Hardware and 3D Printing Documentation
Robot-assisted Subdermal Foreign Object Detection and Removal
For Franka Emika Panda & Similar Robots

Required Hardware:

1x M6 Bolt - 40mm: attachment of the ultrasound holder to the Franka hand
3x (Optional) M6 Bolt - 10mm: tray fastening depends on mounting surface and tray used

2x M3 Bolt - 45mm: attachment of the clamp to the holder
2x M3 Bolt - 20mm: attachment of the grippers to the end-effector
5x M3 Bolt - 12mm: attachment of malleable materials to rigid bodies

7x M3 Nuts
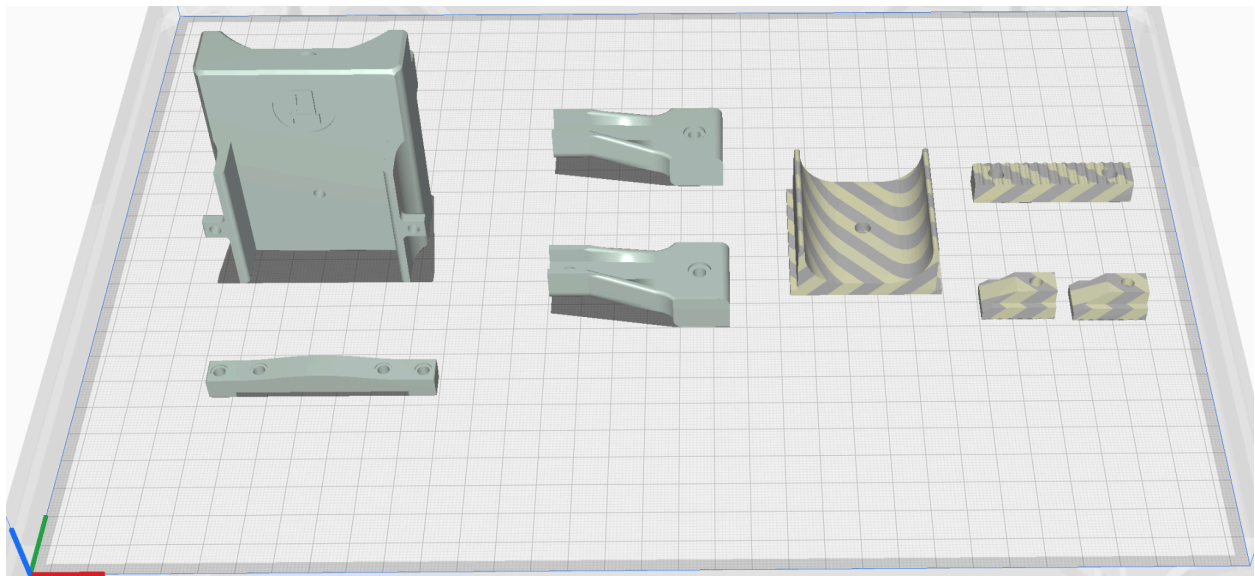6x M3 Thumb Nuts - 12x4mm

Printing Instructions:

Objects shown in light green are to be printed in PLA or another suitable material; it is preferable to use tree supports and print with four walls and 20-35 percent infill, depending on the material.

Objects shown in light blue from left to right are Franka_probe_holder.stl, Franka_probe_holder.stl, and (2x) Franka_gripper.stl

Objects shown in yellow/gray stripes are to be printed in a malleable material such as TPU, and shore hardness; preferably print with a brim, no supports, four walls and use Cross3D or similar deformation-compliant infill pattern at 10-25 percent infill.

Objects shown in striped yellow/gray from left to right are: Franka_probe_softjaw.stl, Franka_probe_holder_softjaw.stl and (2x) Franka_gripper_softjaw.stl

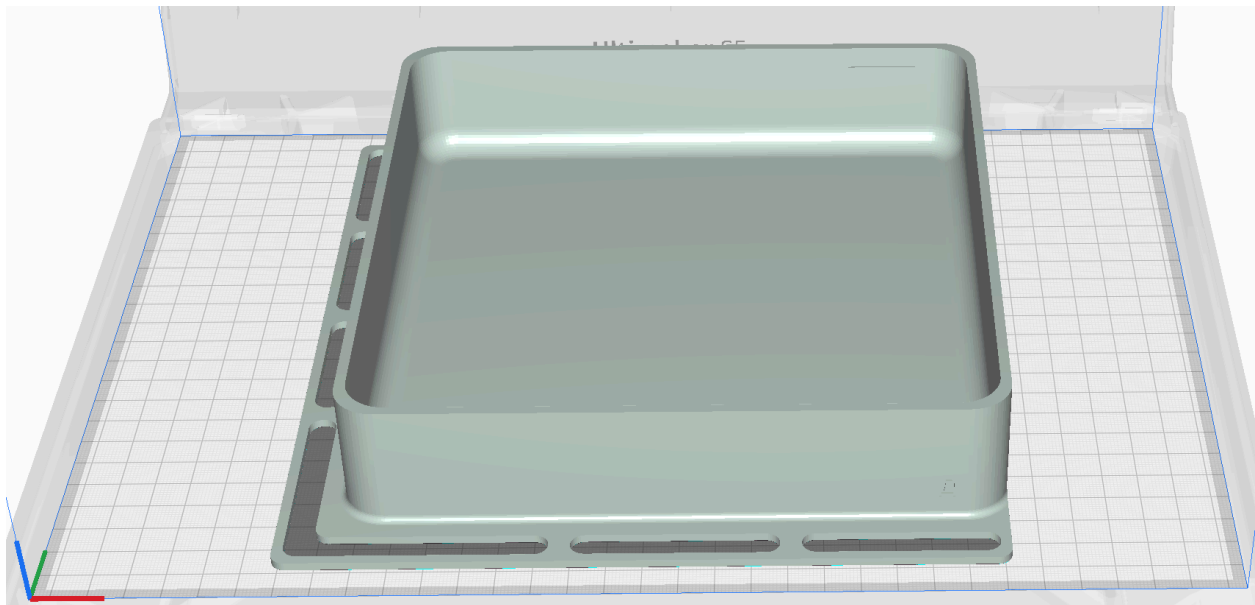Below is the suggested printed orientation for each object:

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You may use the tray provided as Tray_surgery_mock.stl to hold ultrasound gel/liquid for the surgery mock; any other rigid pan or tray will also work, but it must be fastened and waterproofed correctly.

The figure below shows the orientation for printing Tray_surgery_mock.stl; use an attachment glue as large flat square objects will warp when cooling for most materials. Print in PLA or another suitable material; no supports are needed, and print with six walls and 20-35 percent infill, depending on the material. Use as large of a skirt as possible when printing.

The Tray used in this project is quite large and may not be suitable for all users depending on printer limitations; users should scale the mock or use an alternative method to hold the gel/water and shrapnel.

Assembly:
Use 12mm M3 bolts to attach all TPU parts to rigid parts, with bolts.
Use the 20mm M3 bolts and the thumb screws to attach the grippers to the flange extenders.
Use the 45mm M3 bolts to attach the clamp to the ultrasound holder, alongside two bolts and four thumb screws.
Use the 40mm M6 bolt to attach the probe holder to the Franka Panda robot.

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Photos of assembled components are provided below: