



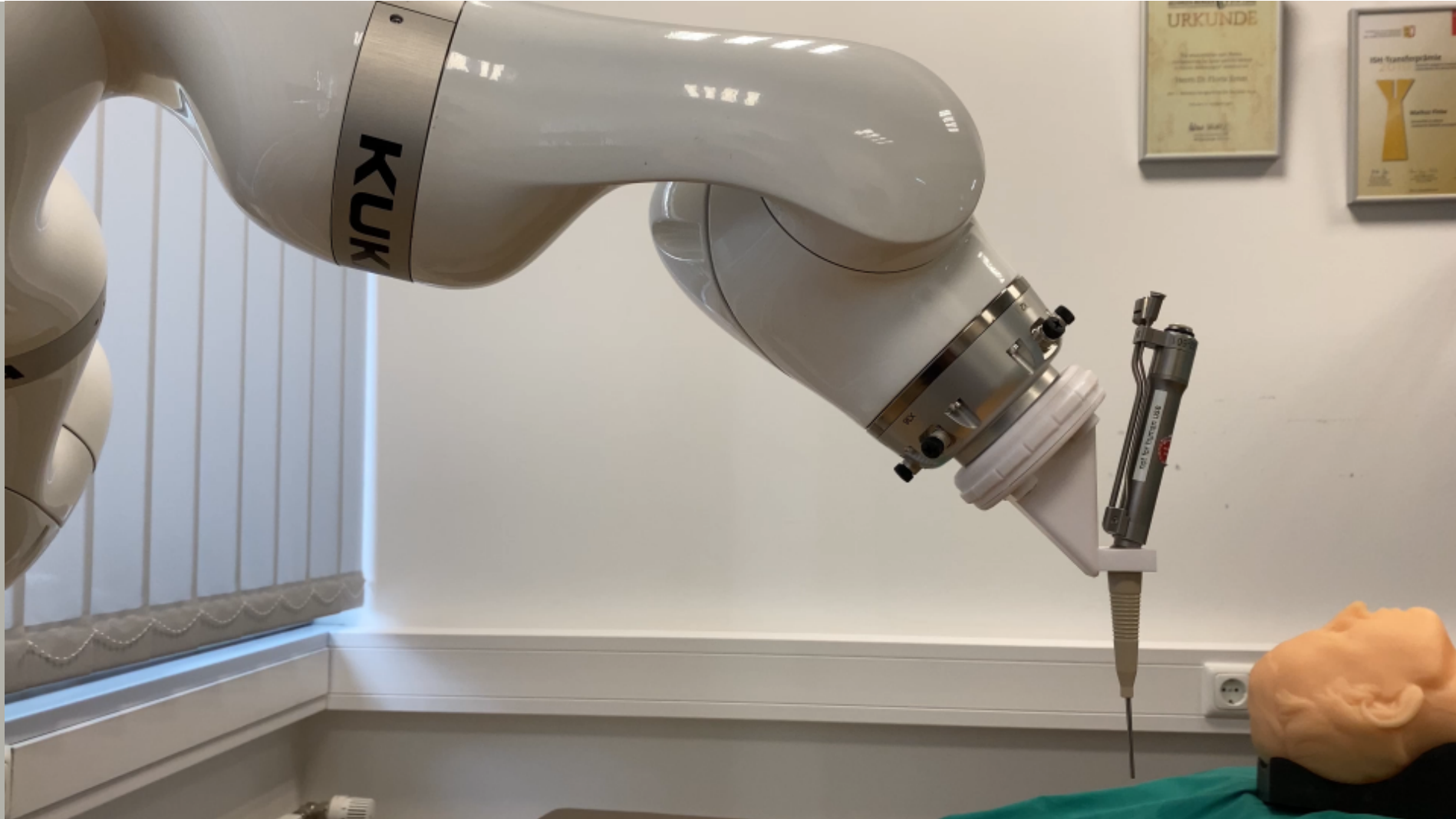
Toward robotic-guided control of an ultrasonic aspirator

Bachelorproject

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Zhiwei Sun

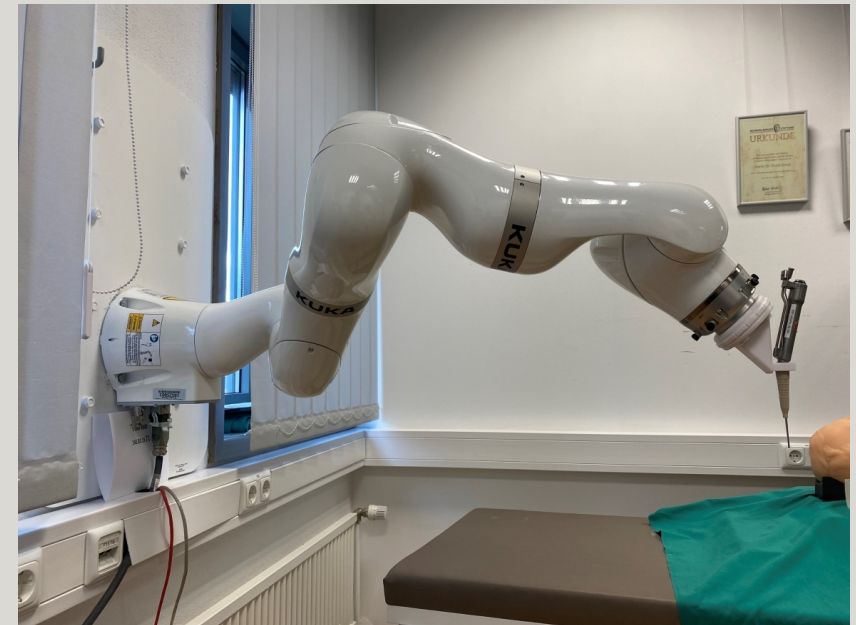
04.04.2023



Control

- Initialize: vertical and at (1m , 20 cm, 0)

$$T_i = \begin{pmatrix} \cos(-45) & 0 & \sin(-45) & 1000 \\ 0 & 1 & 0 & 200 \\ -\sin(-45) & 0 & \cos(45) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$



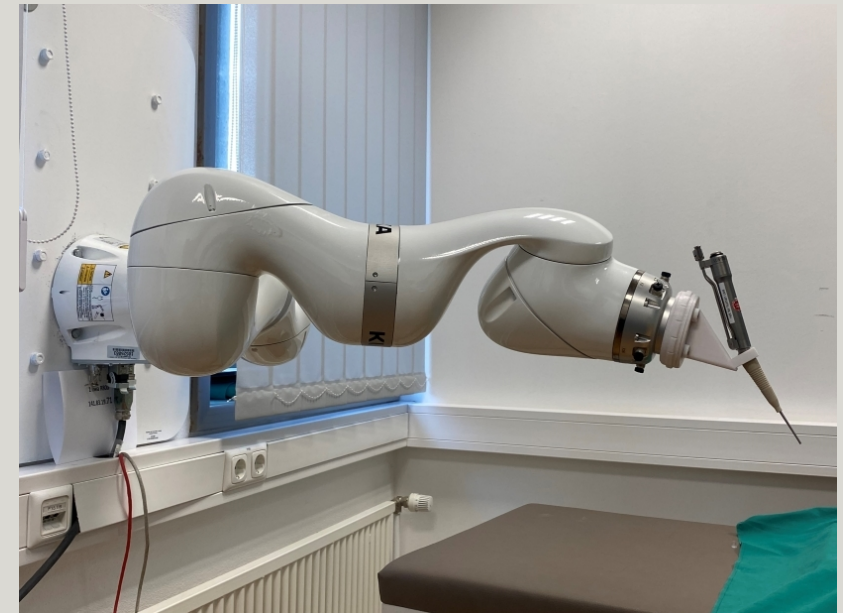
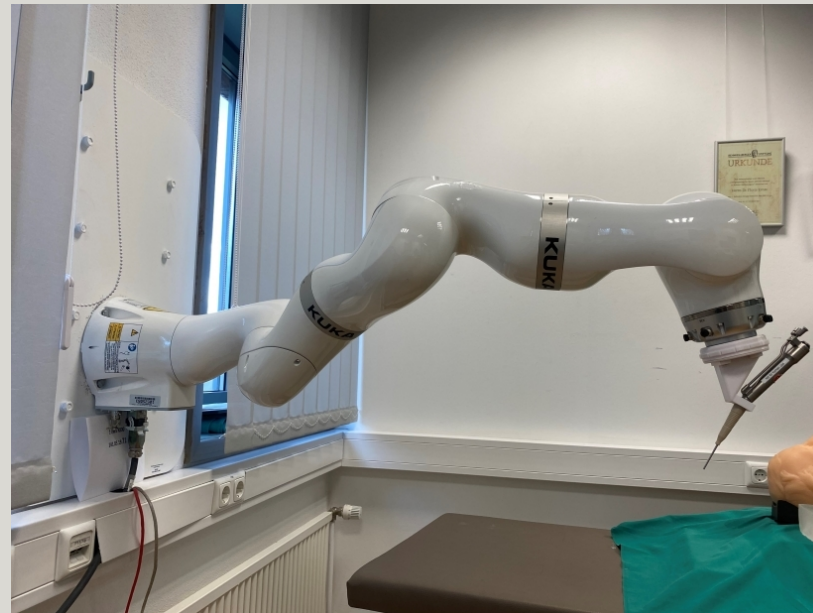
Control

