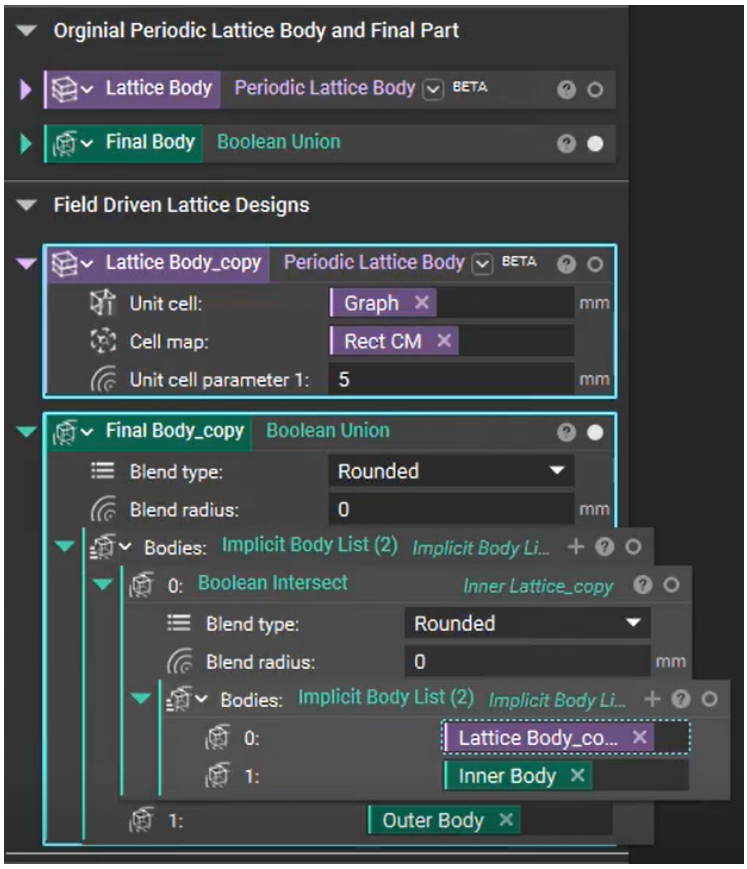
Follow Along: Field Driven Bracket

In this video, we walk through the different ways to use fields to drive the design of a latticed bracket. The lesson will demonstrate how to use the **Ramp** block, the **Transfer Function** block, and the **Mix** block found in the Math Tab → Utilities.

Please download the starter nTop file below to follow along with the tutorial. This file is the completed file without descriptions from the "Follow Along: Periodic Lattice" Lesson in the 210: Intro to Lattices Course.

Step 1: Create a new section called 'Field Driven Lattice Designs'. While holding Ctrl, select both the Lattice Body block and Final Body block and press Ctrl + C to copy. Place the white line under the newly created section of the Notebook, then press Ctrl + V to paste.



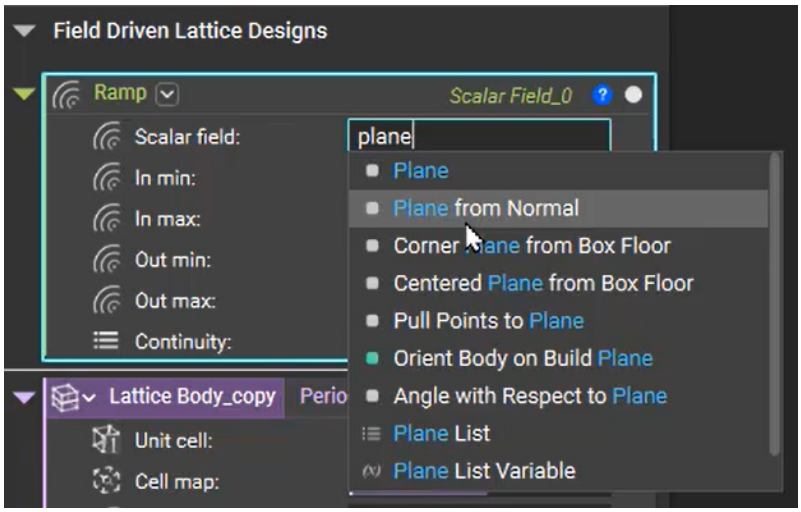
The following steps will create multiple different design variations for the latticed bracket by varying **Periodic Lattice** block's Unit cell parameter 1, which defines the lattice beam thickness.

Ramp 1: Using the Field a Plane

Last updated on 1.1.2022 with version 3.15.2.

Step 2: Add the **Ramp** block to the Notebook, this block will be used to gradually vary the lattice thickness from one point ‘In min’ on the referenced scalar field to the other ‘In max’.

