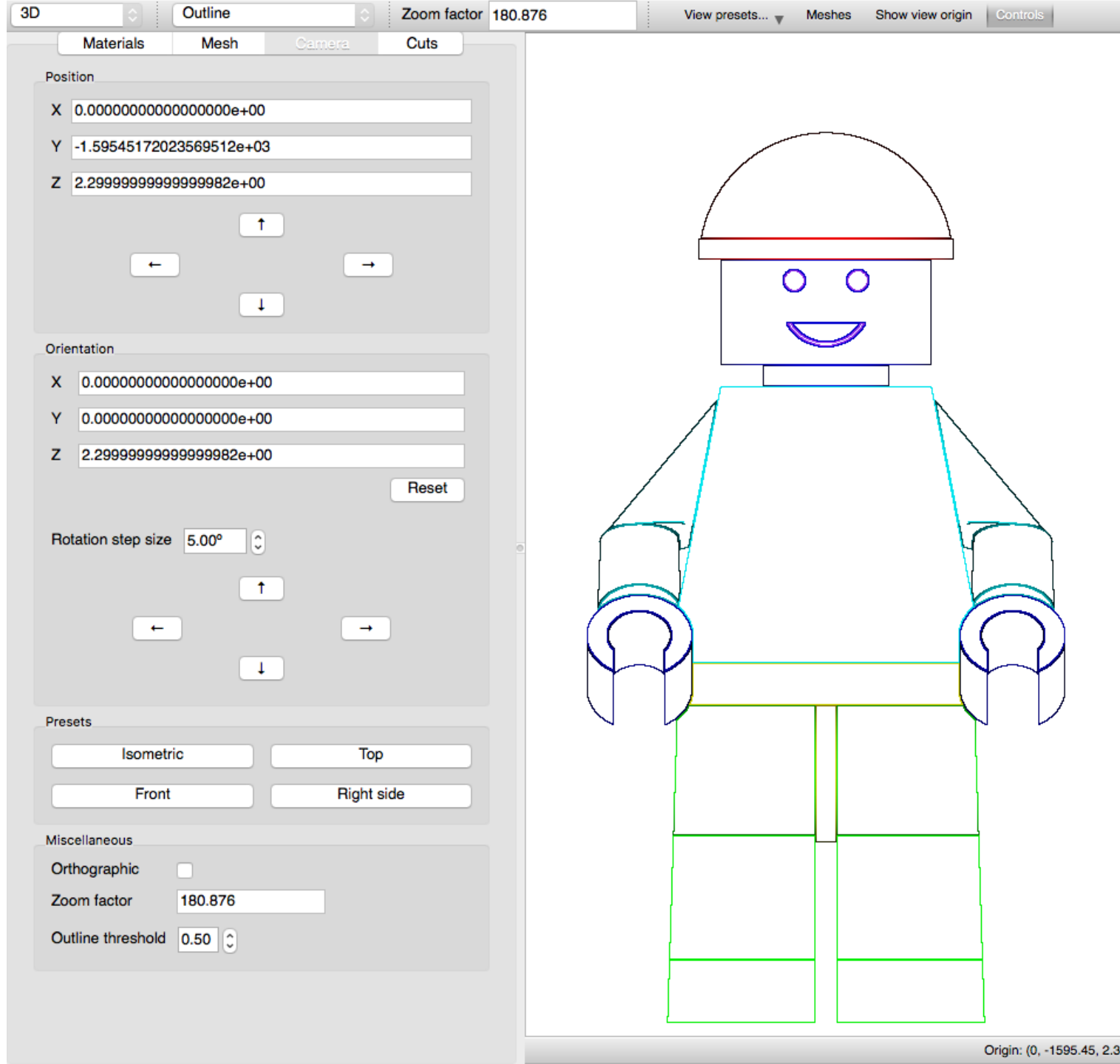
Model Cutting

- **Named Block** and **Pie slice** model cut styles

- Boundary box cut **clamping**

- **Cut offsets** allow for moving the origin of the cut

- **Rotation** uses Euler angle convention to rotate cuts to desired angles

- Ability to **remove** and **edit/save** existing cuts

Model Cutting: Cut Styles

- **Block**
  - Top half (+Z)
  - Bottom half (-Z)
  - Left half (-X)
  - Right half (+X)
  - Front half (-Y)
  - Back half (+Y)
  - Front-right quarter (-Y,+X)

- **Pie slice**
  - X axis (opening in –Y)
  - Y axis (opening in –Z)
  - Z axis (opening in -Y)

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Model Cutting: Cut Styles

- **Block**
  - **Top half (+Z)**
  - Bottom half (-Z)
  - Left half (-X)
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Model Cutting: Cut Styles

