

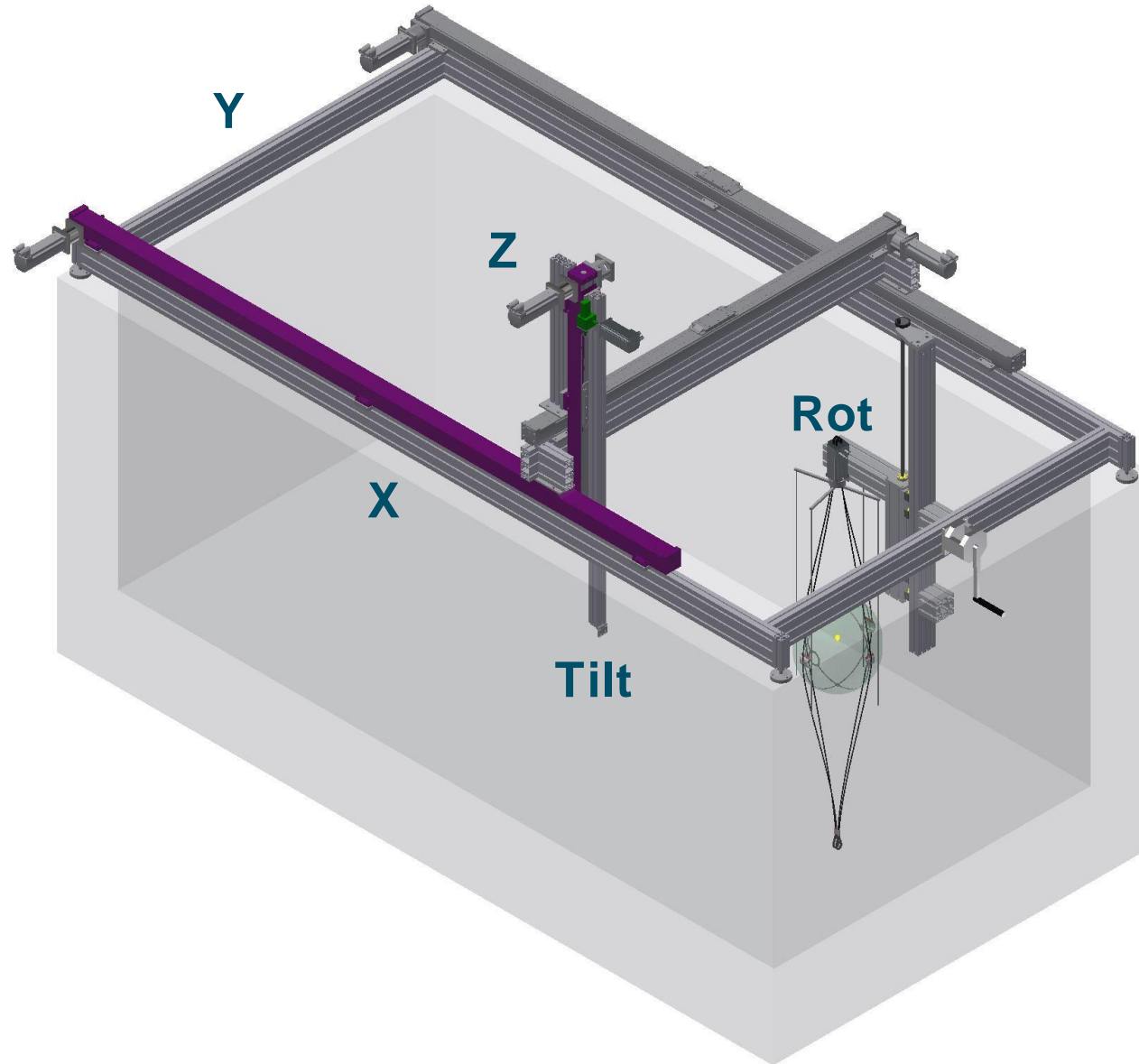


Universität  
Münster

# Calibration of water tank positioning system v2

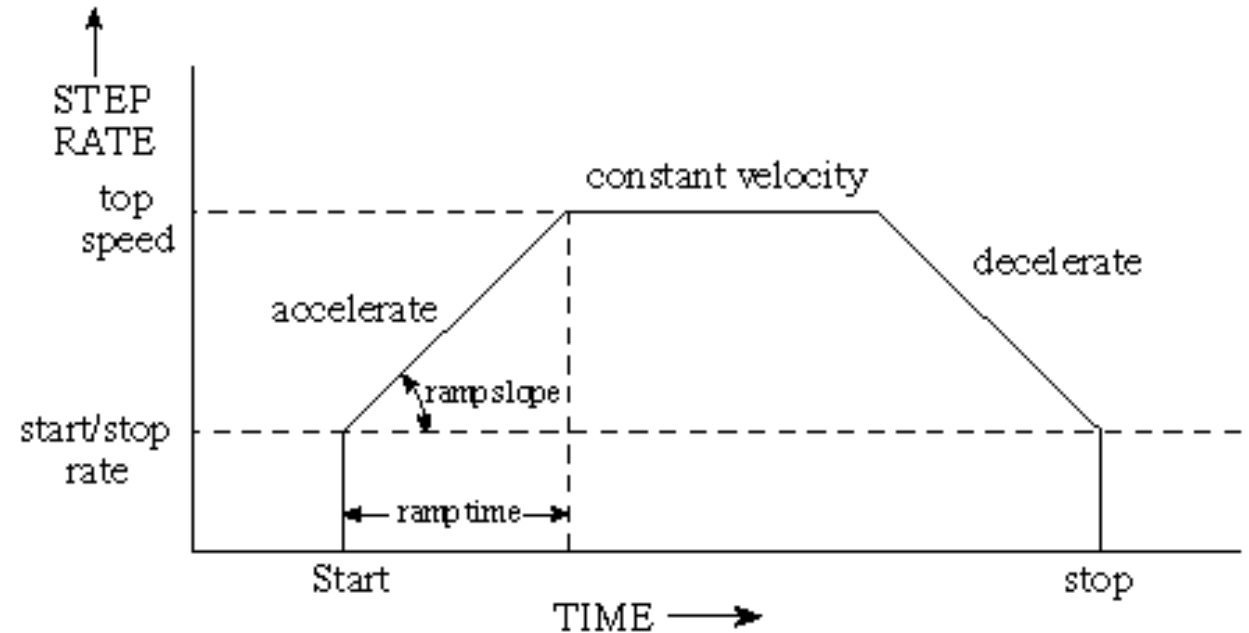
Martin Unland  
11.03.2024

# Coordinate system

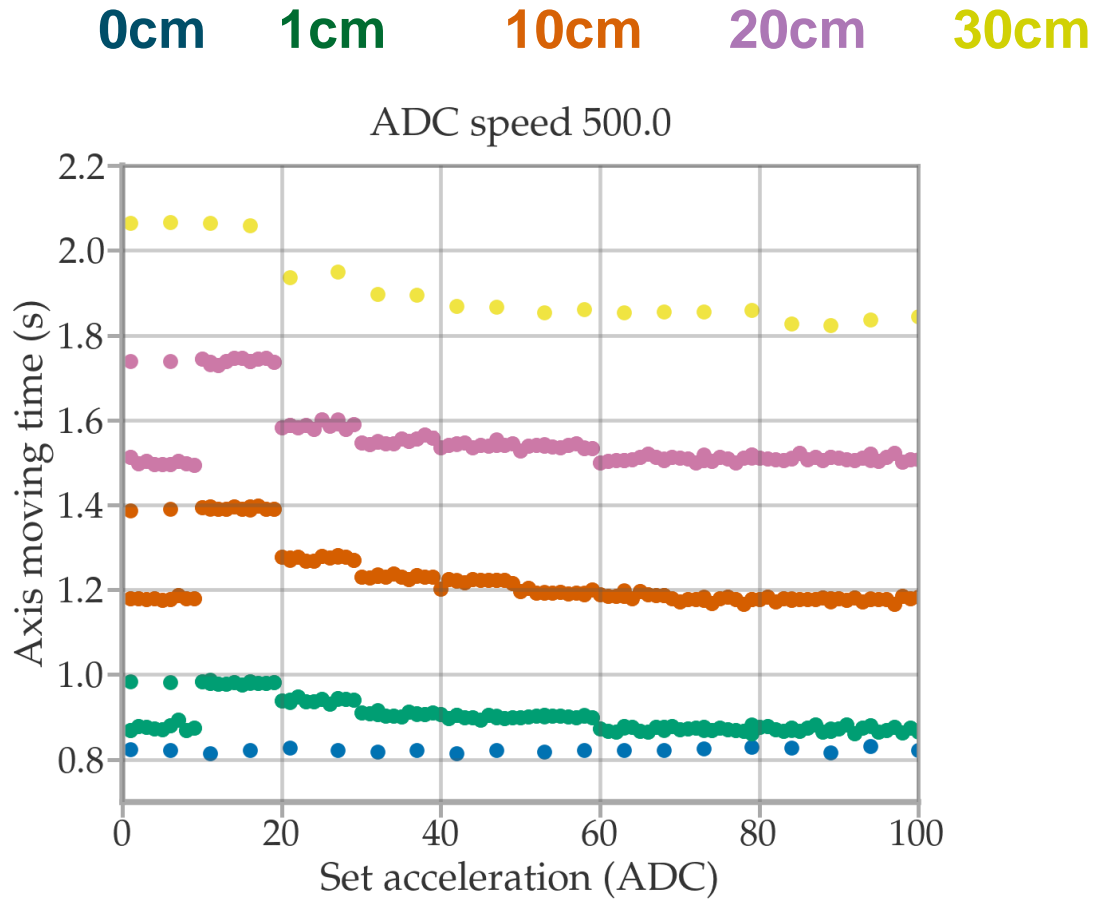


# Calibration of speed and acceleration

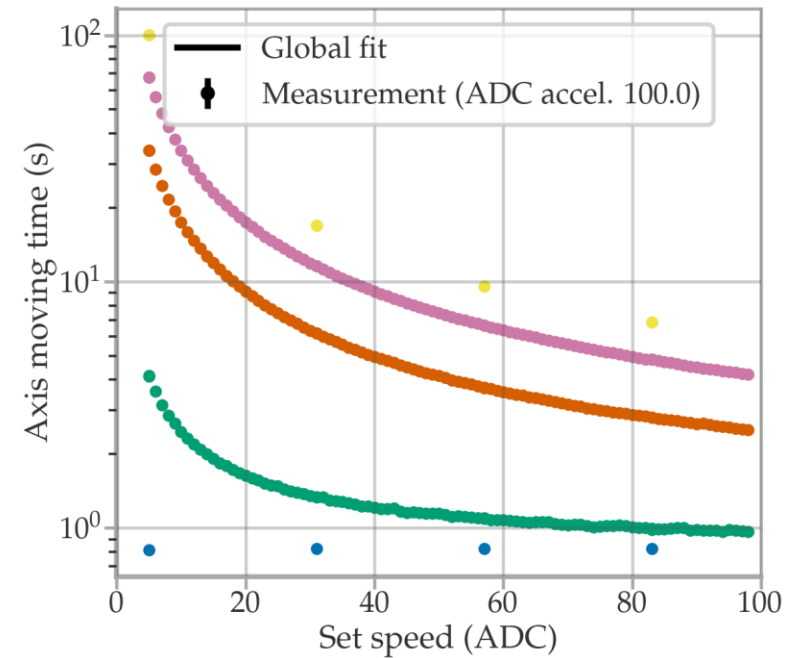
- Speed and acceleration are set via ADC value
- Calibration of these ADC values performed by measuring moving time of each axis for several distances at different speeds & accelerations
- No load on rot / tilt axis... acceleration calibration will probably change
- Assumptions:
  - Linear relationship between ADC & real values
  - Equal acceleration & deacceleration



# Few comments

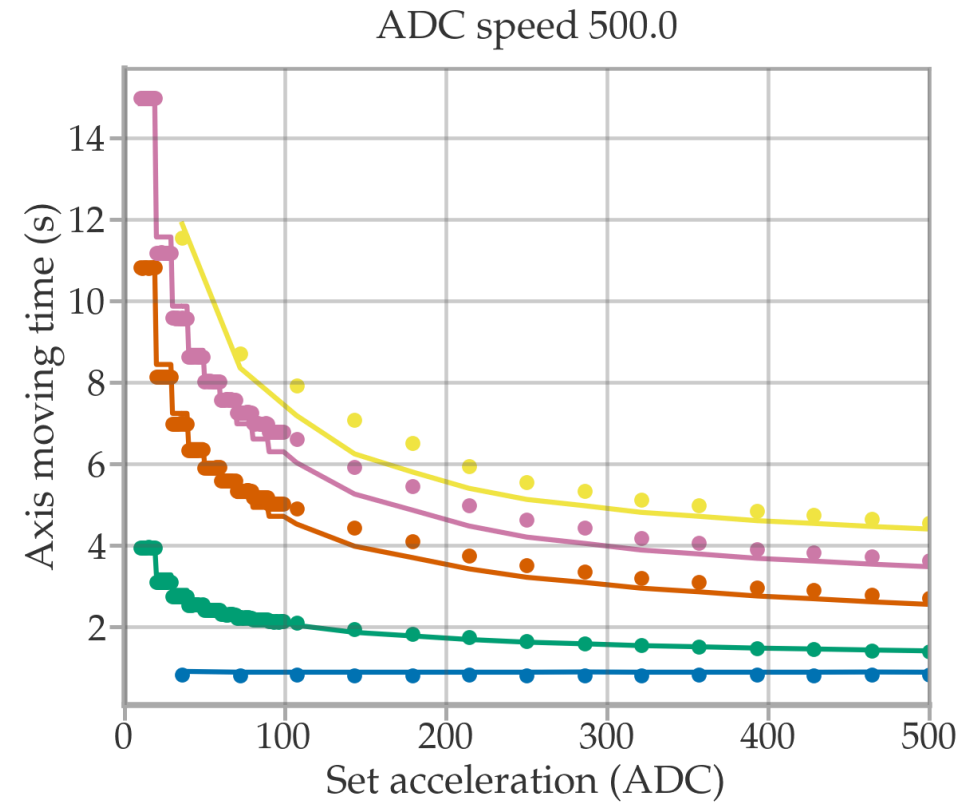
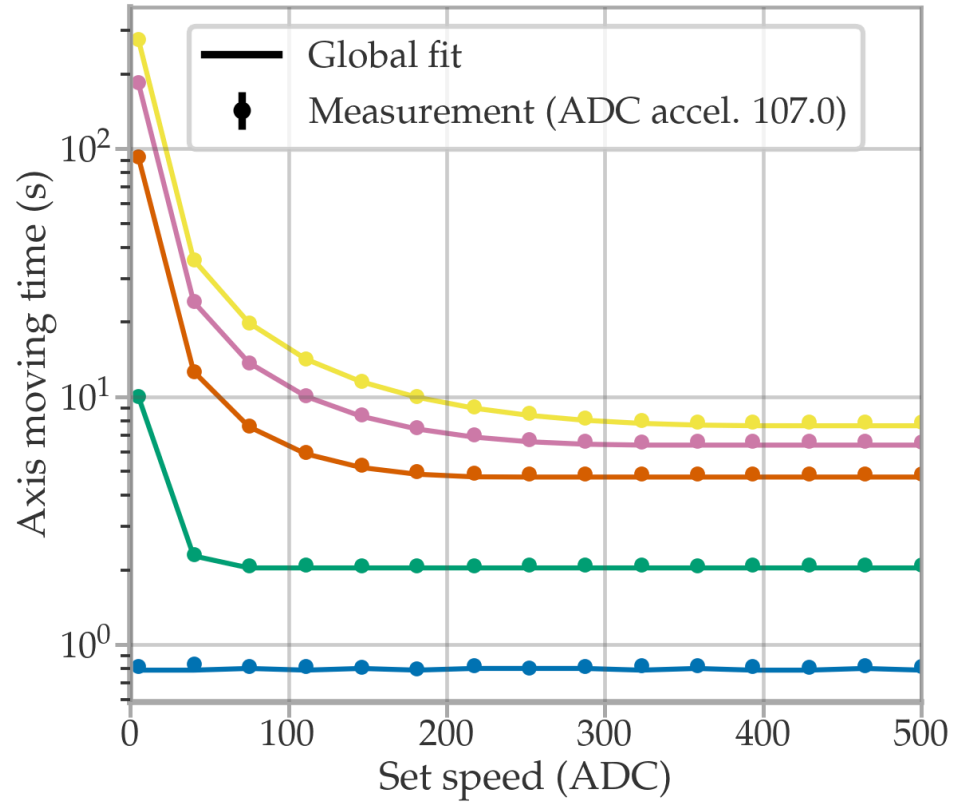


- Real acceleration changes only every 10 ADC steps
- Speed seems to change continuously (tested down to 1 ADC steps)
- Acceleration for  $<10$  ADC shows weird behaviour
- For following calibration, data with acceleration  $> 10$  ADC was ignored

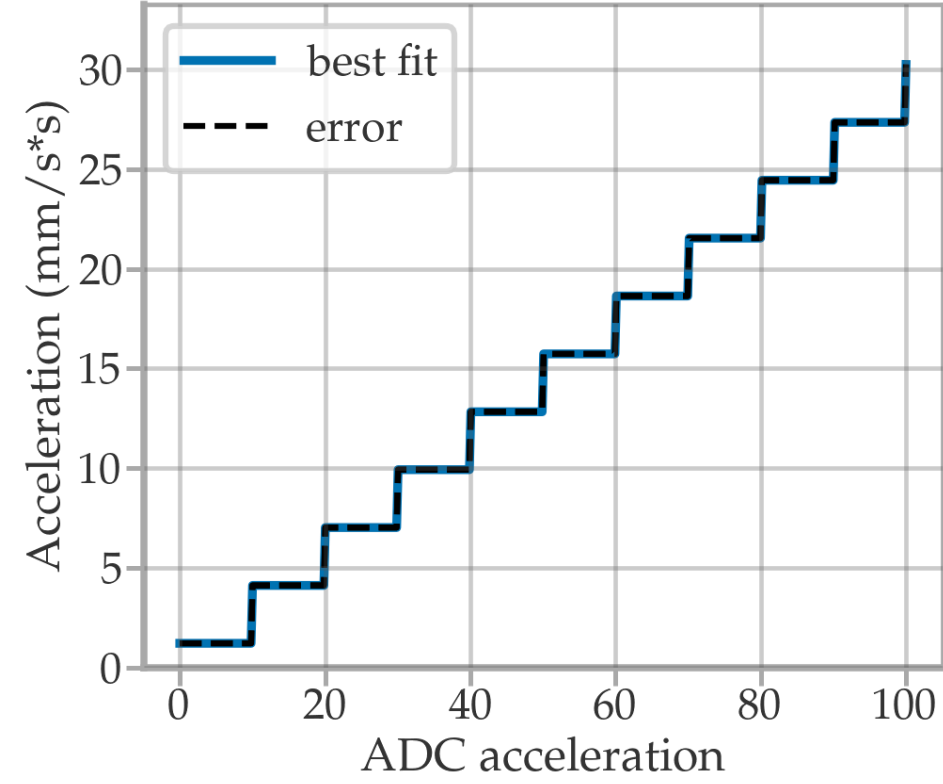
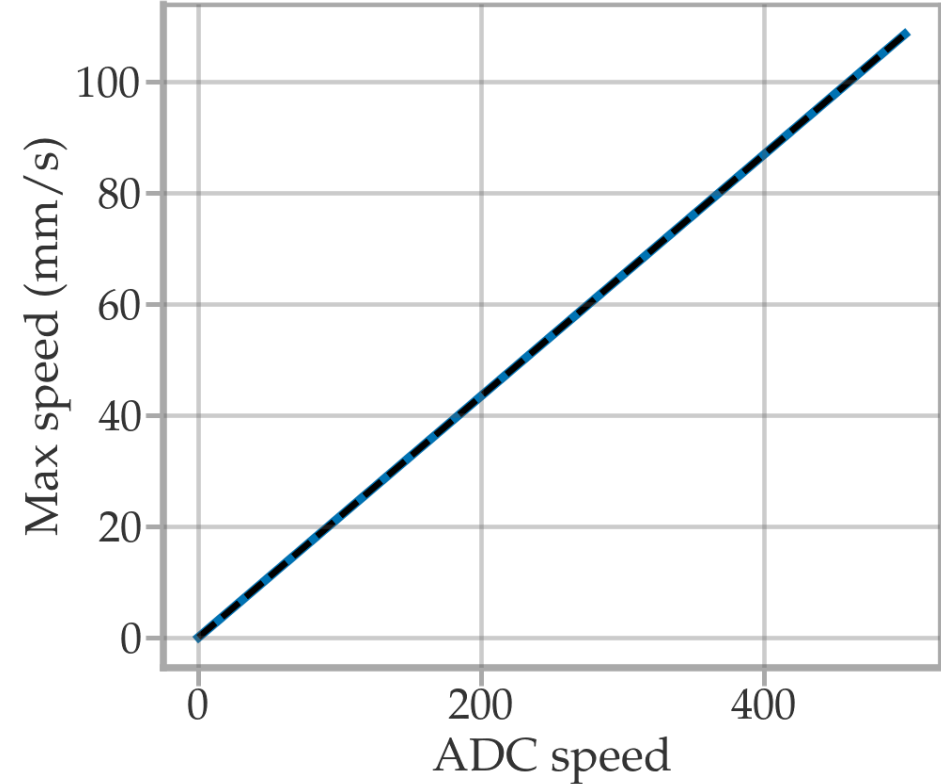


