# MECH467 Prelab #3

Ratthamnoon Prakitpong
#63205165

A1.

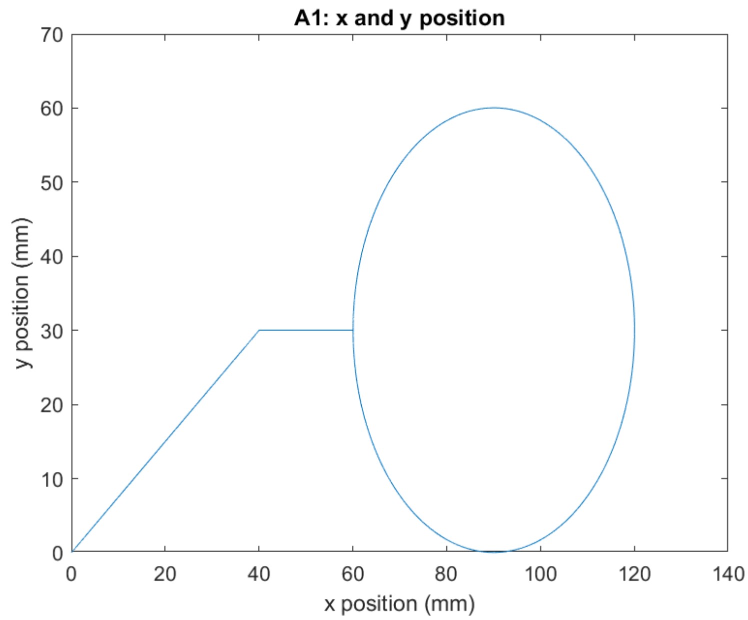


Fig A1: X and Y position of sample trajectory

A2.

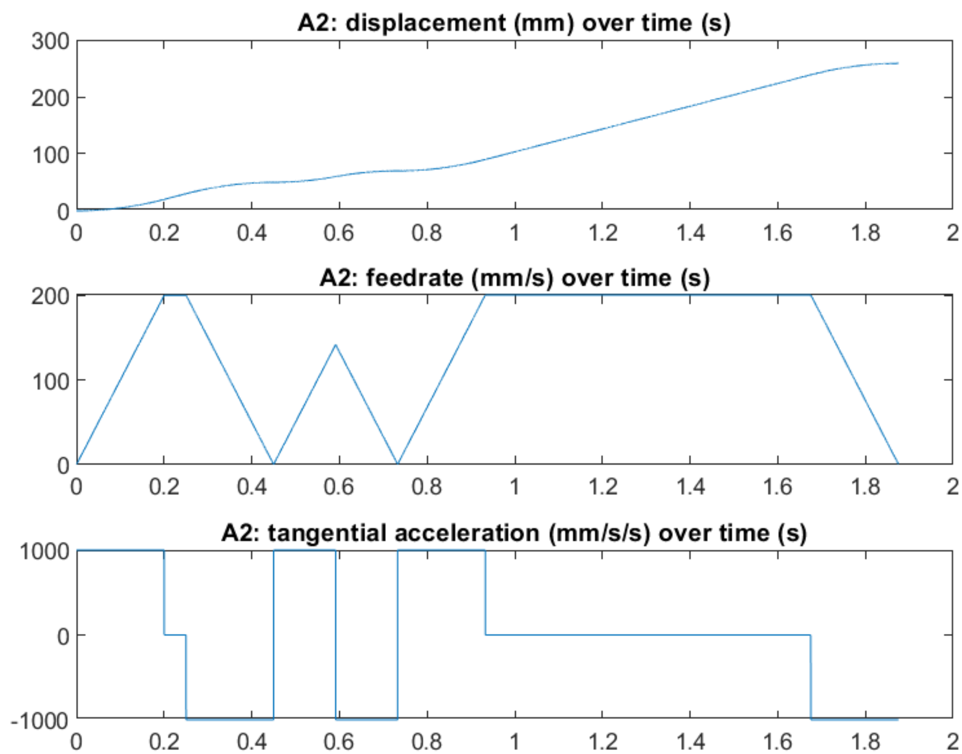


Fig A2: Displacement, feedrate, and tangential acceleration of sample trajectory

A3.

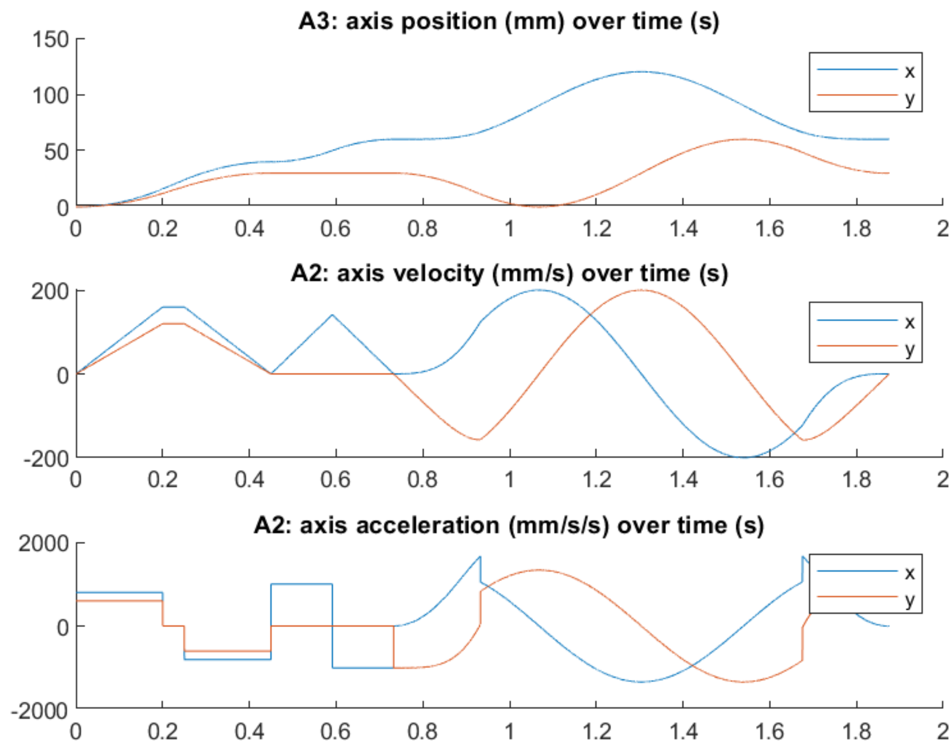


Fig A3: Axis position, velocity, and acceleration of sample trajectory

B1.

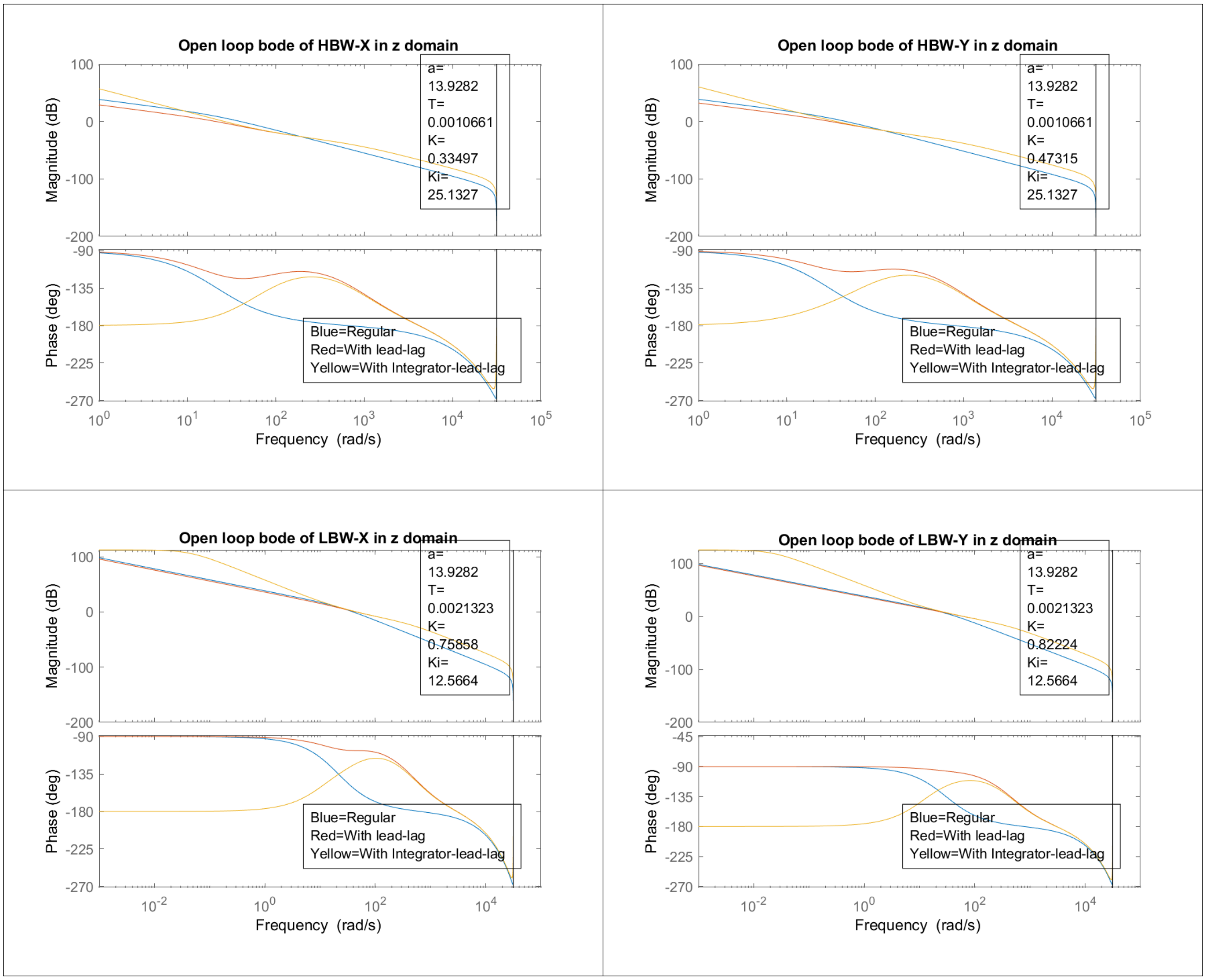


Fig B1: Lead-Lag-Integrator of X and Y axis motors, for LBW and HBW

The parameters of LLI controllers are written in the plot. They can be used in the equations like shown here:

$$\text{Lead-Lag} = K\frac{1+\alpha Ts}{1+Ts}$$

$$\text{Integrator} = \frac{K_i + s}{s}$$

B2.