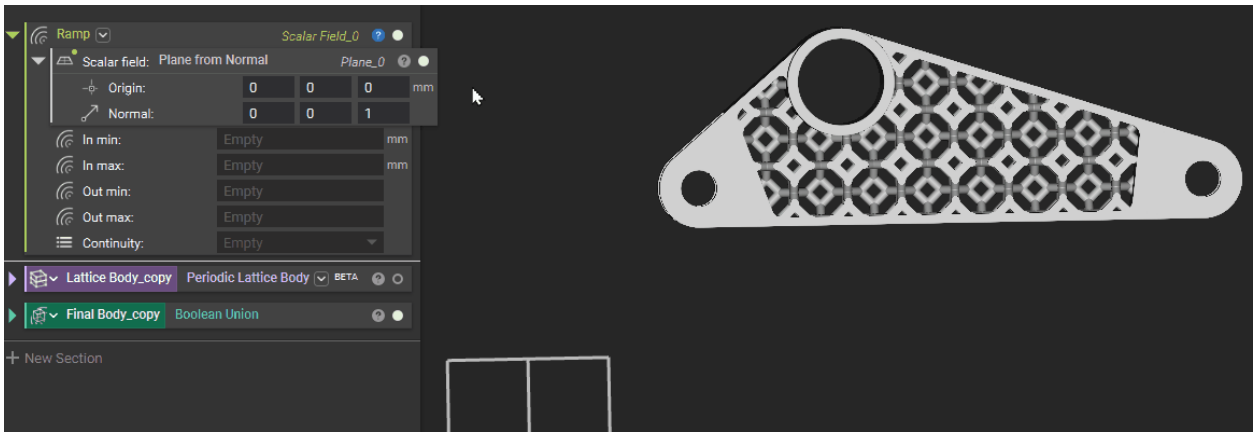
Type ‘Plane’ into the Scalar field input and select **Plane from Normal** from the drop down list.



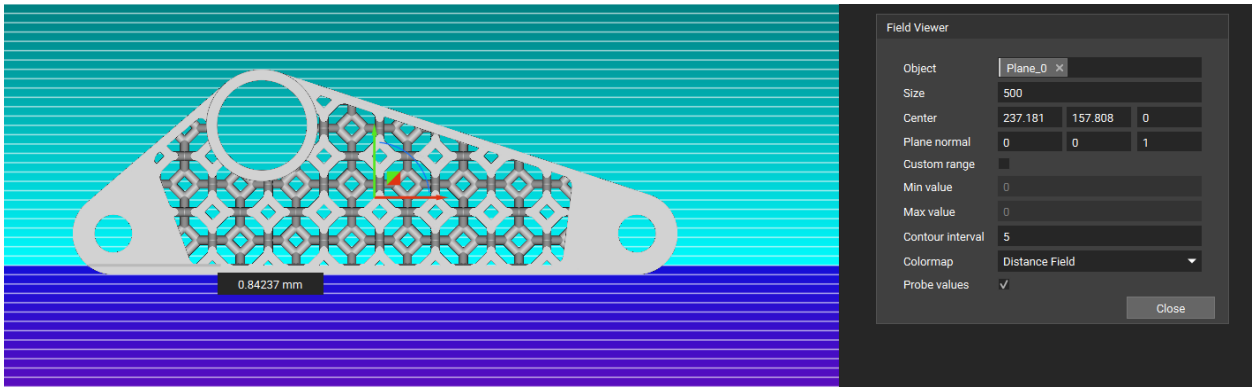
Step 3: Move the plane to the bottom of the trimmed lattice structure where it interfaces the outer bracket frame, this will serve as the zero reference point.

To do this, click into the Origin input field then drag the gimbal on the plane. For more precise placement, use the bounding box’s *min point* property from the Inner Body’s properties panel or type ‘Inner Body’ into the Origin input field to select the block and access its properties via drop down lists (press enter after selecting min point).

Change the Normal to [0, 1, 0]. This will indicate the direction of change.



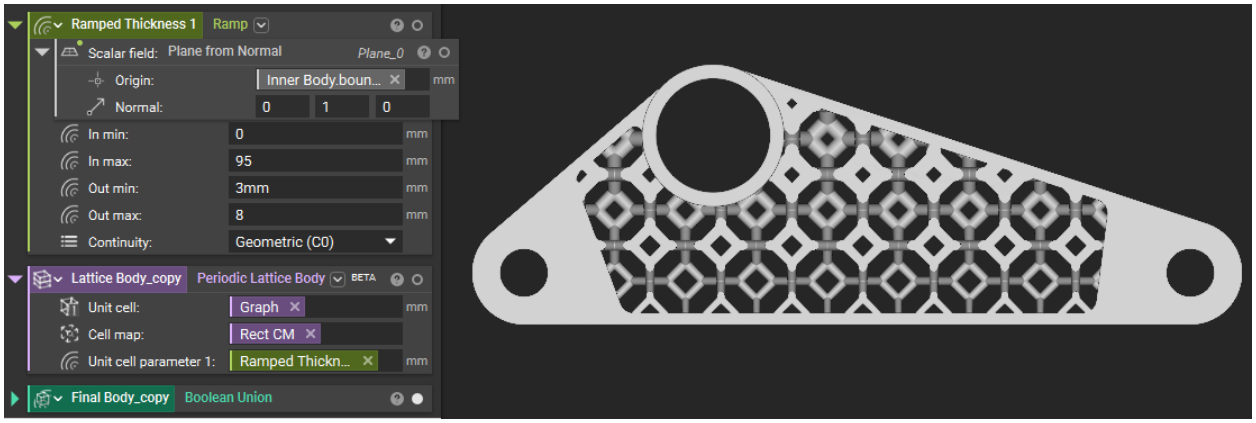
Step 4: Select the **Plane from Normal** Block and press ‘F’ on the keyboard to view its field with the visibility of the original ‘Final Body’ turned on. Move the field to where the Bracket is then adjust its size to 500, give a contour interval of 5, and check probe values.