# X-Axis (1)

0cm    1cm    10cm    20cm    30cm



# X-Axis (1)

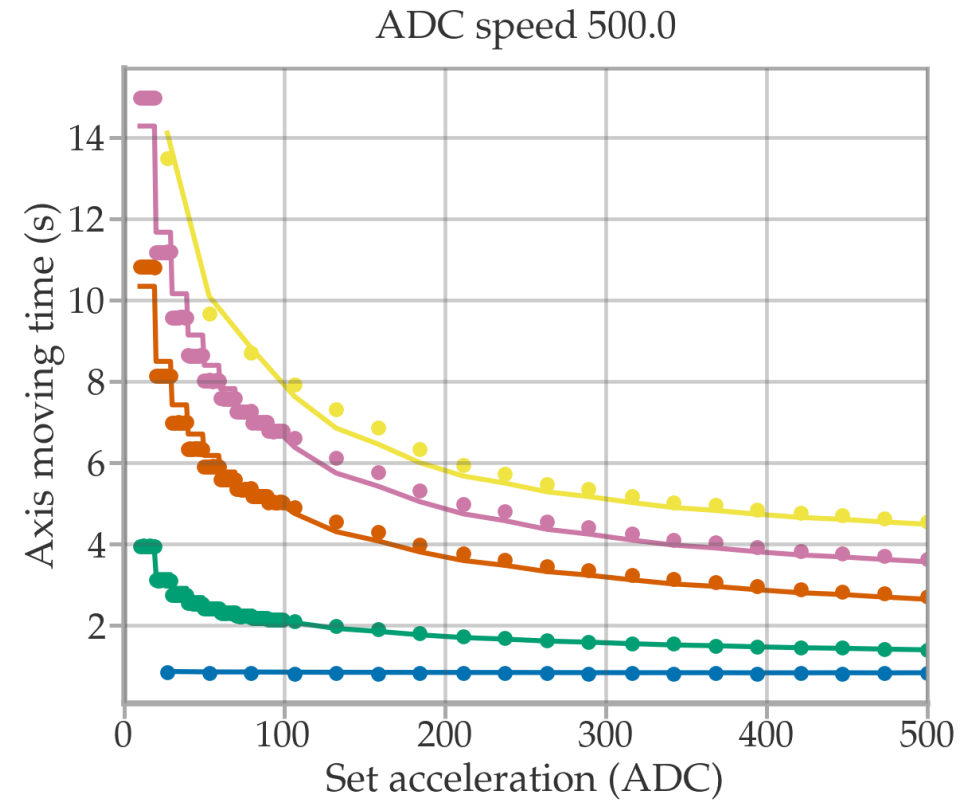
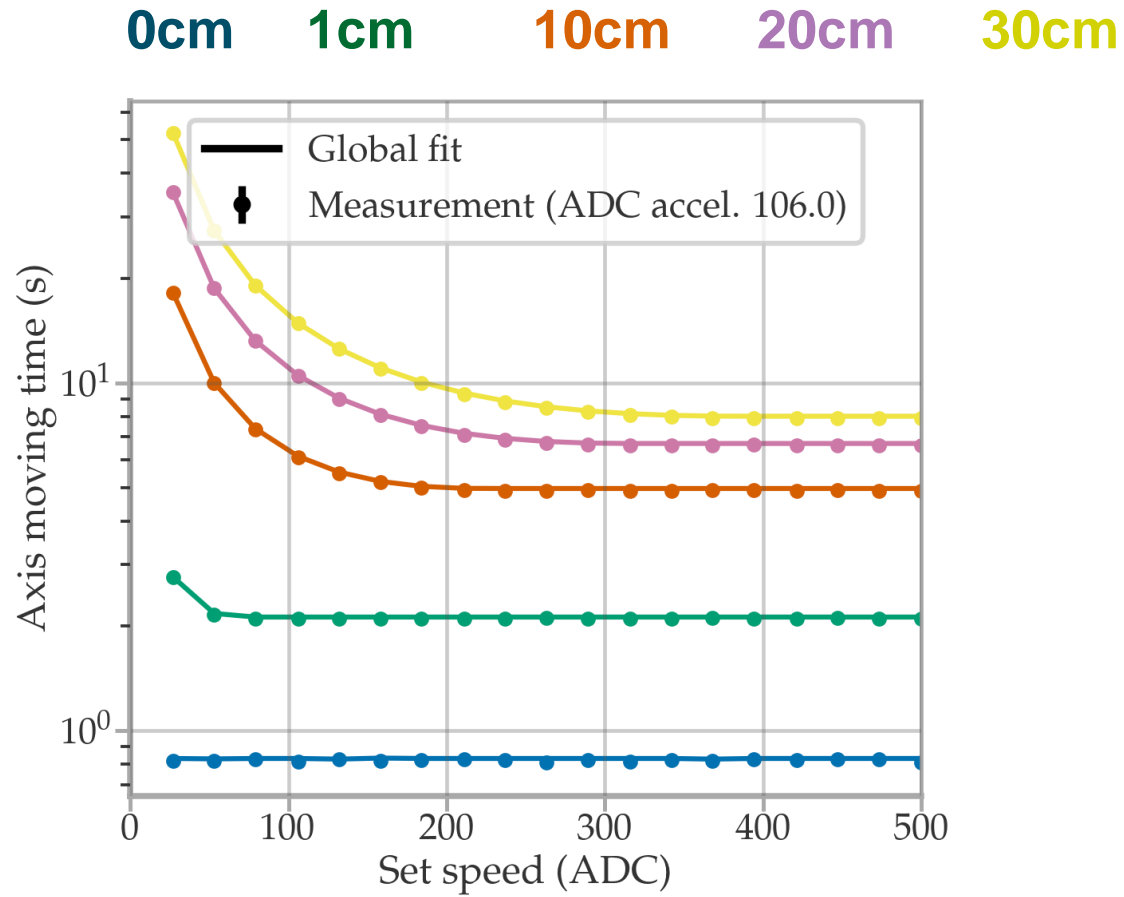


Global fit:

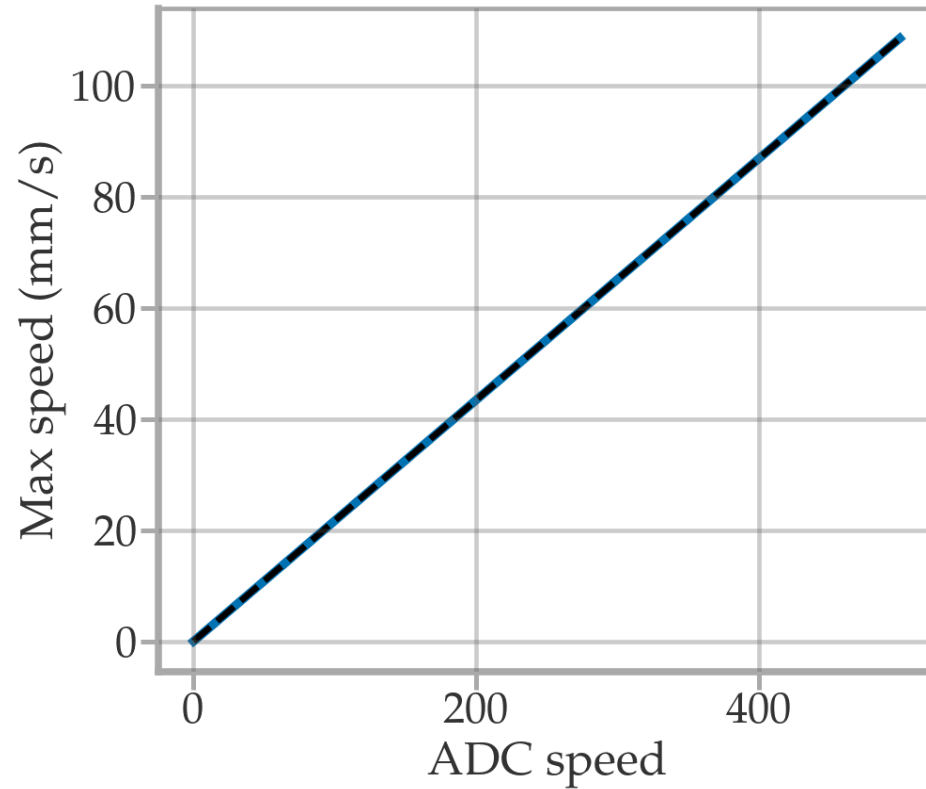
Speed slope ( mm/s / ADC )	Speed const ( mm/s )
$(216.381 \pm 0.004)e-3$	$(1.899 \pm 0.019)e-3$

Acceleration slope ( mm/s <sup>2</sup> / ADC )	Acceleration const ( mm/s <sup>2</sup> )
$(290.441 \pm 0.035)e-3$	$1.2077 \pm 0.0004$

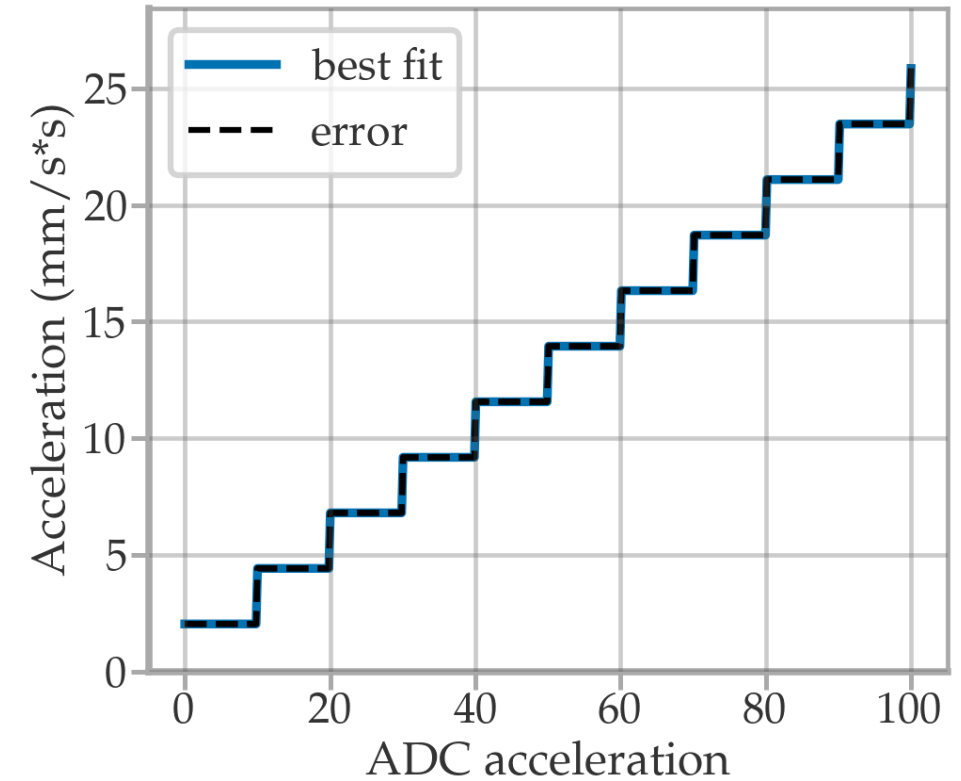
# Y-Axis (2)



## Y-Axis (2)



Speed slope (mm/s / ADC)	Speed const (mm/s)
$(216.5920 \pm 0.0021)e-3$	$(0.789 \pm 0.026)e-3$

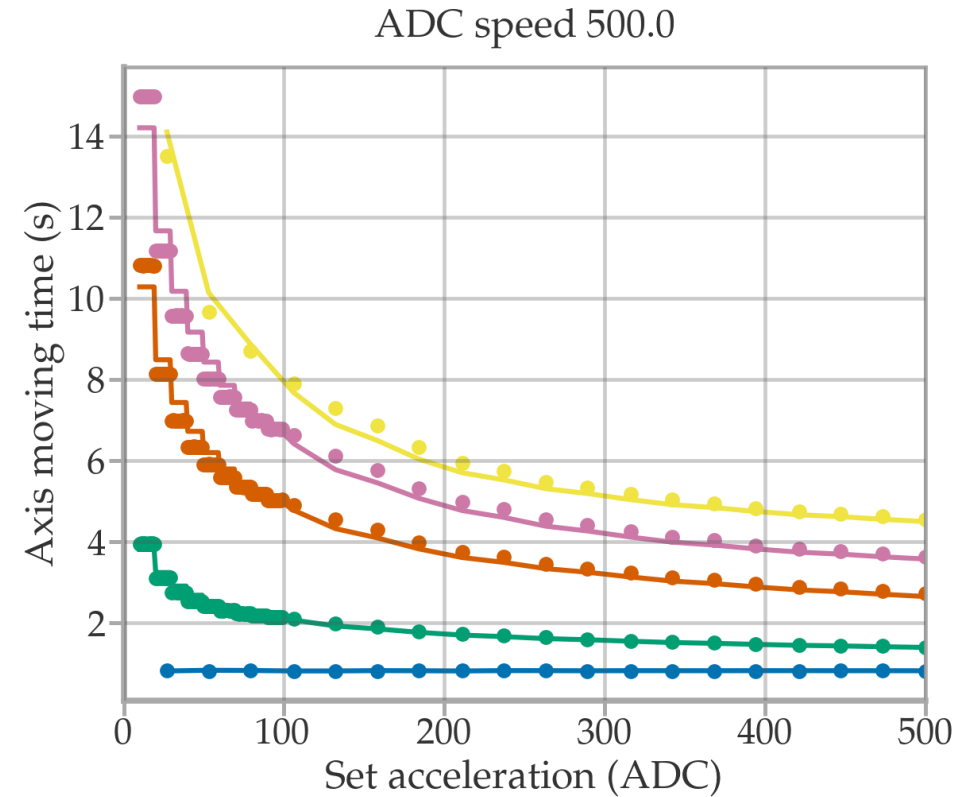
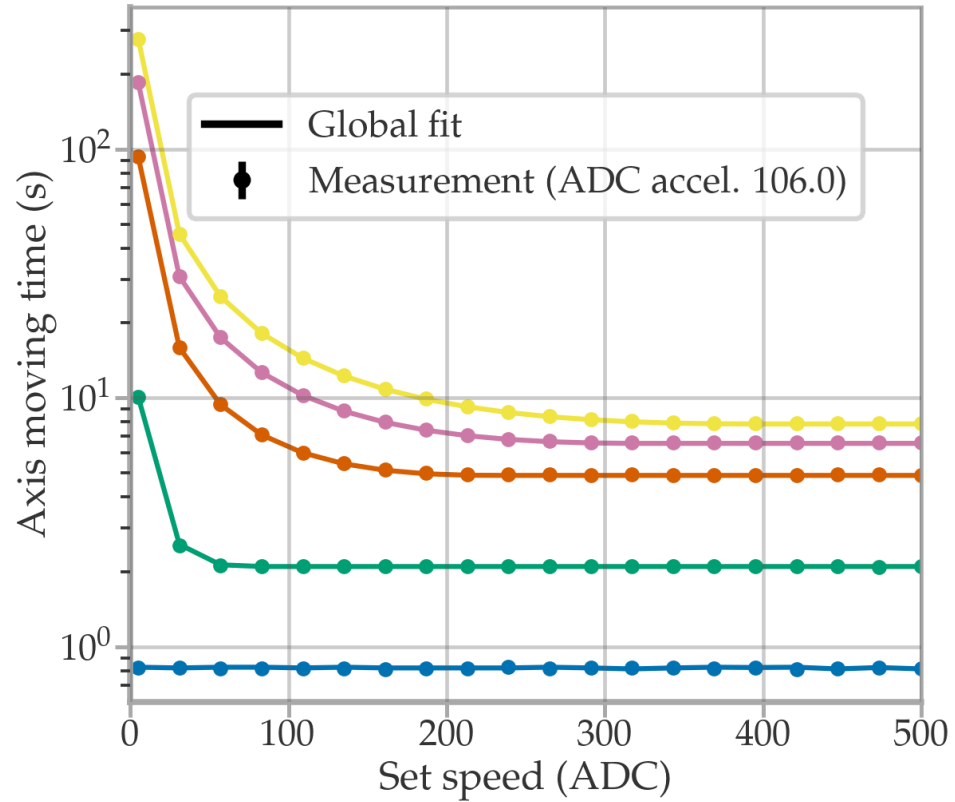


Acceleration slope (mm/s <sup>2</sup> / ADC)	Acceleration const (mm/s <sup>2</sup> )
$(238.28 \pm 0.023)e-3$	$2.0345 \pm 0.0004$

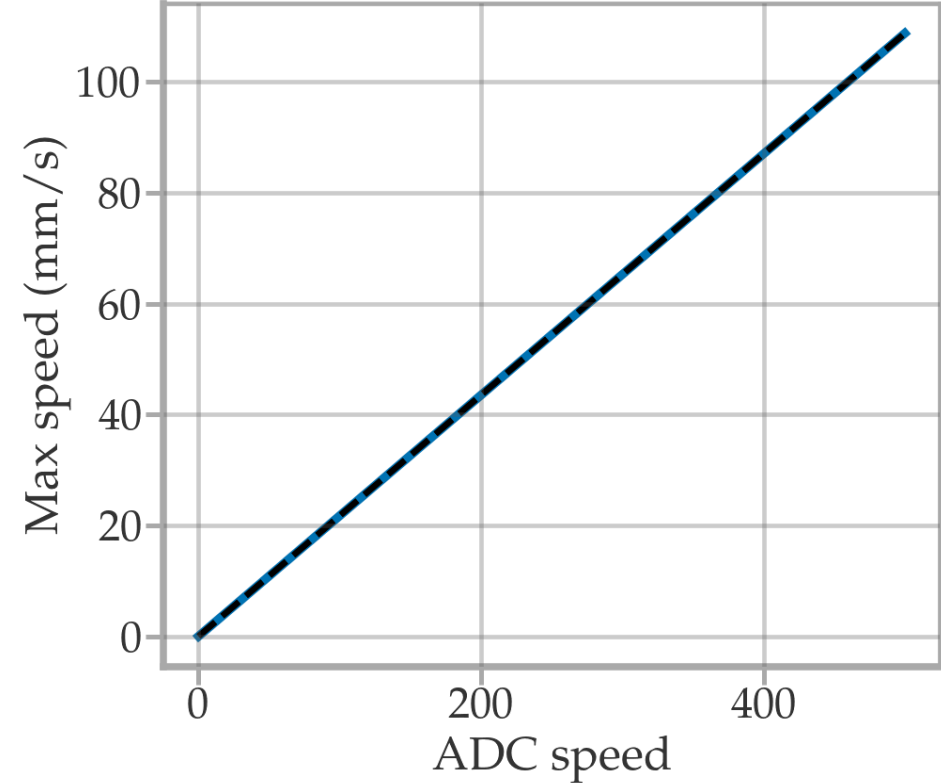


# Z-Axis (3)

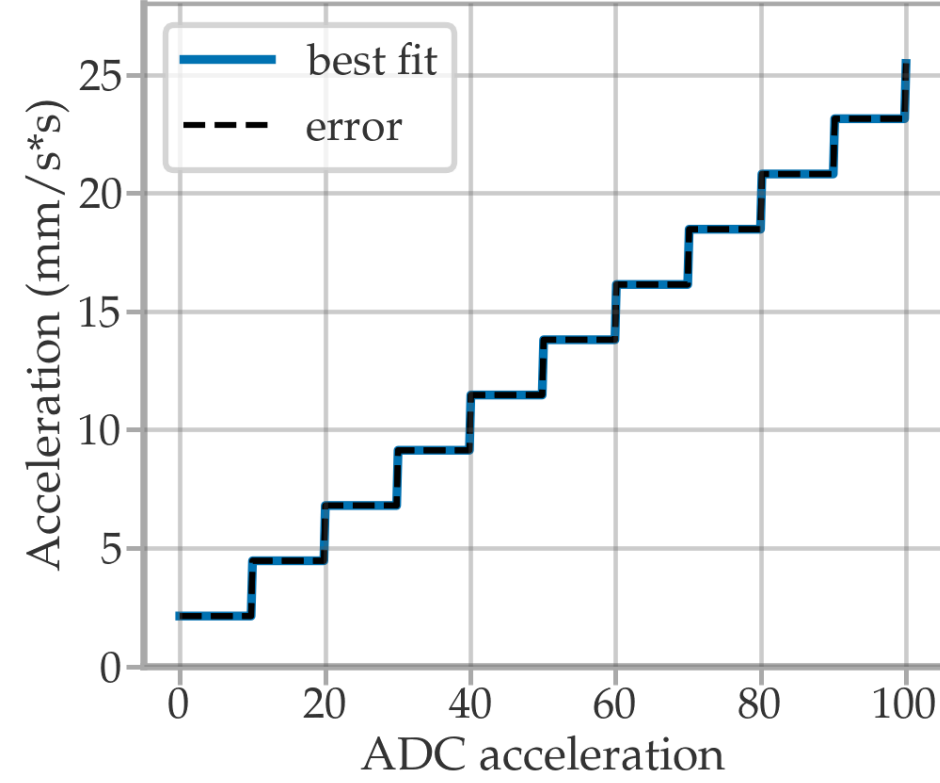
0cm    1cm    10cm    20cm    30cm



# Z-Axis (3)



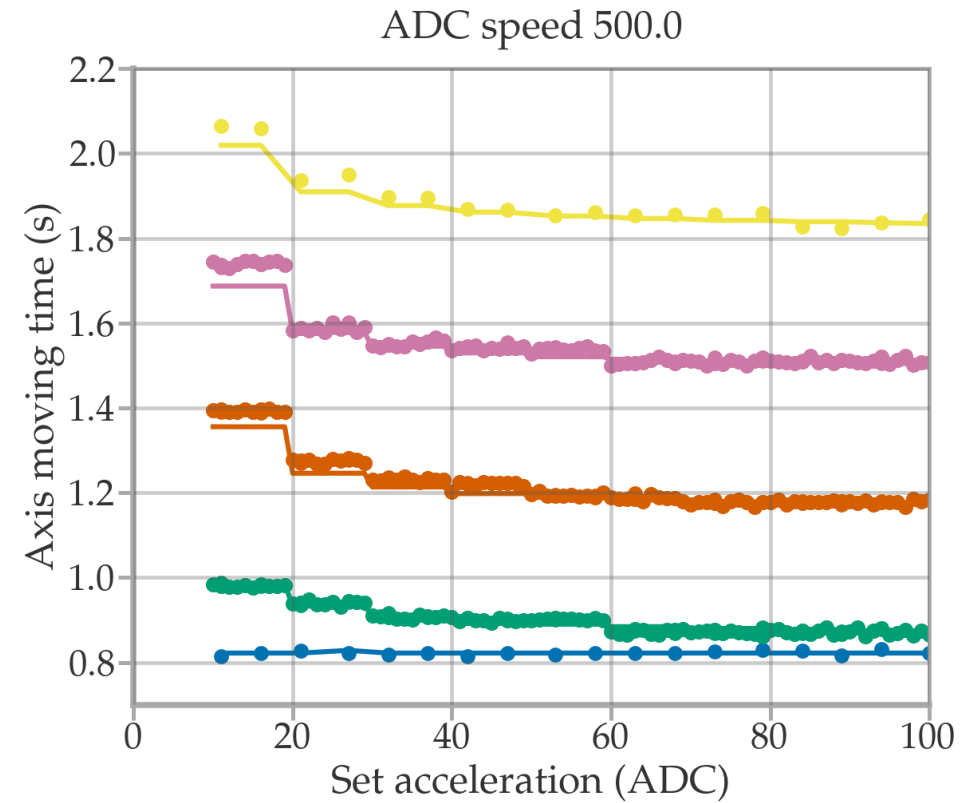
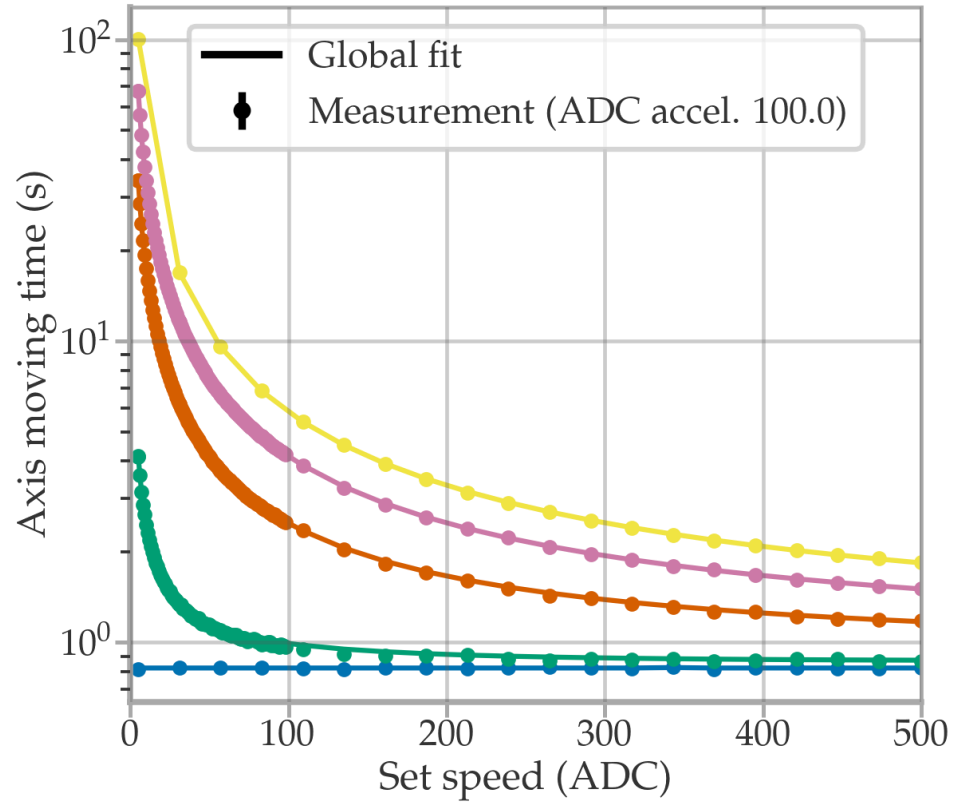
Speed slope ( mm/s / ADC)	Speed const ( mm/s )
(216.526 ± 0.002)e-3	(0.773 ± 0.011)e-3



Acceleration slope ( mm/s² / ADC)	Acceleration const ( mm/s² )
(233.427 ± 0.017)e-3	2.1272 ± 0.0004

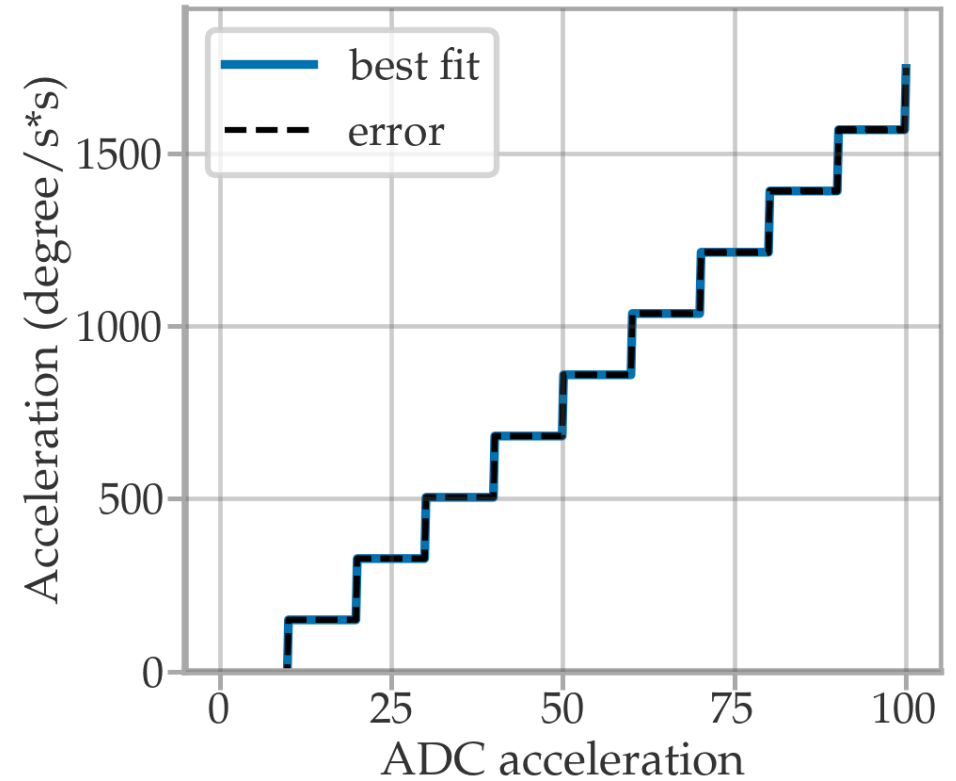
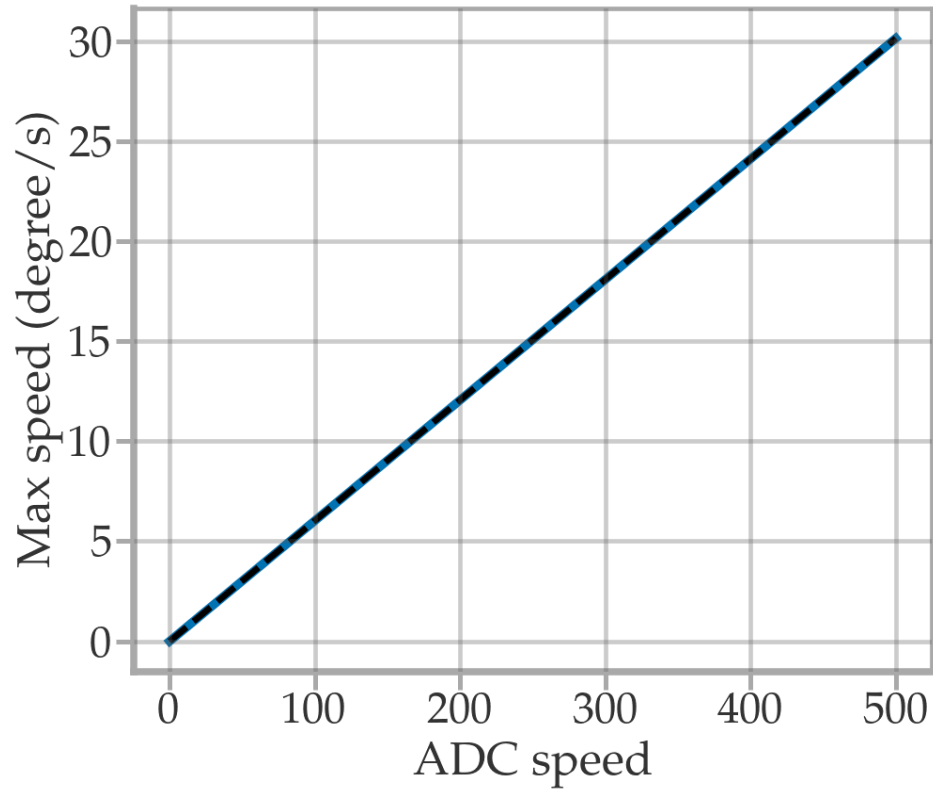
# Tilt-Axis (5)