- Incline : input the angle and incline with y axis

$$T_x = \begin{pmatrix} 1 & 0 & 0 & x \\ 0 & \cos(a) & -\sin(a) & y \\ 0 & \sin(a) & \cos(a) & z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$T_y = \begin{pmatrix} \cos(a) & 0 & \sin(a) & x \\ 0 & 1 & 0 & y \\ -\sin(a) & 0 & \cos(a) & z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$T_z = \begin{pmatrix} \cos(a) & -\sin(a) & 0 & x \\ \sin(a) & \cos(a) & 0 & y \\ 0 & 0 & 1 & z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

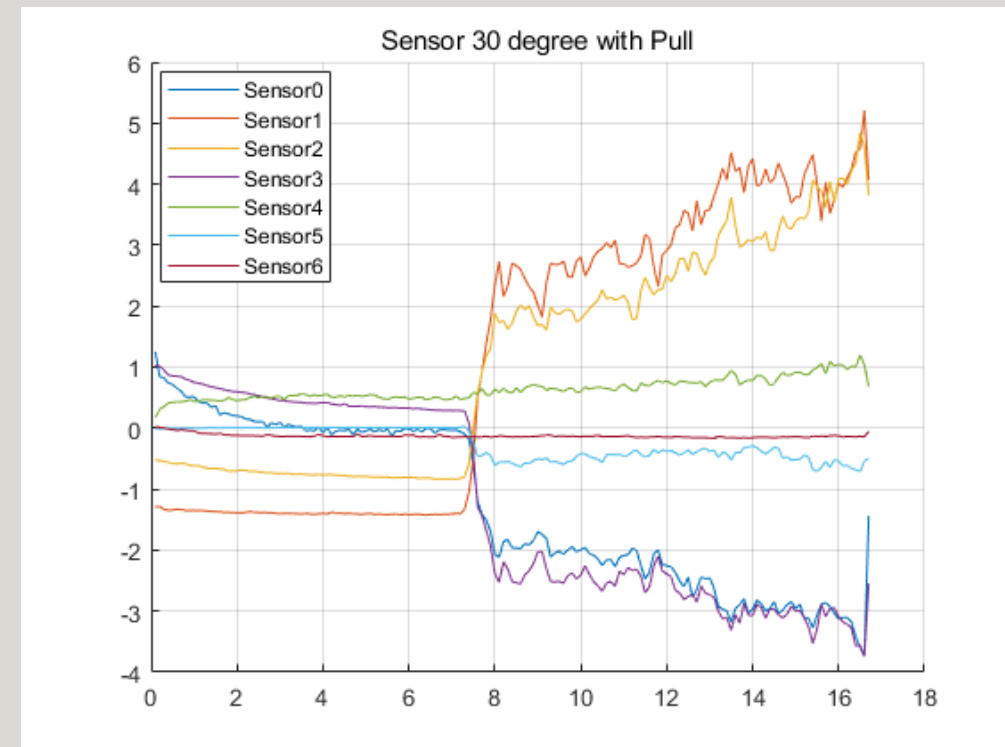
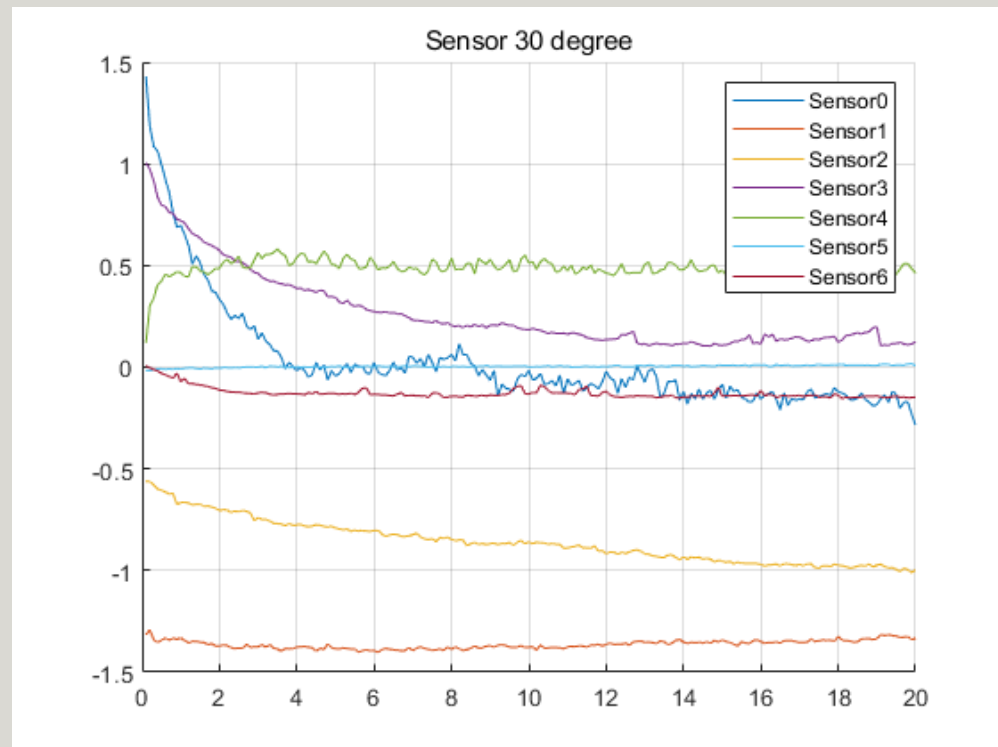