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  - X axis (opening in –Y)
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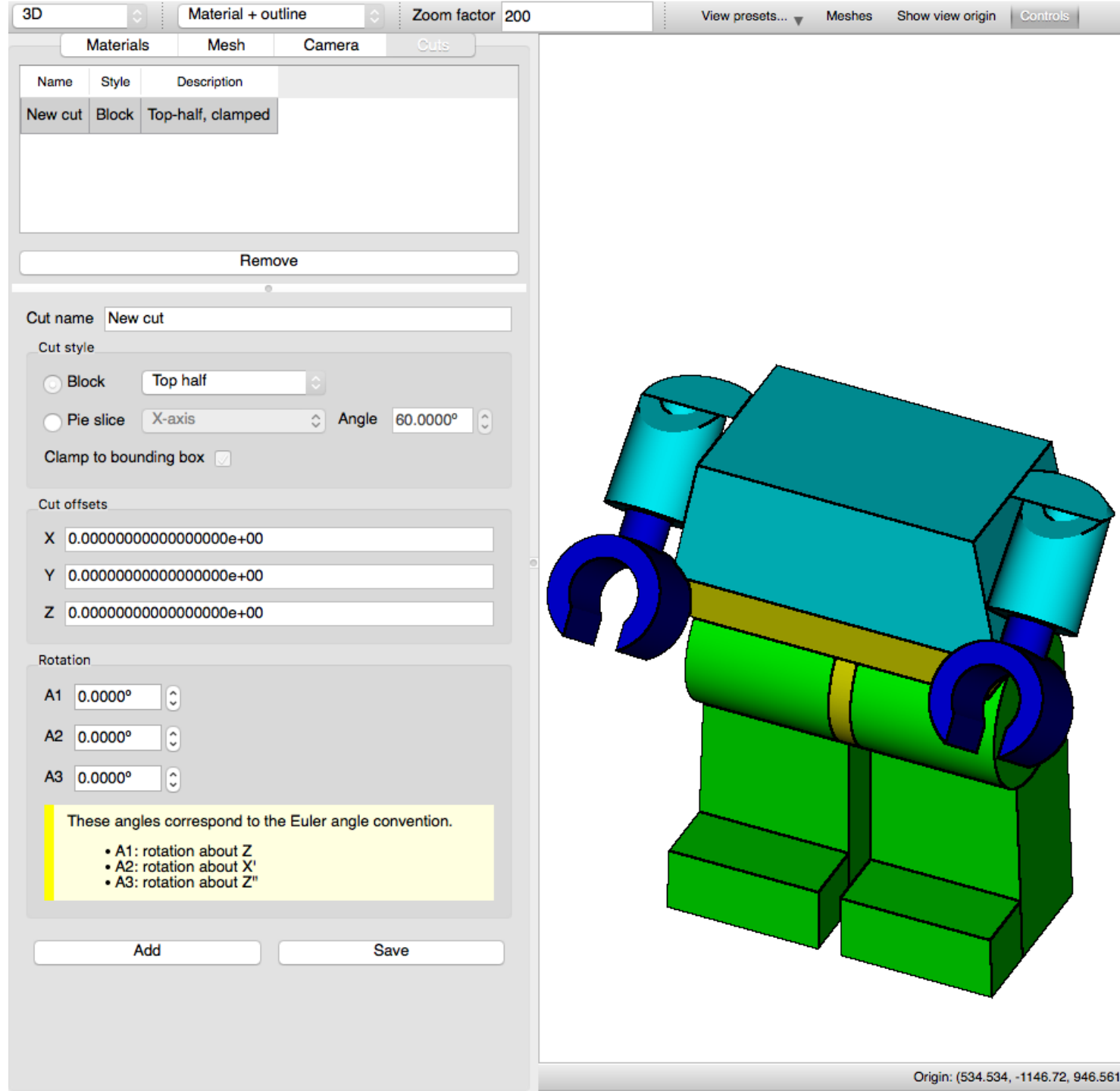
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Model Cutting: Cut Styles

- **Block**
  - Top half (+Z)
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  - **Right half (+X)**
  - Front half (-Y)
  - Back half (+Y)
  - Front-right quarter (-Y,+X)