Notice the value of the field is zero where the plane is placed and increasingly positive in the direction of the normal the farther away from the plane.

Step 5: Choose values for ‘In min’ and ‘In max’ on the field corresponding to the locations of the start and end of the change. Define the starting beam thickness ‘Out min’ and ending thickness ‘Out max’. Choose Geometric Continuity. Remember to input units!

Make the block a variable called ‘Ramp Thickness 1’, use it as input for Unit Cell Parameter 1 and isolate ‘Final Body_copy’ to see the result.

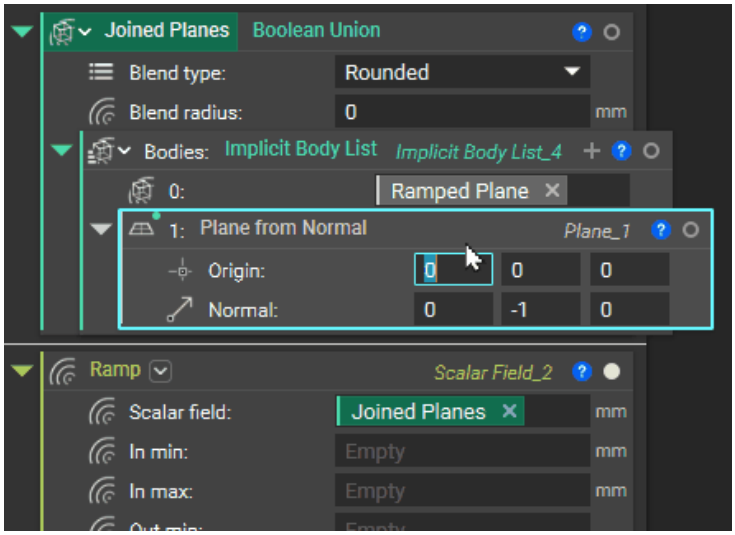


Ramp 2: Using the Field Two Unioned Planes

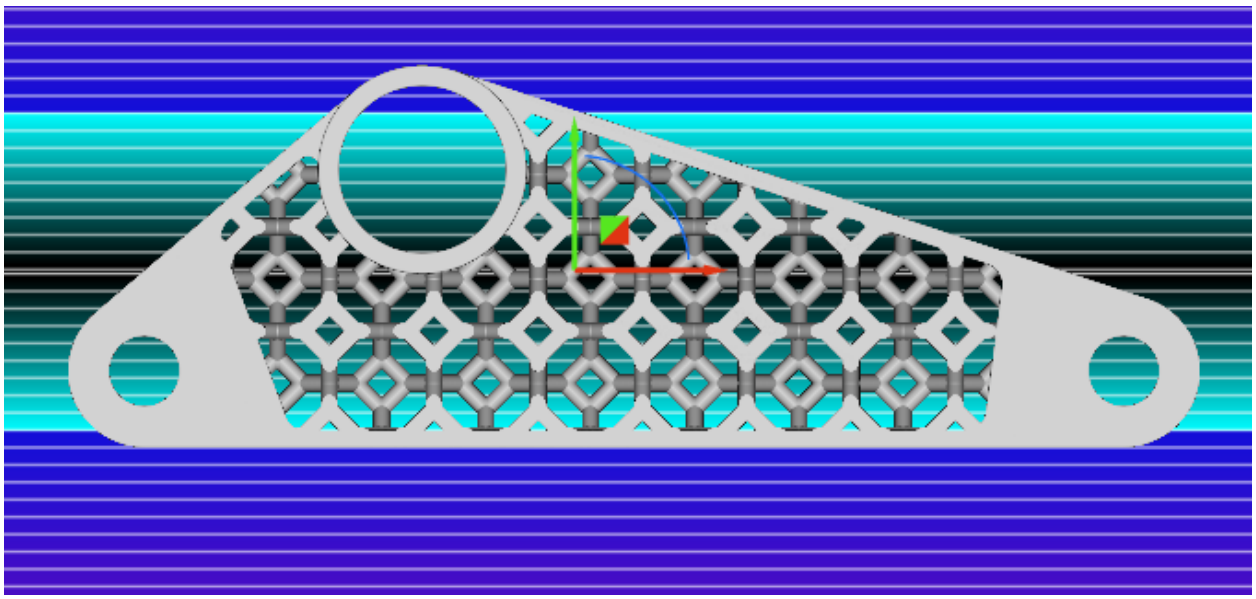
Step 6: Add a new **Ramp** block to the Notebook. For the Scalar field input, create ‘Joined Planes’ by unioning a new **Plane from Normal** with the previously created one. Make the previously created plane into a variable named ‘Ramp Plane’ to reuse it in the **Boolean Union** block.

Last updated on 1.1.2022 with version 3.15.2.