Control

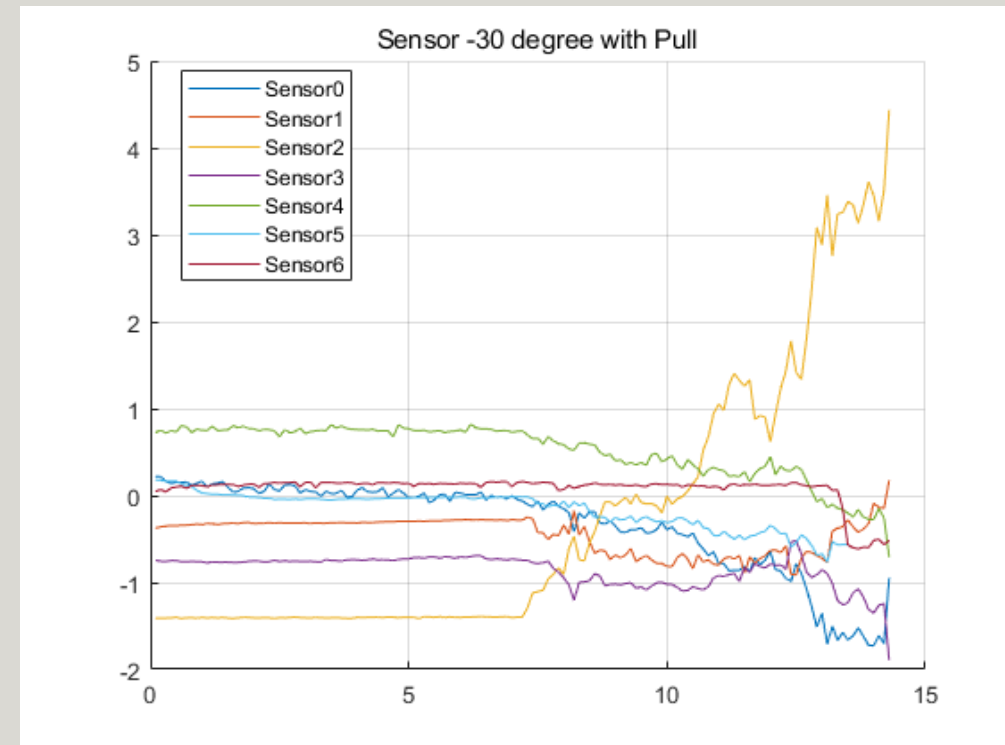
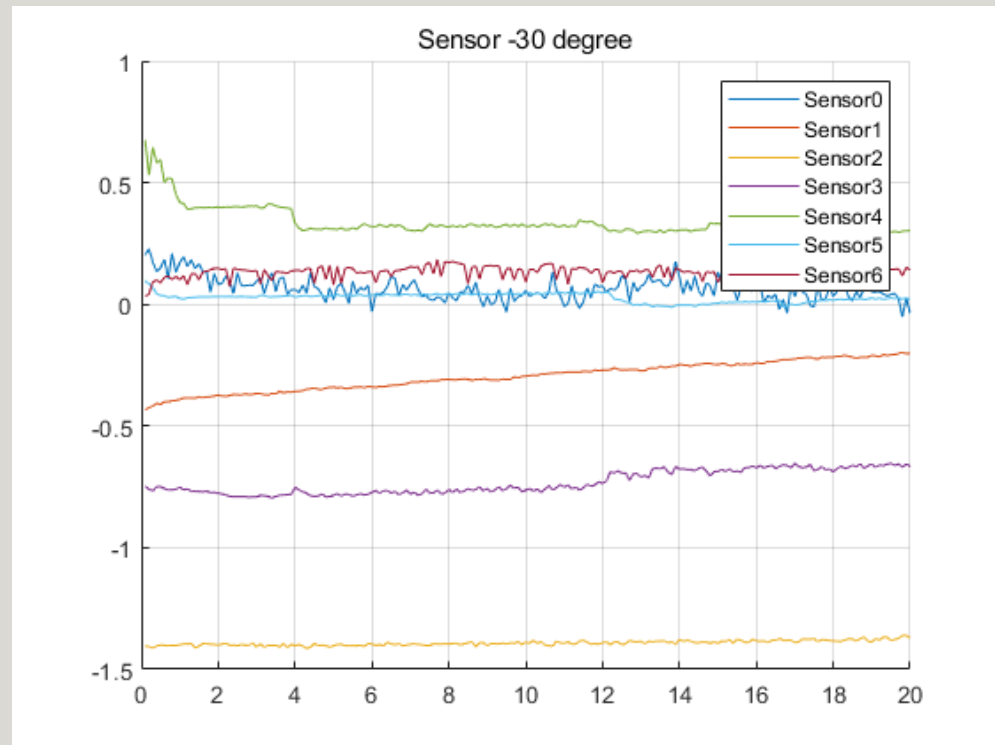
- Straight Movement: input the length along z and x

$$M = \begin{pmatrix} & R & \boxed{x} \\ & & y \\ & & \boxed{z} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Sensor Choice and Force Recognition