- **Pie slice**
  - X axis (opening in –Y)
  - Y axis (opening in –Z)
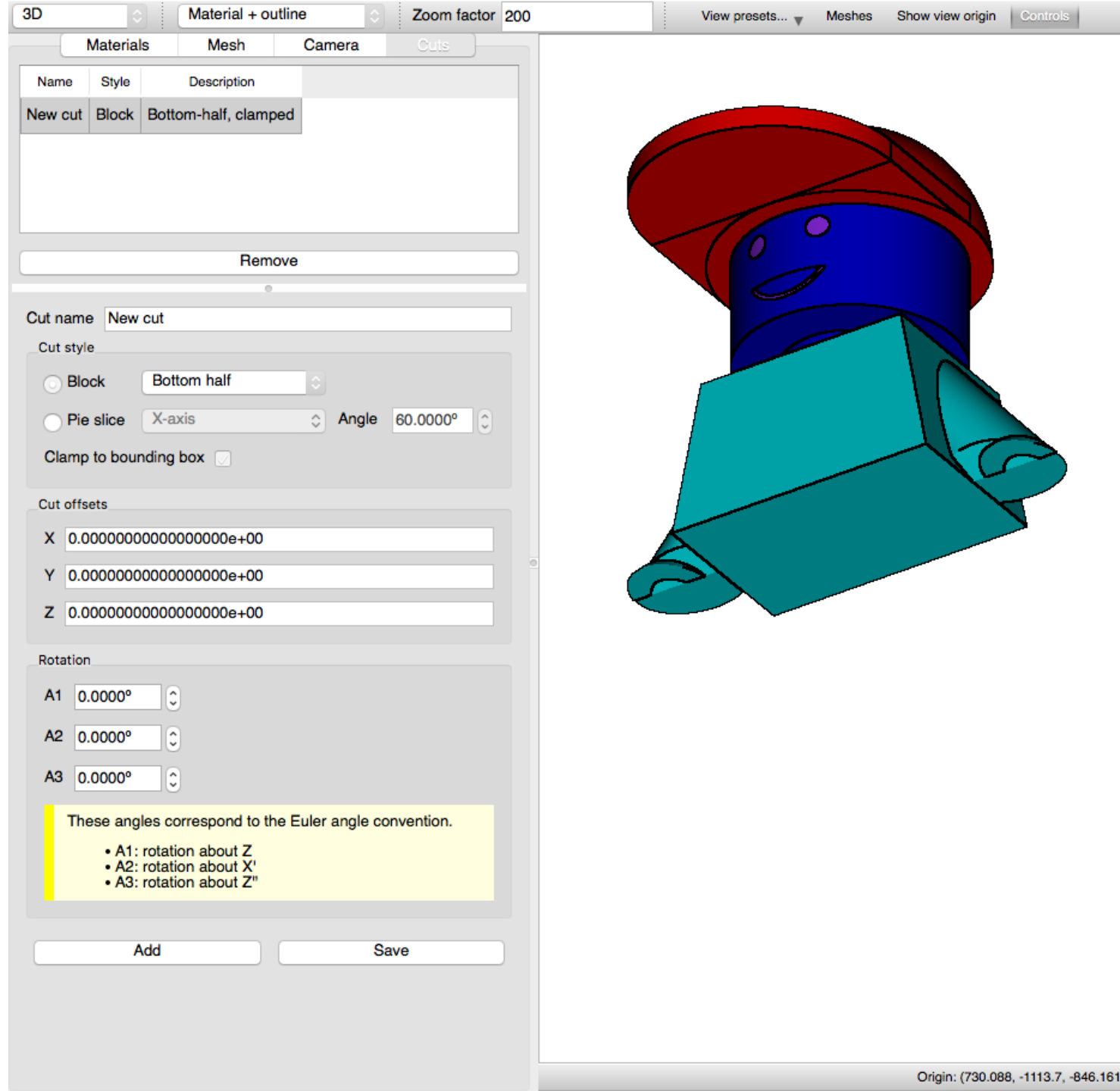 - Z axis (opening in -Y)

Model Cutting: Cut Styles

- ## Block
  - Top half (+Z)
  - Bottom half (-Z)
  - Left half (-X)
  - Right half (+X)
  - **Front half (-Y)**
  - Back half (+Y)
  - Front-right quarter (-Y,+X)

- ## Pie slice
  - X axis (opening in –Y)
  - Y axis (opening in –Z)
  - Z axis (opening in -Y)

🌳 **OAK RIDGE**
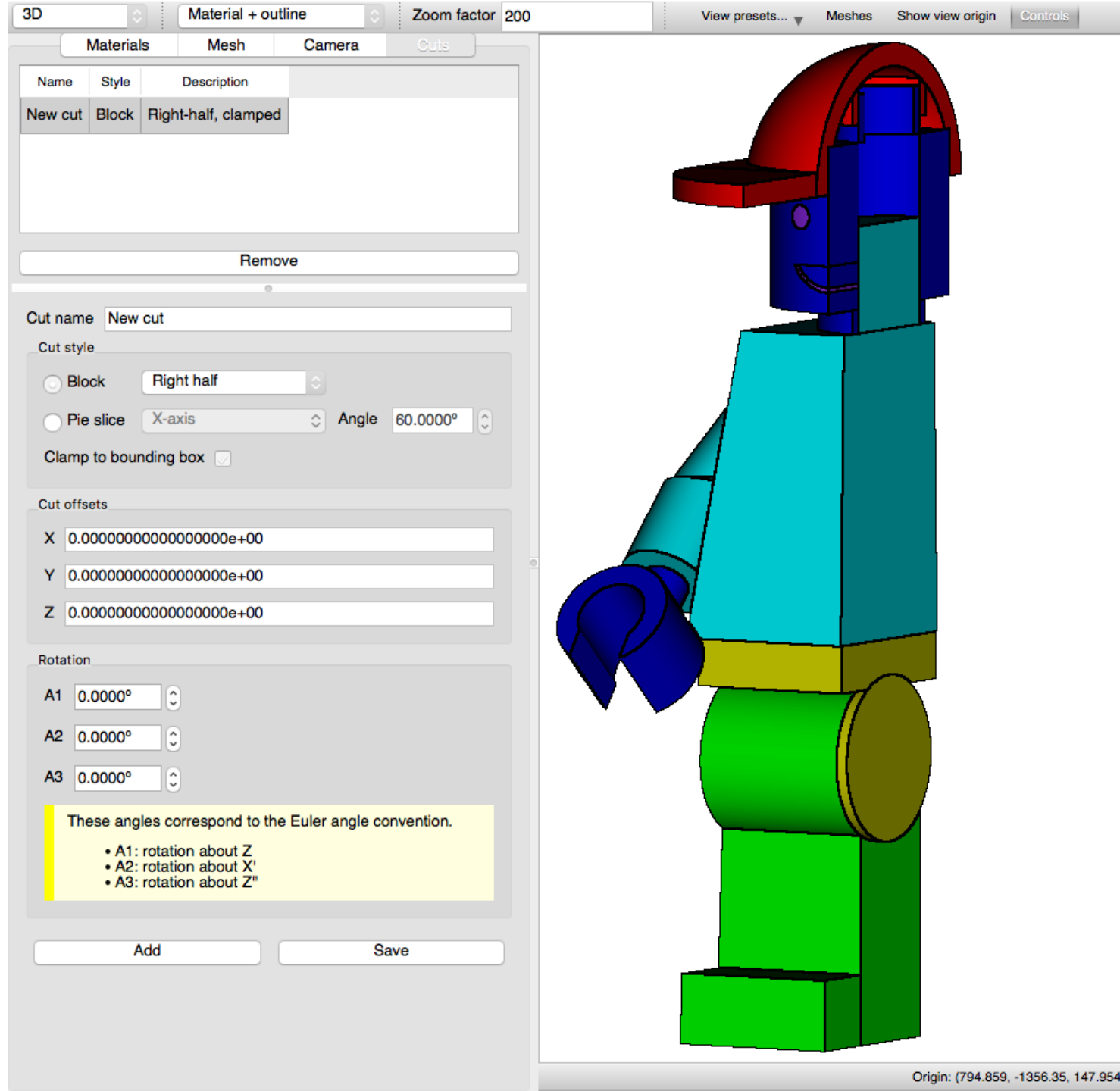National Laboratory

Model Cutting: Cut Styles

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  - Left half (-X)
  - Right half (+X)
  - Front half (-Y)
  - **Back half (+Y)**
  - Front-right quarter (-Y,+X)

- **Pie slice**
  - X axis (opening in –Y)
  - Y axis (opening in –Z)
  - Z axis (opening in -Y)

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Model Cutting: Cut Styles

- **Block**
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  - Right half (+X)
  - Front half (-Y)
  - Back half (+Y)
  - **<u>Front-right quarter (-Y,+X)</u>**