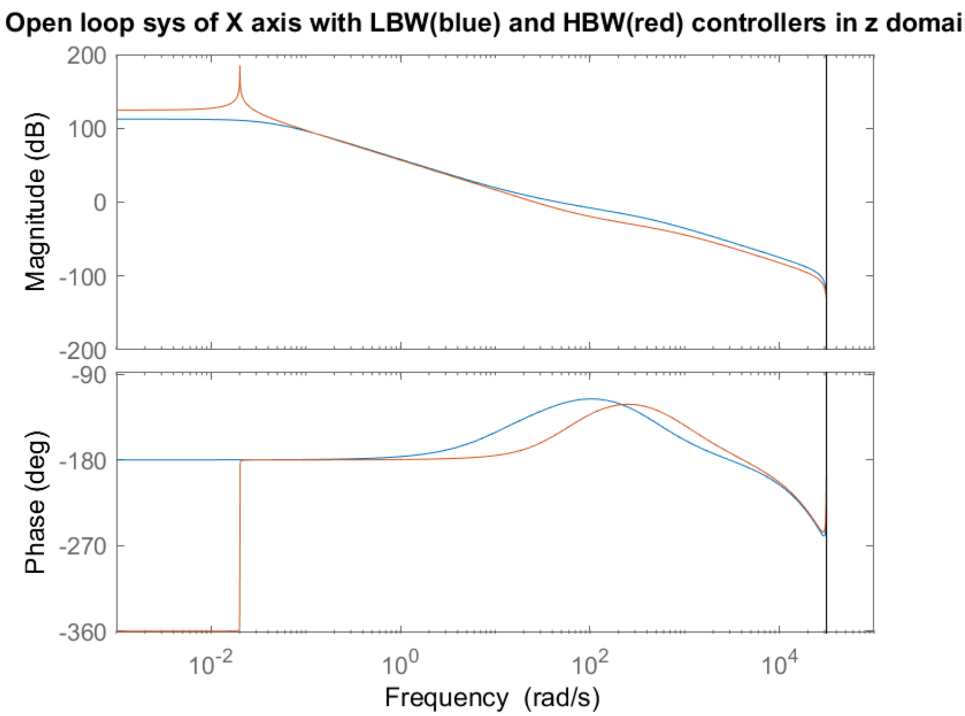


Fig B2.1: Open loop system of X axis with LBW and HBW controllers, in z domain

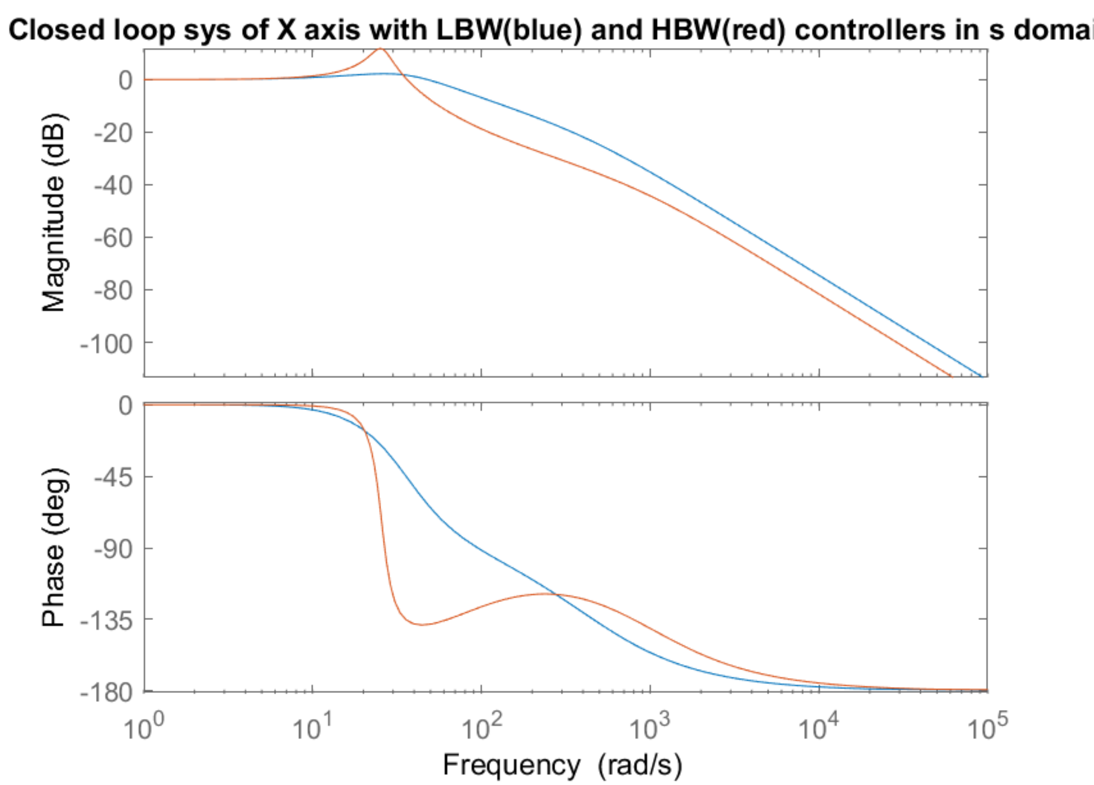


Fig B2.2: Close loop system of X axis with LBW and HBE controllers, in s domain

B3.

| System | Domain | Bandwidth(rad/s) | Zero | Pole | RiseTime(s) | Overshoot(%) |
|---|---|---|---|---|---|---|
| LBW-X | z | 67.6374 | [-1;1;1] | [1;1+0.0026i;1-0.0026i;0.96] | 0.0259 | 23.0245 |
| LBW-X | s | 67.4119 | [-34;-13] | [-4.3e+02;-24+26i;-24-26i;-14] | 0.025995 | 22.9486 |
| LBW-Y | z | 90.1982 | [-1;1;1] | [1;1+0.0012i;1-0.0012i;0.96] | 0.0202 | 13.9894 |
| LBW-Y | s | 89.8381 | [-34;-13] | [-4e+02;-43+13i;-43-13i;-16] | 0.020406 | 13.949 |
| HBW-X | z | 40.4458 | [-1;1;0.99] | [1+0.0025i;1-0.0025i;1;0.91] | 0.041 | 67.1054 |
| HBW-X | s | 40.4492 | [-67;-25] | [-9.3e+02;-23;-3.4+25i;-3.4-25i] | 0.04174 | 66.9174 |
| HBW-Y | z | 55.572 | [-1;1;0.99] | [1+0.0032i;1-0.0032i;1;0.91] | 0.0305 | 47.9008 |
| HBW-Y | s | 55.5764 | [-67;-25] | [-9.2e+02;-9.9+32i;-9.9-32i;-28] | 0.030648 | 47.6812 |

