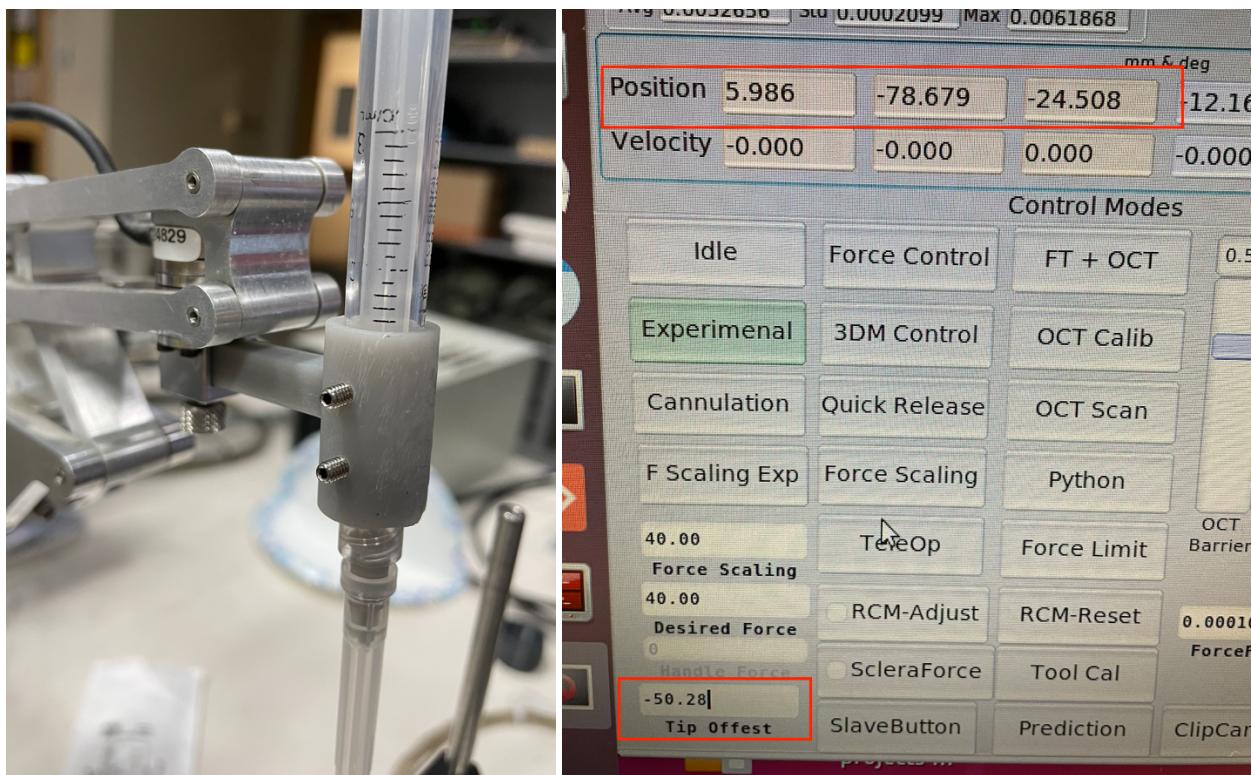


The following is the procedure of subretinal injection using keyboard control for intact eye experiments:

Commands are marked italic and blue, and you can find the code in the user named peiyao on the exx desktop.

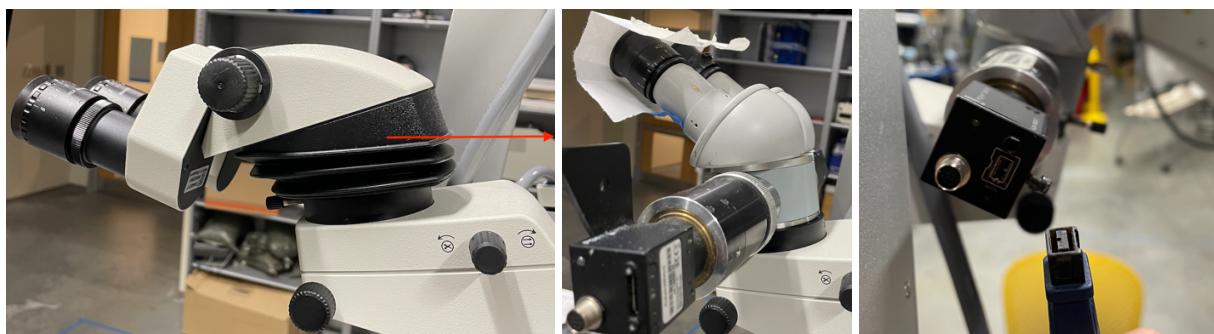
#### Experimental Setup:

1. Mount the syringe to the end-effector of the robot and set the offset to get the tool-tip position in the GUI



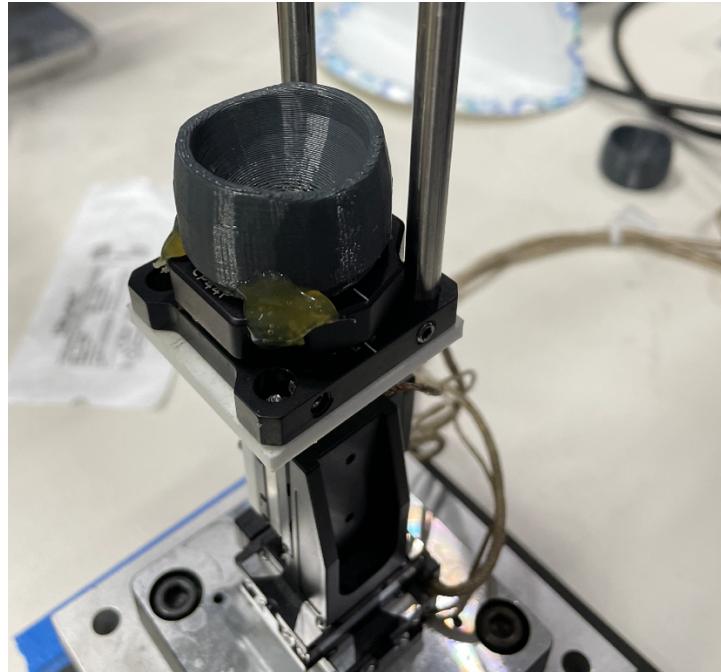
2. Replace the assistant ocular with Zeiss ocular, which has a camera mounted on the side. Connect the firewire cable to the camera and desktop. Visualize the top-down view using:

*sudo coriander*

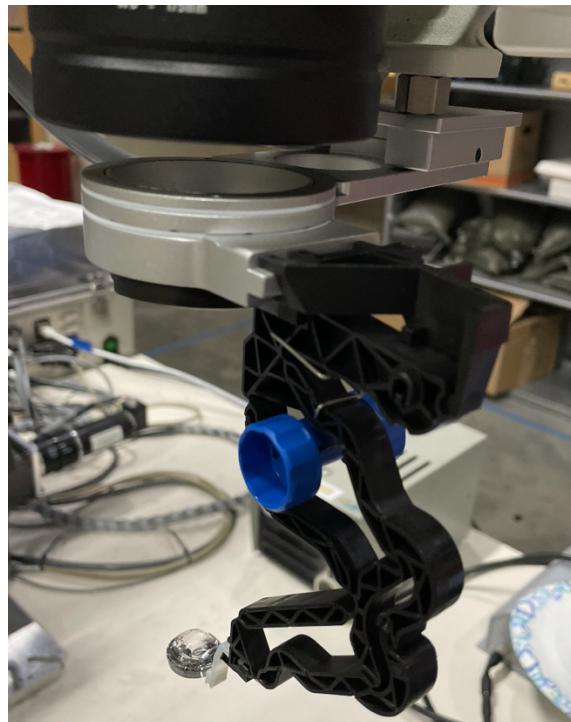


3. Mount an eye socket to the XYZ linear stage; adjust the linear stage to the proper position using:

```
cd peiyao/xyz_linear_stage  
python xyz_stage_move_to_position.py
```



4. Mount the BIOM lens to the Leica OCT system



5. Prepare the eye by removing the surrounding tissues and insert two trocars on the scleral wall (one for surgical needle and one for light source)
6. Turn on the Leica OCT system; move the microscope to proper position until we can see clear top-down view and B-scan image of the retina
7. The over all setup before starting experiment (the following figure only contains one trocar, because we only have 23G trocars and the size of the used light source is 20G) :



#### Experimental Procedure:

1. Turn on the robot

*roscore*

*rosrun eye\_robot\_example eye\_robot\_example*

2. Control the surgical needle to insert into the trocar a little bit using Experimental mode and record current tooltip position as the rcm position. Change the rcm position in peiyao/keyboard\_controller/src/ keyboard\_controller/key\_move/src/key\_move.py
3. Switch to Cannulation mode and navigate the surgical needle to the desired initial position inside the camera view
4. Initialize the keyboard controller:

*cd peiyao/keyboard\_controller*

*sudo -s*

*source devel/setup.bash*

*rosrun key\_publisher key\_publisher.py*

open another terminal:

*cd peiyao/keyboard\_controller*

*source devel/setup.bash*

*rosrun key\_move key\_move.py*

Now we can use the keyboard to control the movement of the surgical tool:

Up arrow: move up

Down arrow: move down

Left arrow: move left

Right arrow: move right

U key: increase the height (move along positive z axis)

D key: decrease the height (move along negative z axis)

F key: move forward along the tool shaft direction

B key: move backward along the tool shaft direction

5. Navigate the surgical tool to the used defined position above the retina using the top-down camera view
6. Manually select the B-scan position to visualize the needle in the B-scan
7. Insert the needle to the position above the RPE layer
8. Inject the liquid manually until a detachment is seen in the B-scan (see the following figure):