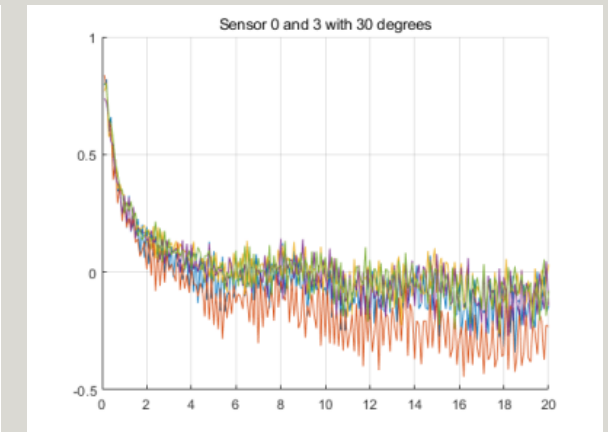
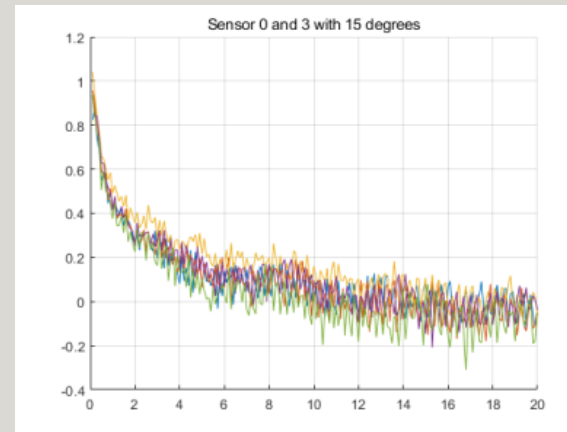
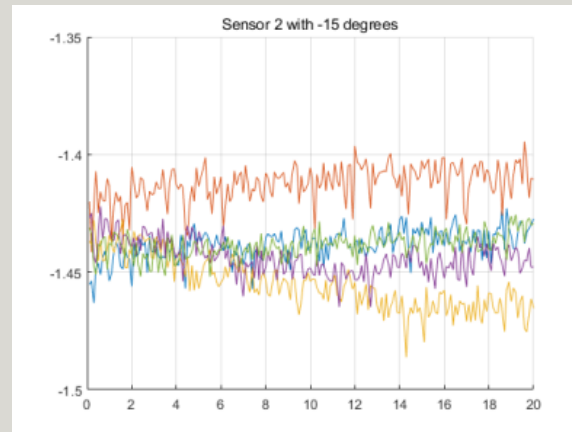
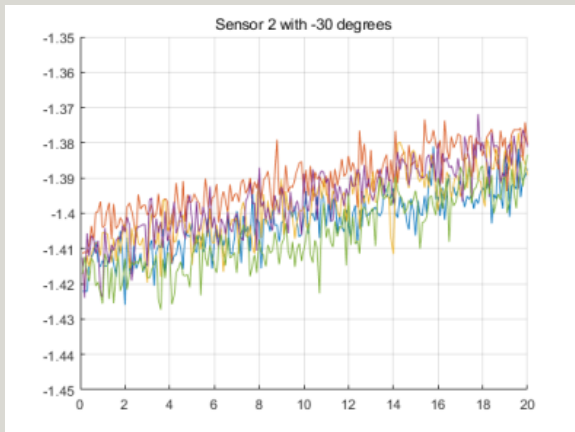