Table B3: Bandwidth, zeros, poles, rise time, and overshoot for each combination of bandwidth, axis, and domain in a closed loop system

C1.

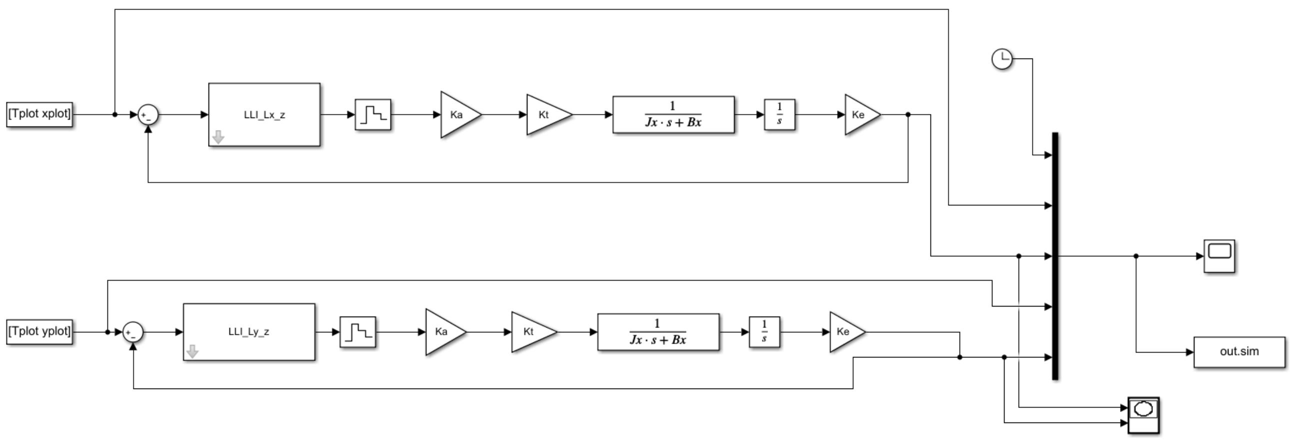


Fig C1.1: Simulink model

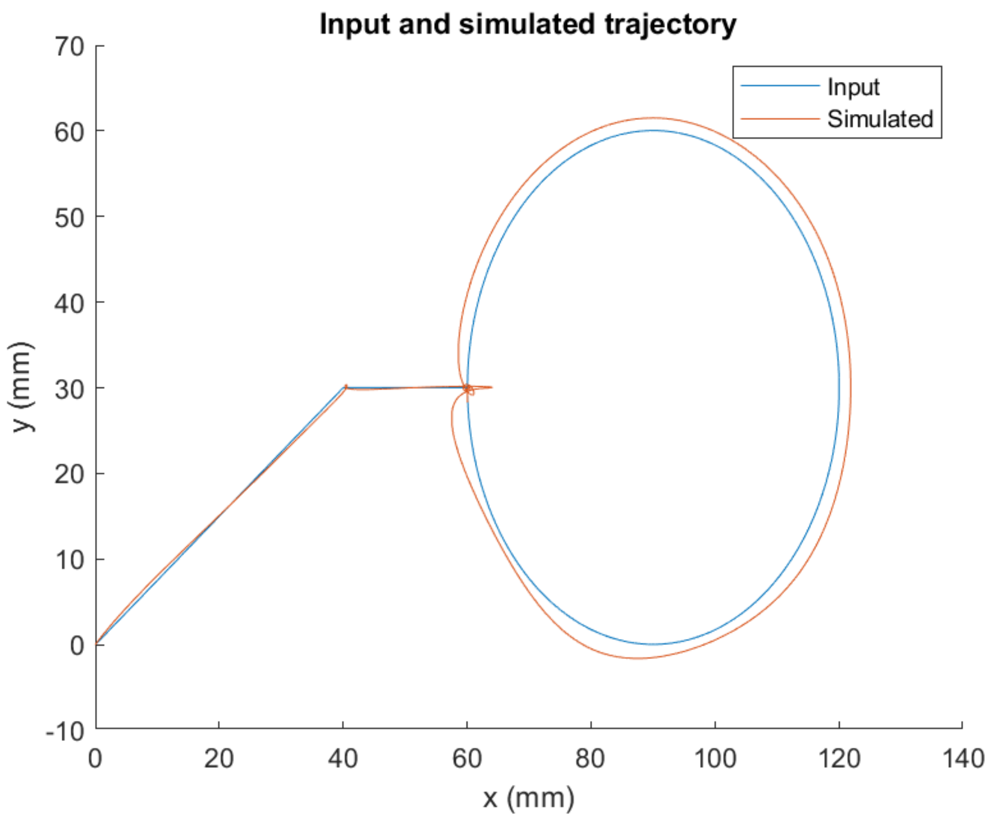


Fig C1.2: Input and simulated toolpath

Controllers has some issues at the point where the circle starts due to overshoot of P2-to-P3 path, and consequently causes misalignment in the rest of the tool path. To