Place the new plane at the top of the lattice structure this time, using the Inner Body's bounding box's *max point*, and change the normal to [0,-1,0].



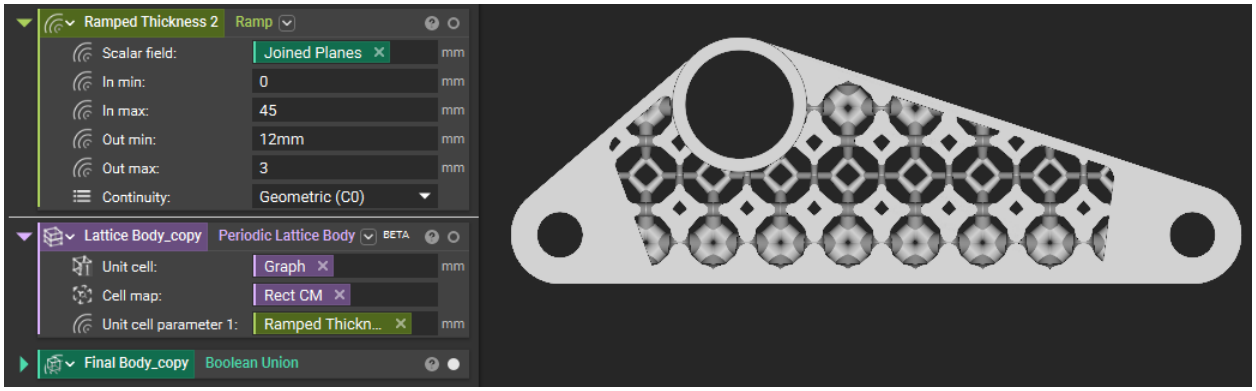
Turn off the visibility of the **Boolean Union** block and view its field with the original 'Final Body' turned on, using the same Field Viewer settings as in **Step 4** to probe for in min and in max values.



Notice the values of the field at the top and bottom of the lattice structure where the two planes are placed are 0 and both increasingly positive in their normal directions, reaching a maximum value at the midpoint between the two planes.

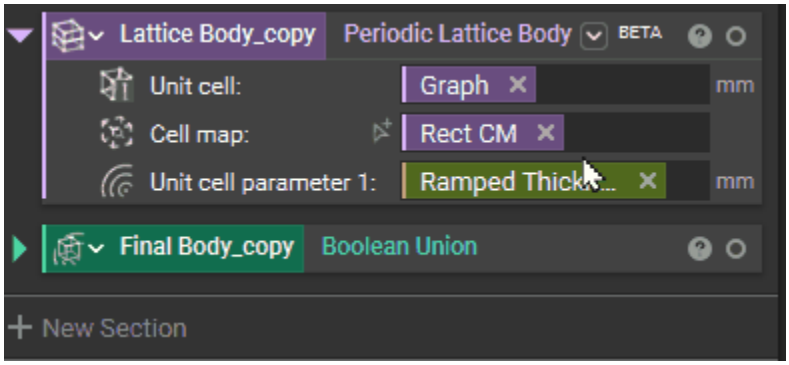
Step 7: Fill out the In min, In max, Out min, Out max and choose Geometric Continuity (see image below).

Make the block a variable called ‘Ramp Thickness 2’, use it as input for Unit Cell Parameter 1 and isolate ‘Final Body_copy’ to see the result.

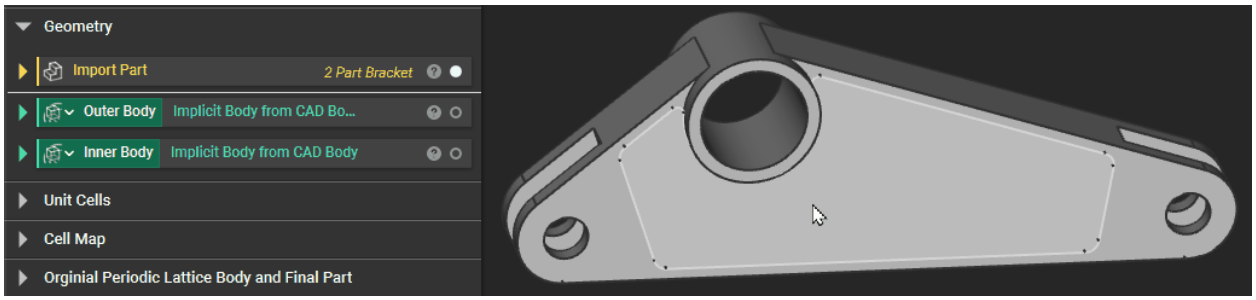


Ramp 3: Using the Field of the Hole Surface’s Implicit Body to Create a Radial Change

Step 8: Change the Cell Map type of the ‘Lattice Body_copy’ block to ‘Cyl CM’