Sensor Choice and Force Recognition



Tresh and Triggering Conditions

the value of force are different at same situation in every times



Tresh and Triggering Conditions

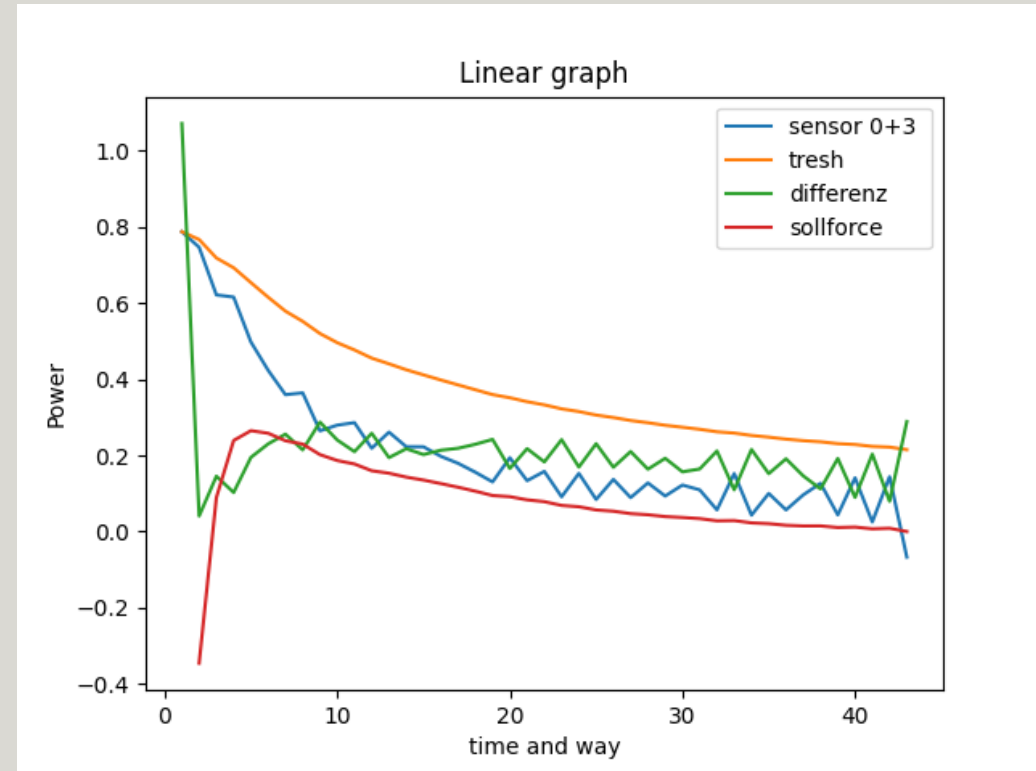
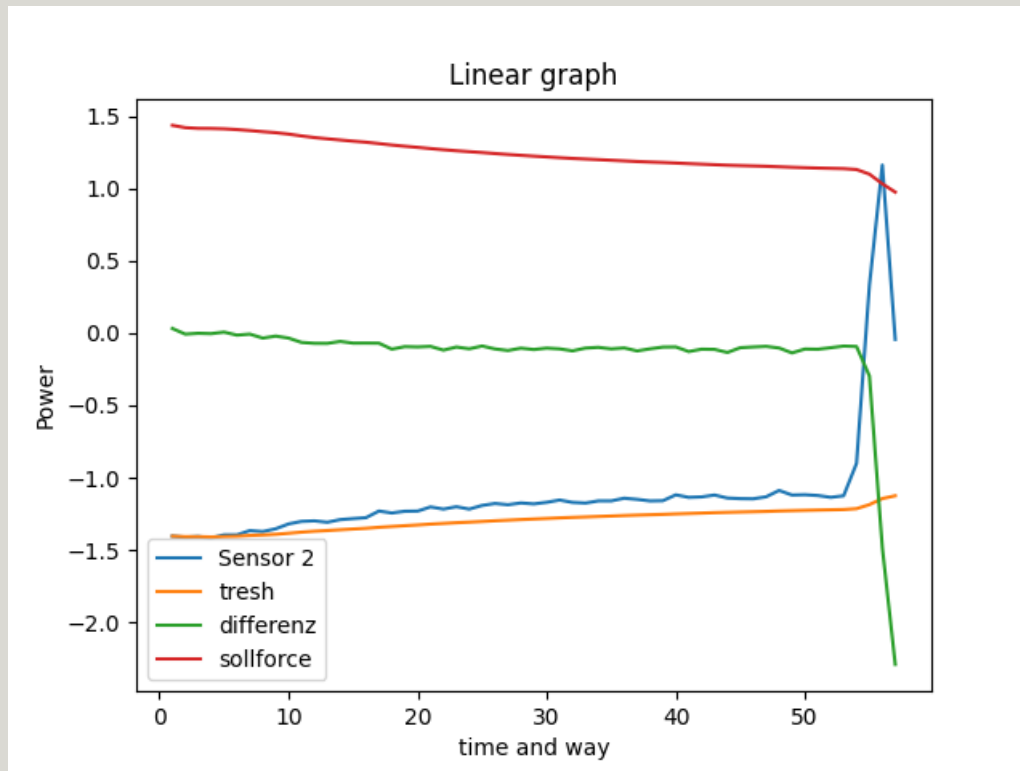
- Parameter: *force* - Tresh - Difference - ShouldValue