reduce error, it is recommended that gain is increased. Likely that the rule-of-thumb used to get Ki (Ki = wc / 10) resulted in Ki that is not large enough to eliminate steady state error.

C2.

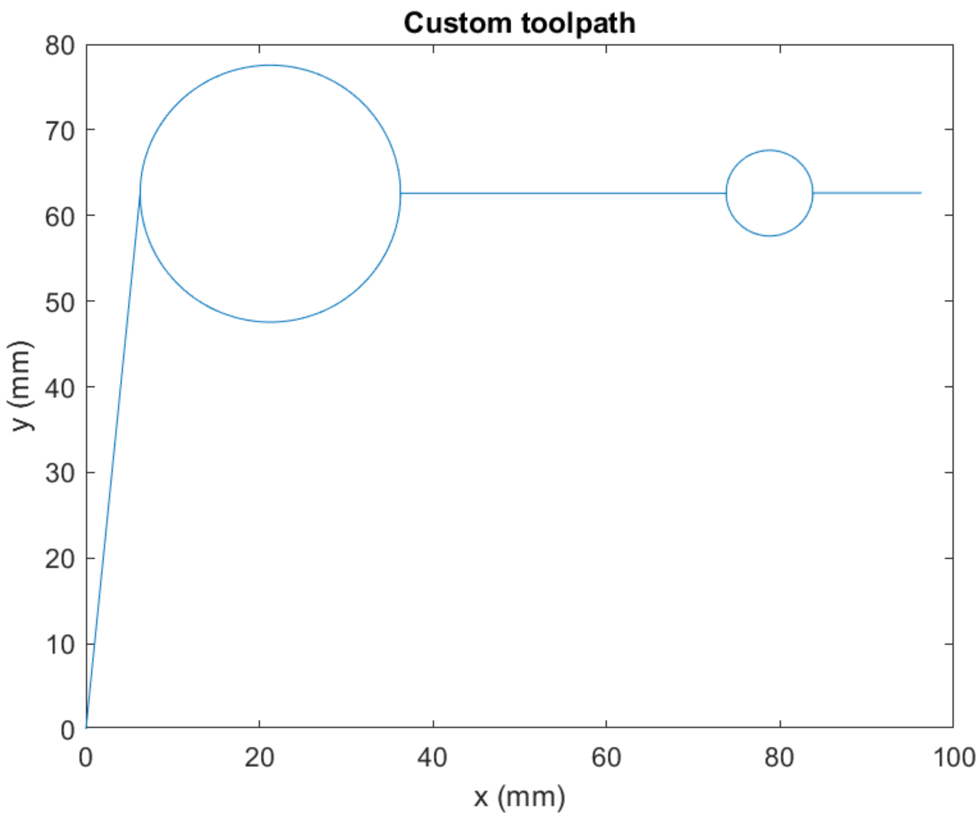


Fig C2: Custom toolpath

The toolpath takes multiple cuts around the circles to ensure nicer finish.

Appendix:

1. Part A Matlab code
2. Part B Matlab code
3. Part C Matlab code
4. myTraj.m (attached separately to this pdf)