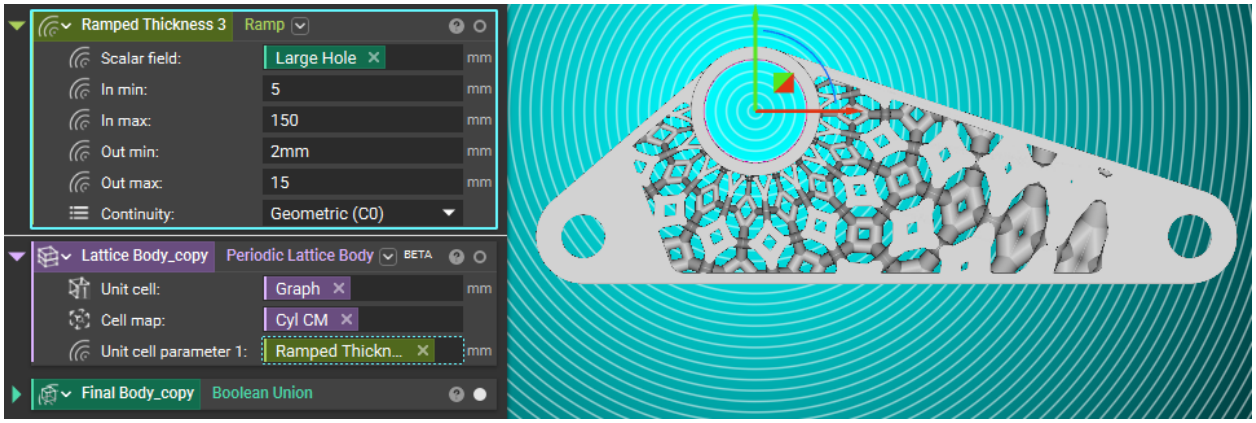


Step 9: Add a new **Ramp** block to the Notebook. For the Scalar Field, create ‘Large Hole’ Implicit body by converting the CAD surface into an implicit body and using **Thicken Body** block to add 1 mm thickness to the surface.

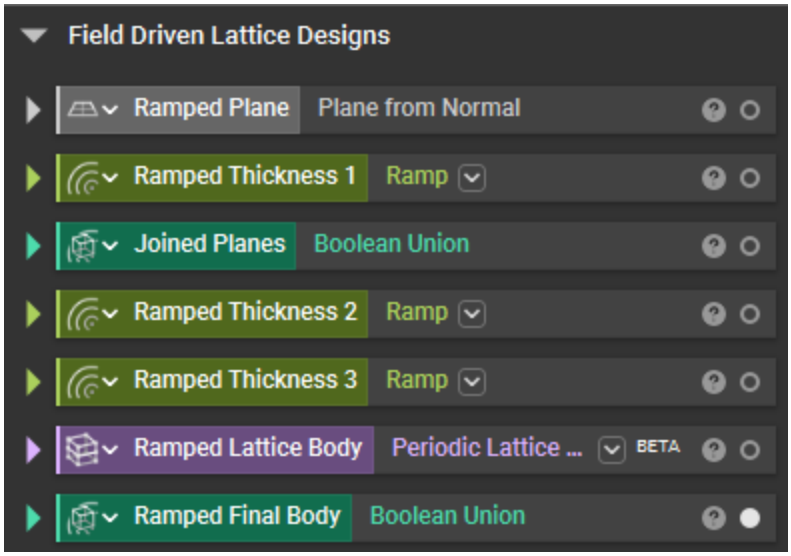


Step 10: View the field of 'Large Hole' Implicit Body using the same Field Viewer settings as in **Step 4** to probe for in min and in max values. Fill in these values into the new **Ramp** block along with Out min and Out max values (see image below). Choose Geometric Continuity.

Make the block a variable called 'Ramp Thickness 3', use it as input for Unit Cell Parameter 1 and isolate 'Final Body_copy' to see the result.

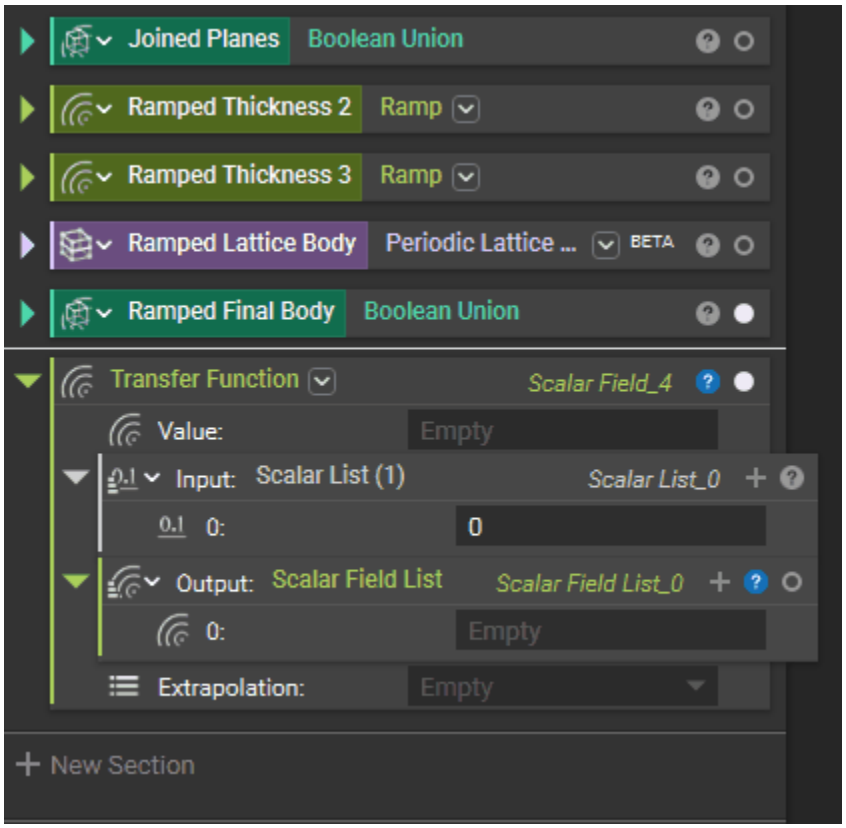


Step 11: Rename 'Lattice Body_copy' and 'Final Body_copy' to 'Ramped Lattice Body' and 'Ramped Final Body' respectively. Collapse all blocks.



Transfer Function

Step 12: Add **Transfer Function** block to the Notebook. Hold Ctrl to select both Ramped Lattice Body and Ramped Final Body blocks, press Ctrl+C and Ctrl+V to copy and paste them at the end of the Notebook.



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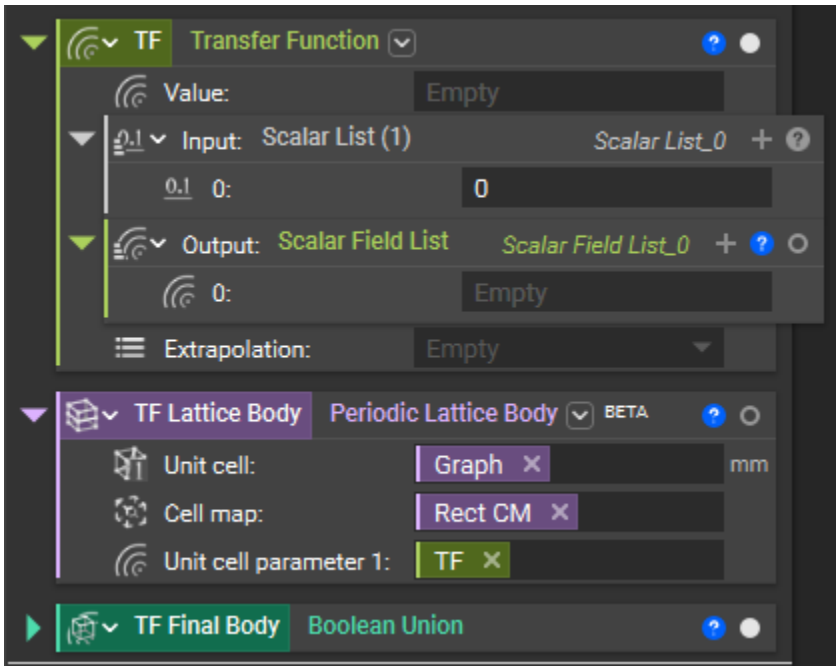
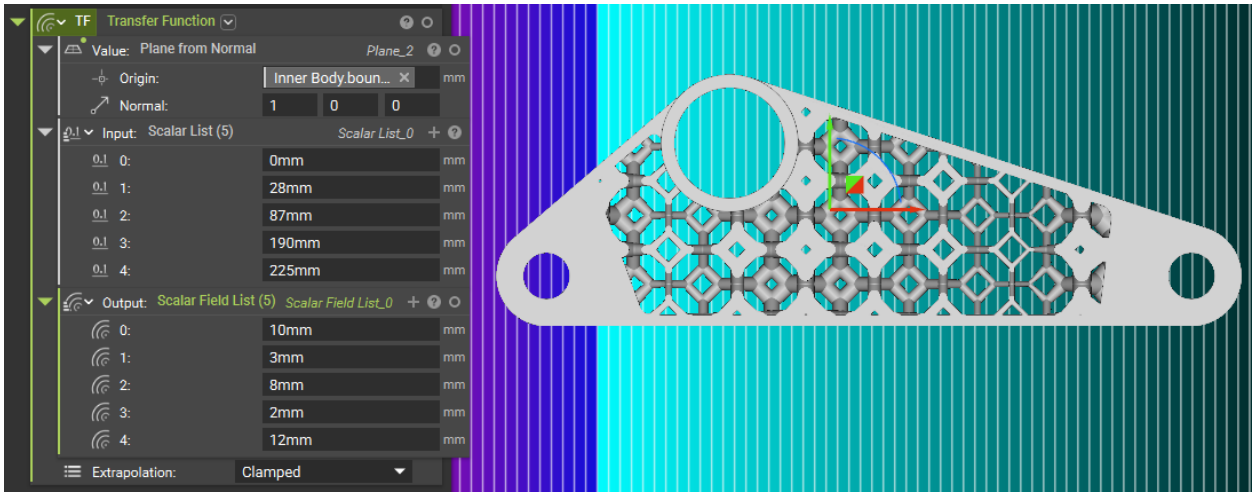
Step 13: Rename the two blocks to ‘TF Lattice Body’ and ‘TF Final Body’. Make the Transfer Function block a variable called ‘TF’ and input it into Unit cell parameter 1. TF stands for Transfer Function.

Change the Cell map back to ‘Rect CM’.