- **Pie slice**
  - X axis (opening in –Y)
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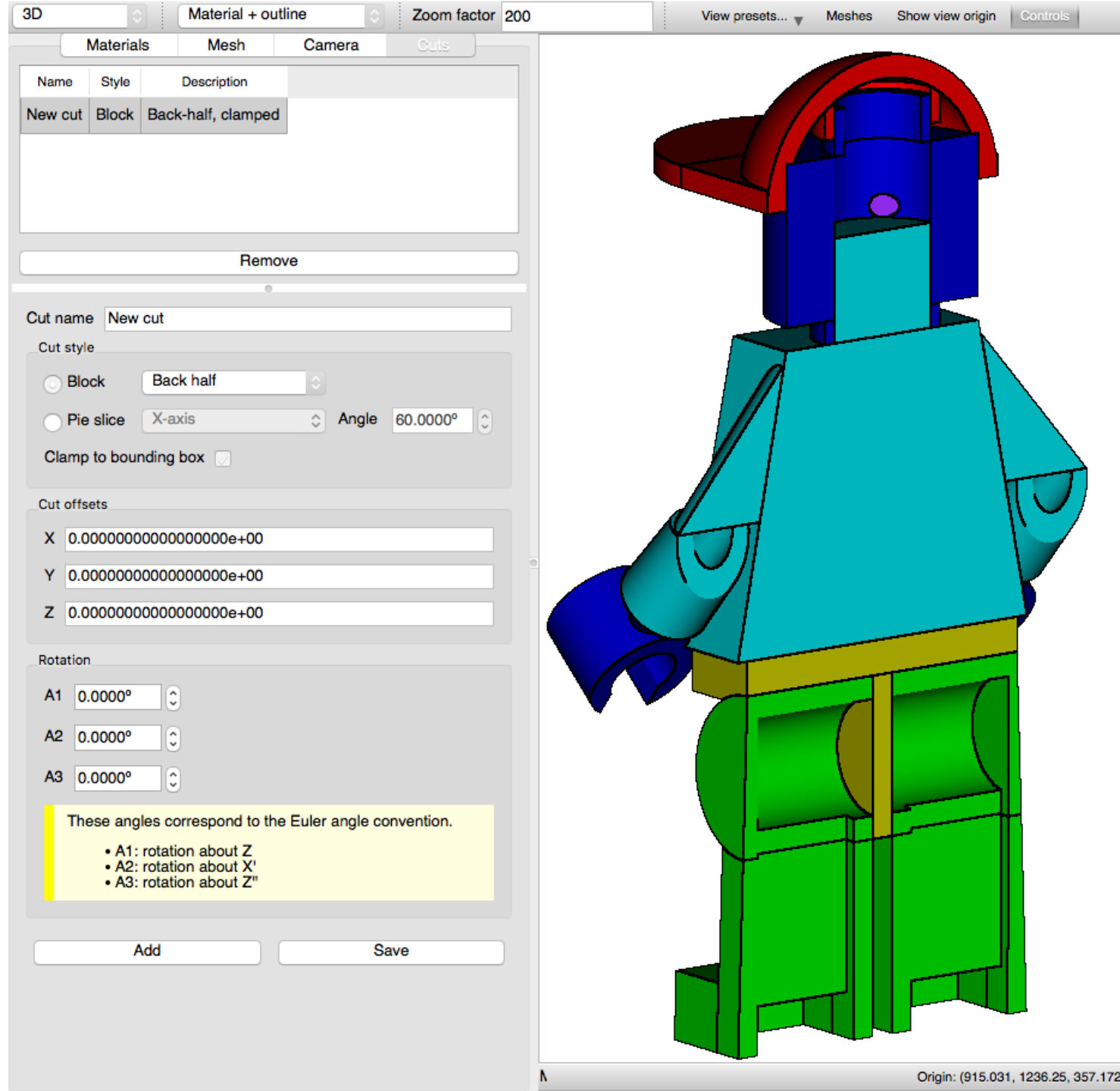
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- ## Pie slice
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  - Y axis (opening in –Z)
  - Z axis (opening in -Y)

