Description of the kuka:

We used a Kuka LBR iiwa 14 R820 to control the position of the probe. The arm is 7 axis collaborative robot, with rounded features and torque sensors in every axis for providing force feedback. With a high level of precision and safety, the robot is widely used in medical procedures and research. We mounted the probe on the Kuka media flange touch electric. The media flange allowed for rigid mounting of the probe. It also allows for electrical signals to be sent to the robot controller or to a connector at the base of the robot, which could provide better wiring setups and would probably be necessary for larger samples or a more robust setup.

How the kuka was used in the experiments:

The probe was positioned vertically facing downwards at the beginning of the program, and it stayed in that orientation for the entire duration. The program was split into two parts: tracing the surface and then performing frequency sweep at specific points. For the tracing, a TCP server running in python allowed for data from the probe’s encoder to be forwarded to the kuka for surface detection. The kuka was commanded to move in a zigzag pattern across the surface, moving downwards at various horizontal positions until it touched the surface. The coordinates of the surface were calculated with the encoder value and saved in a csv file. For the frequency sweeps, the kuka was commanded to move to several horizontal positions. The optimal height for performing the frequency sweep was able to be calculated from the previously recorded trace data.