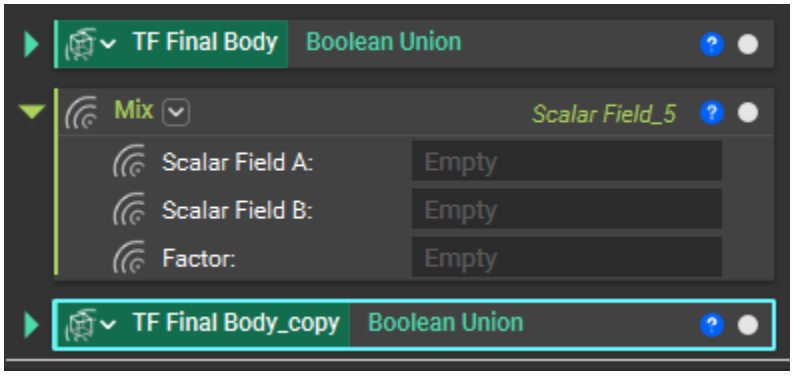
Step 14: In the value input of TF, use a **Plane from Normal** block with the same origin as ‘Ramp Plane’ and set the normal to [1,0,0]. View the field of this plane to probe input values at desired locations on the lattice structure and fill out the output thickness values. Make sure to include units. Choose clamped extrapolation.

Isolate ‘TF Final Body’ to see the result.