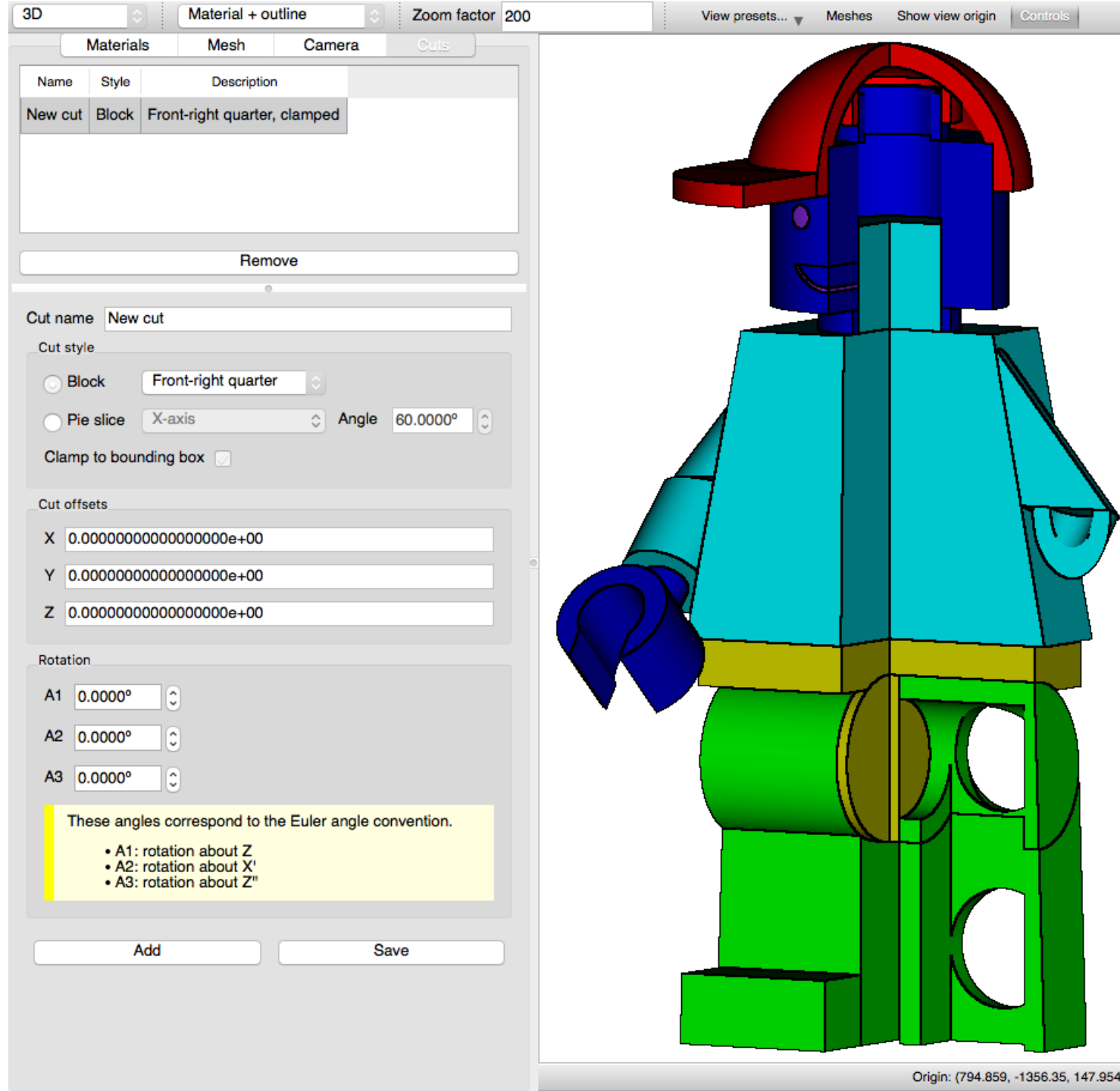**OAK RIDGE**
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Model Cutting: Cut Styles