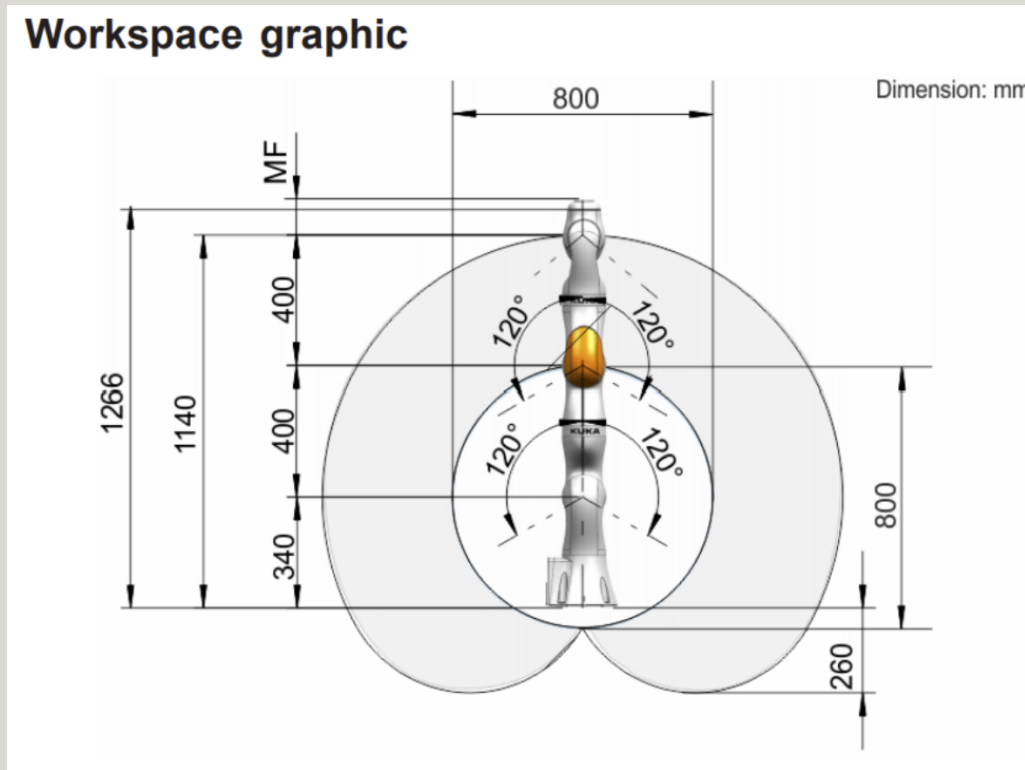
$$tresh(n) = \frac{\sum_{n=0}^{n-1} force(n)}{n - 1}$$

$$diff(n) = \frac{\sum_{n=0}^n [force(n) - thresh(n)]}{n}$$

$$ShouldValue(n + 1) = thresh(n) - diff(n)$$

Tresh and Triggering Conditions





Quelle: https://www.kuka.com/-/media/kuka-downloads/imported/8350ff3ca11642998dbdc81dcc2ed44c/0000246832_en.pdf?rev=3217a00d6a9a4c2f95b088d832f50784&hash=1E6136098A5AA7013F2628C0FFD0E4C7, Accessed on 30.0

Thanks for your attention!

Have a nice Day!

Goodbye!