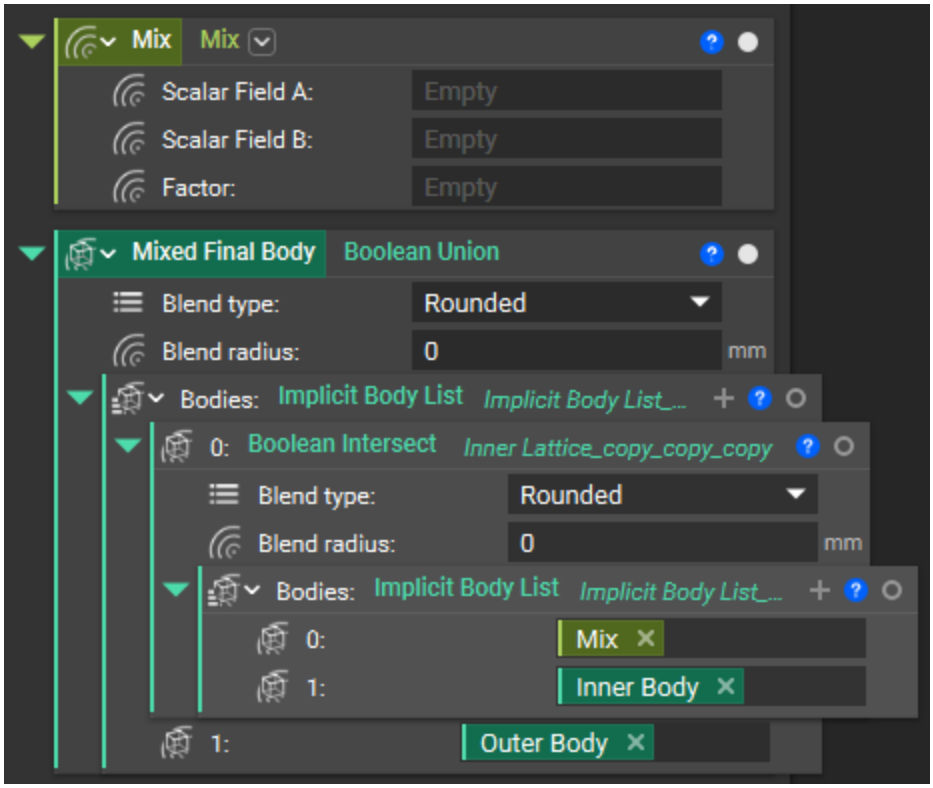


Mix

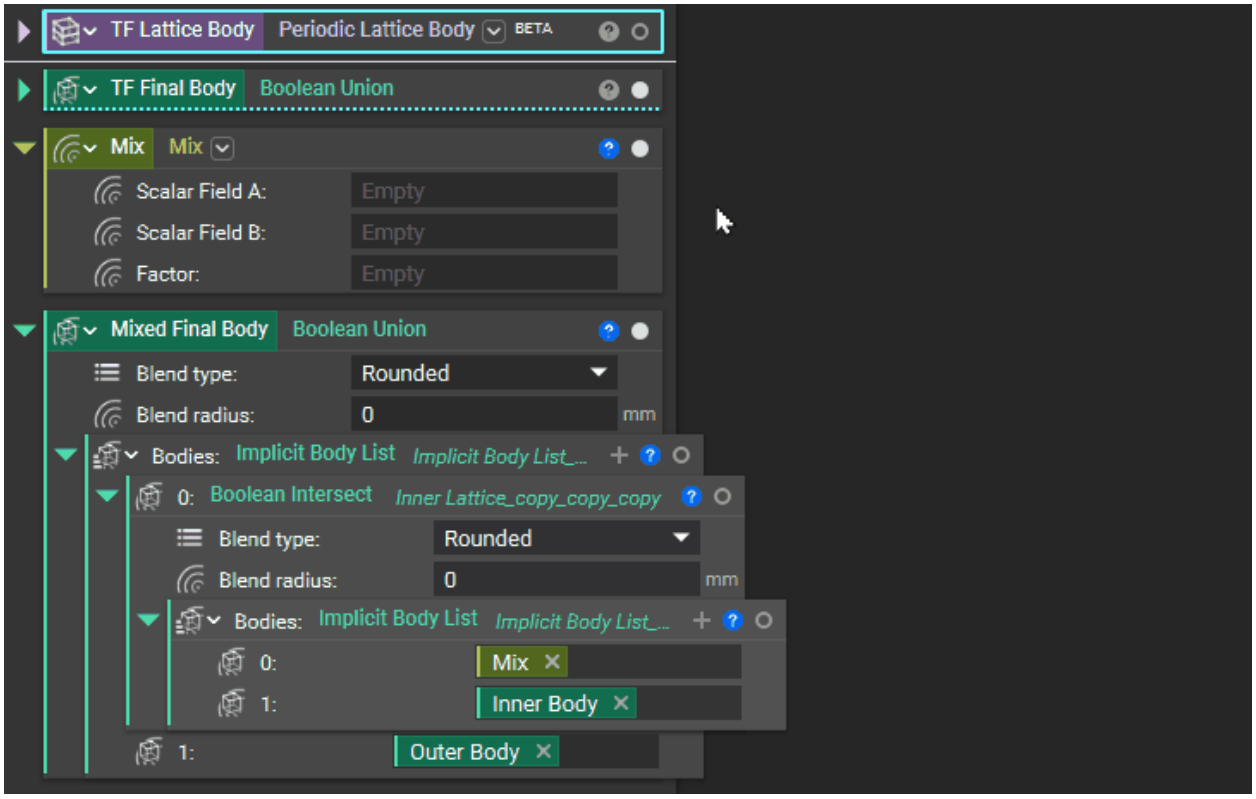
Step 15: Add a **Mix** block to the Notebook. Copy the 'TF Final Body' and paste at the end of the Notebook.



Step 16: Rename 'TF Final Body_copy' to 'Mixed Final Body'. Make the Mix block a variable called 'Mix' and use it as input in the implicit body list within the 'Mixed Final Body' block.

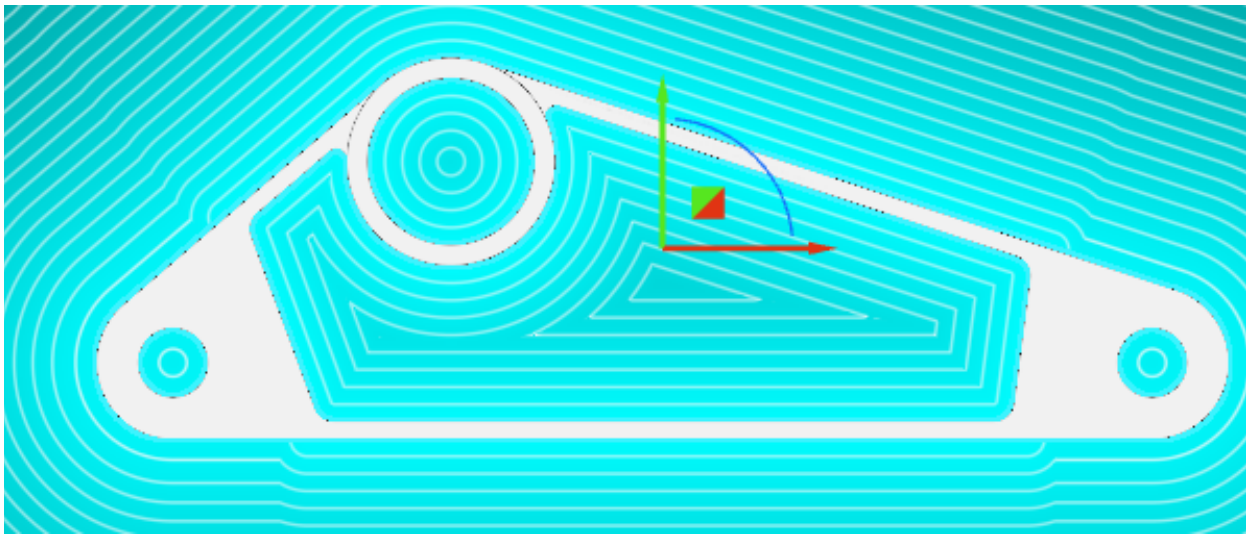


Step 17: For Scalar Field A input, use the implicit property of the ‘TF Lattice Body’. For Scalar Field B, use the Inner Body implicit.



Step 18: Add a **Ramp** block to the Factor input. And use the Outer Body implicit as the Scalar field input to drive the ramp.

View the Outer Body's field and probe values for the **Ramp**'s In min and In max, which represent locations where the blending effect should start and end.



Step 19: The **Ramp** output will become the variable Factor value, which can be between 0 and 1. 0 represents the complete Scalar Field A and 1 represents the complete Scalar Field B.

Isolate ‘Mixed Final Body’ to see the result.