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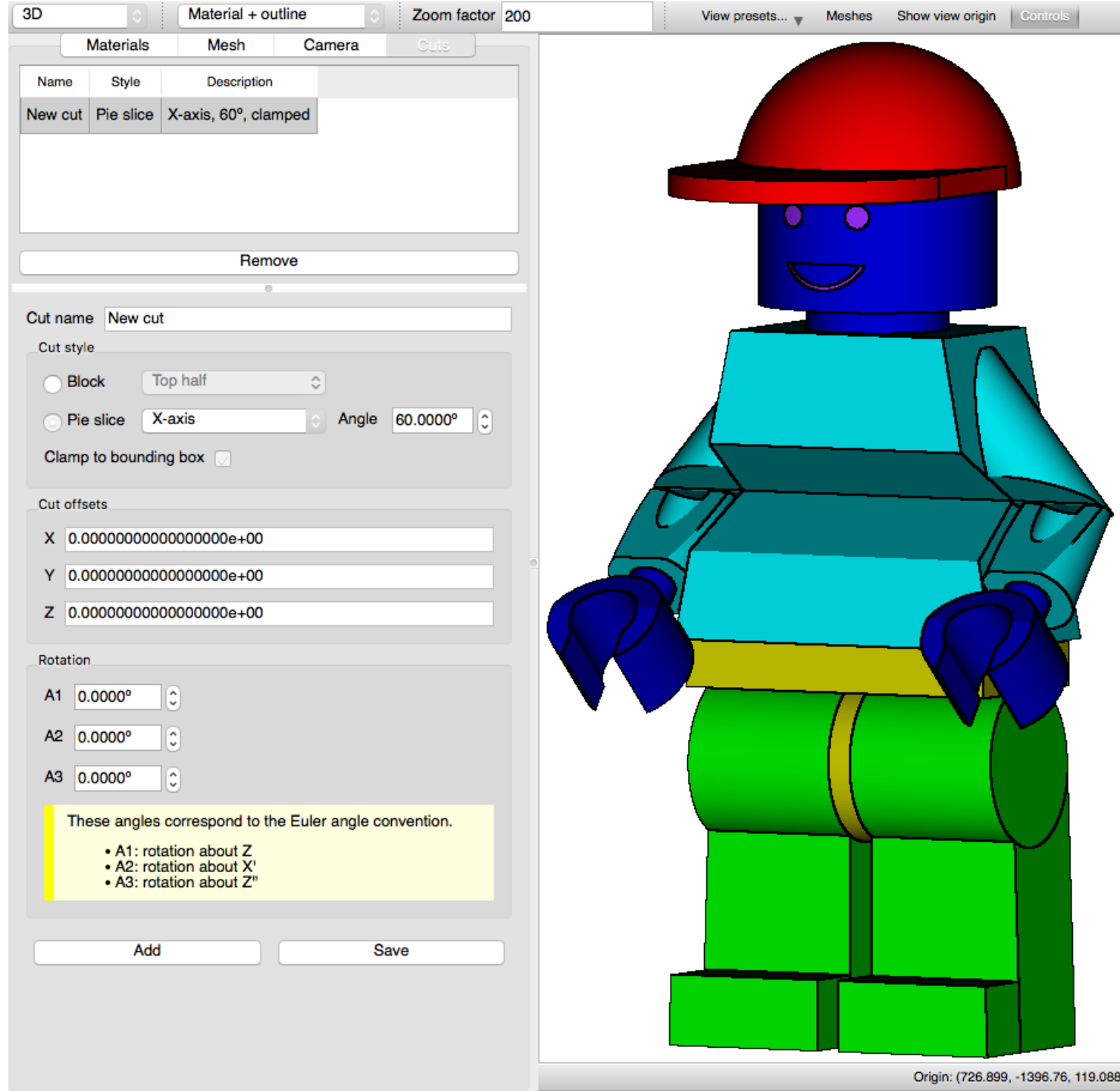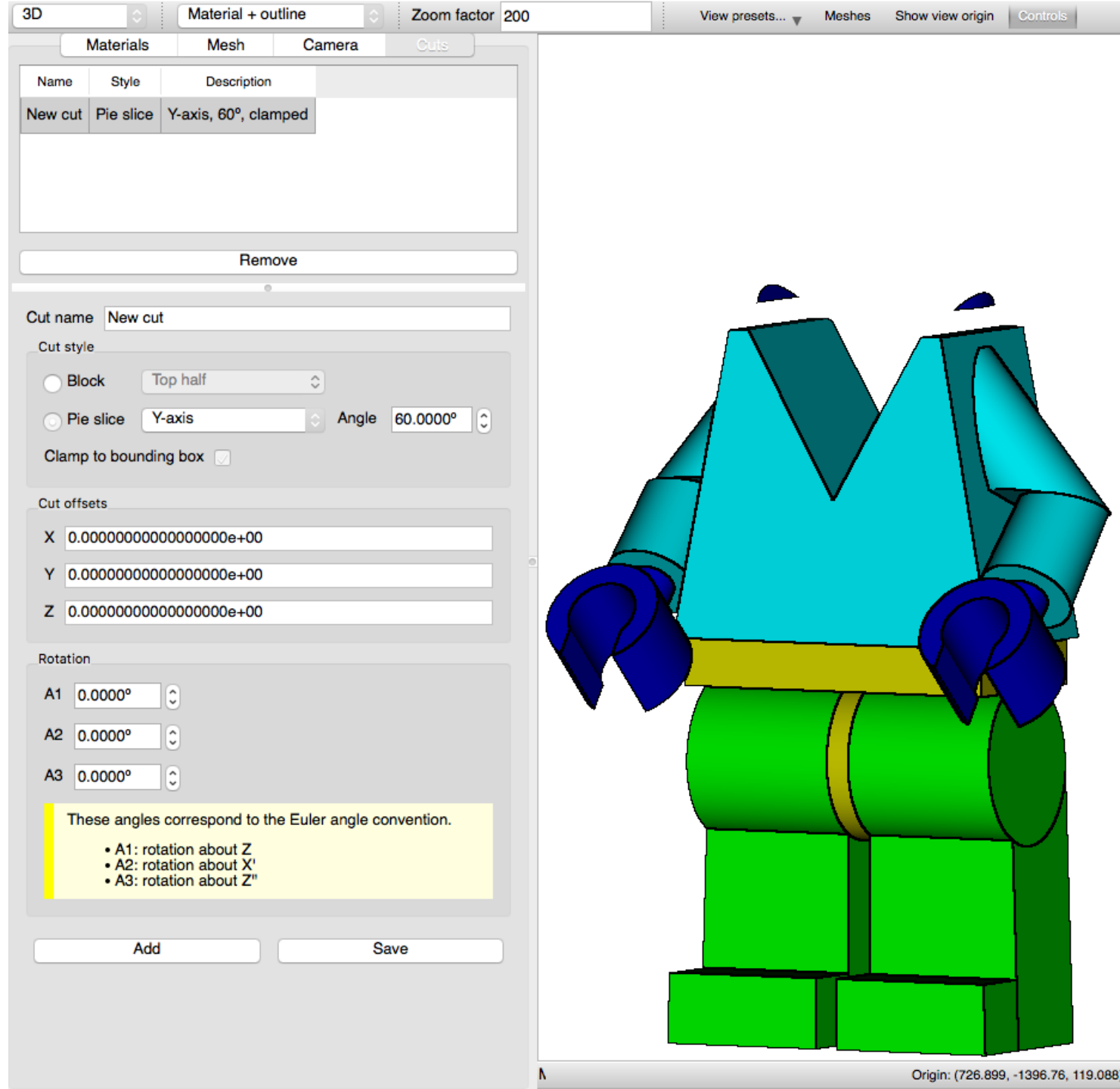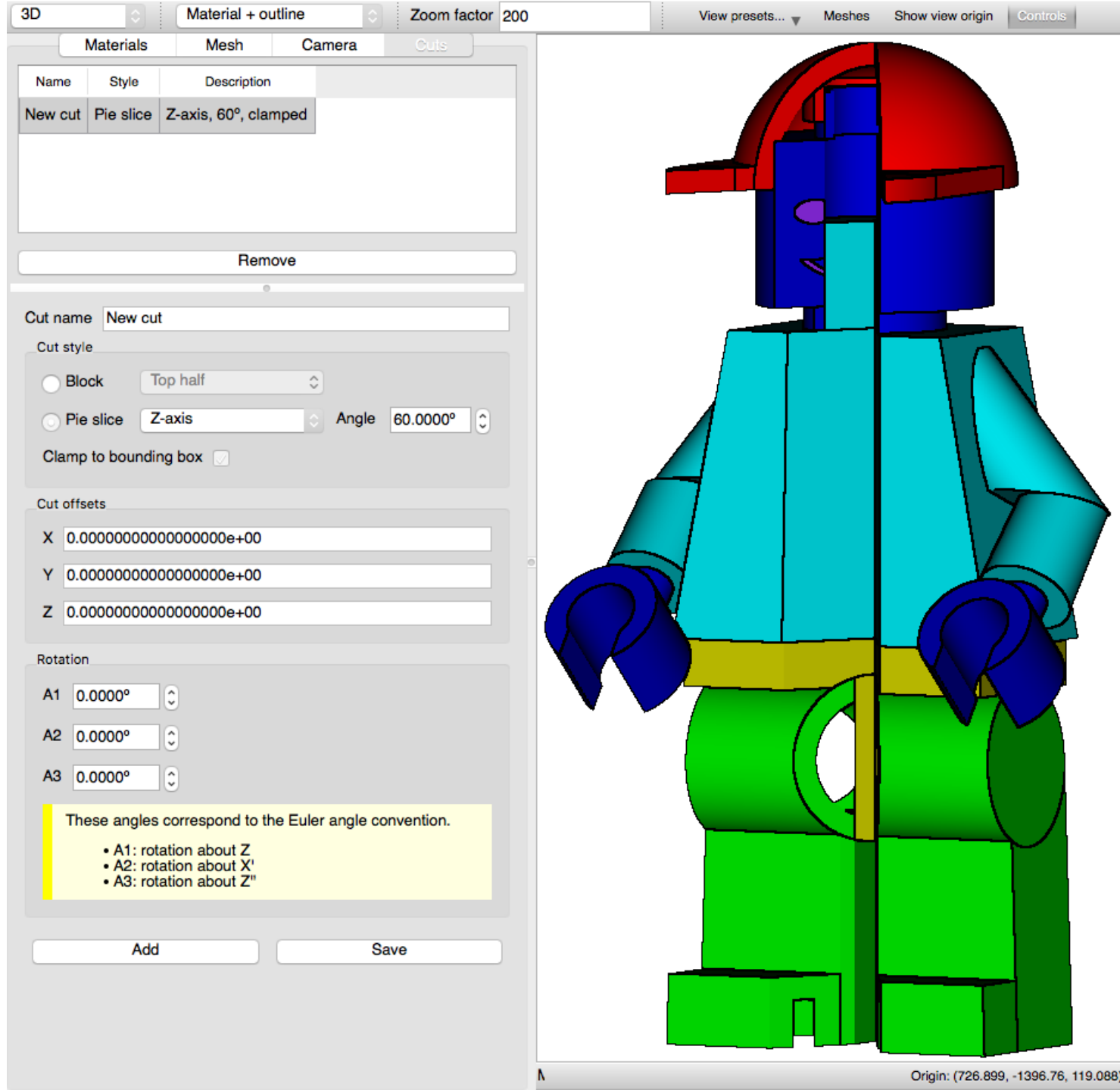
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- ## Block
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- ## Pie slice
  - X axis (opening in –Y)
  - Y axis (opening in –Z)
  - **Z axis (opening in -Y)**

3D Visualization in Fulcrum Summary

- Camera
  - Presets
  - Panning
  - Zooming
  - Rotation

- Rendering modes

- Display metadata

- Material controls
  - Filter material table

- Geometry Cuts

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