0° 1° 10° 20° 30°



Acceleration bounds maybe [20-100]?

# Tilt-Axis (5)

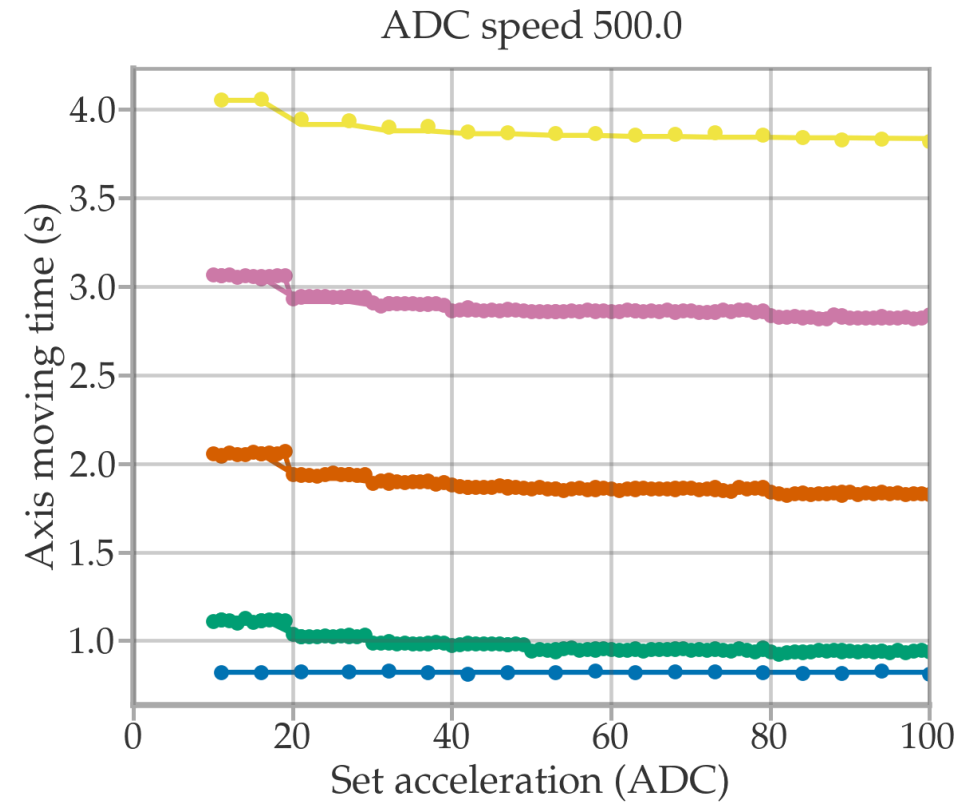
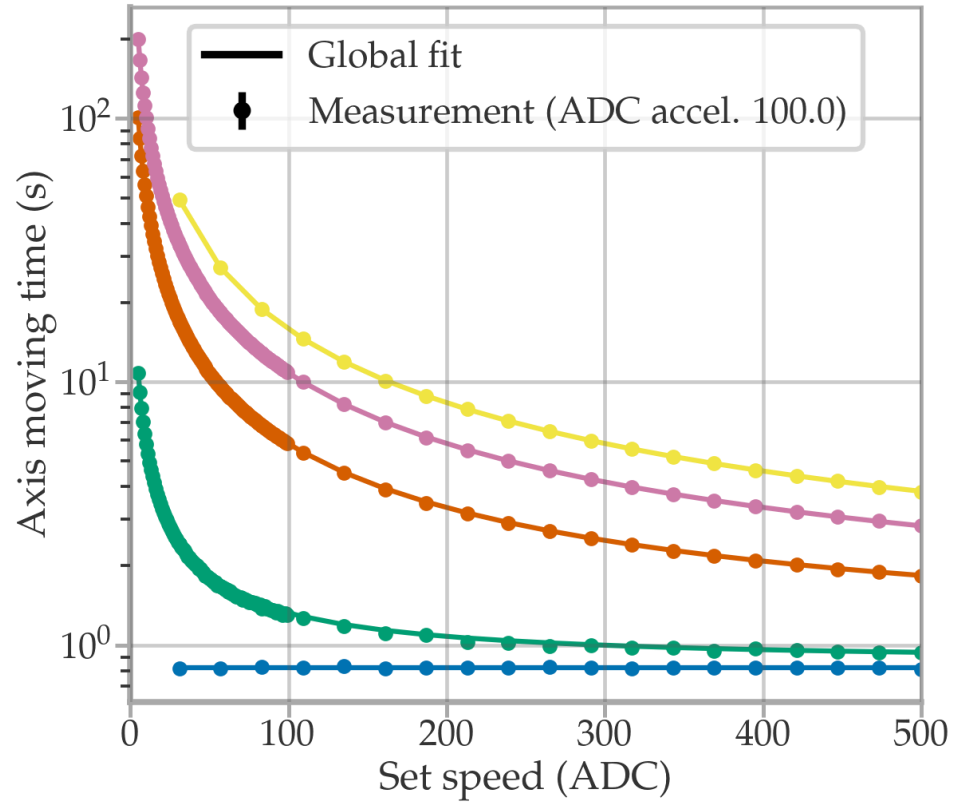


Speed slope ( °/s / ADC)	Speed const ( °/s )
(60.272 ± 0.002)e-3	(-1.236 ± 0.009)e-3

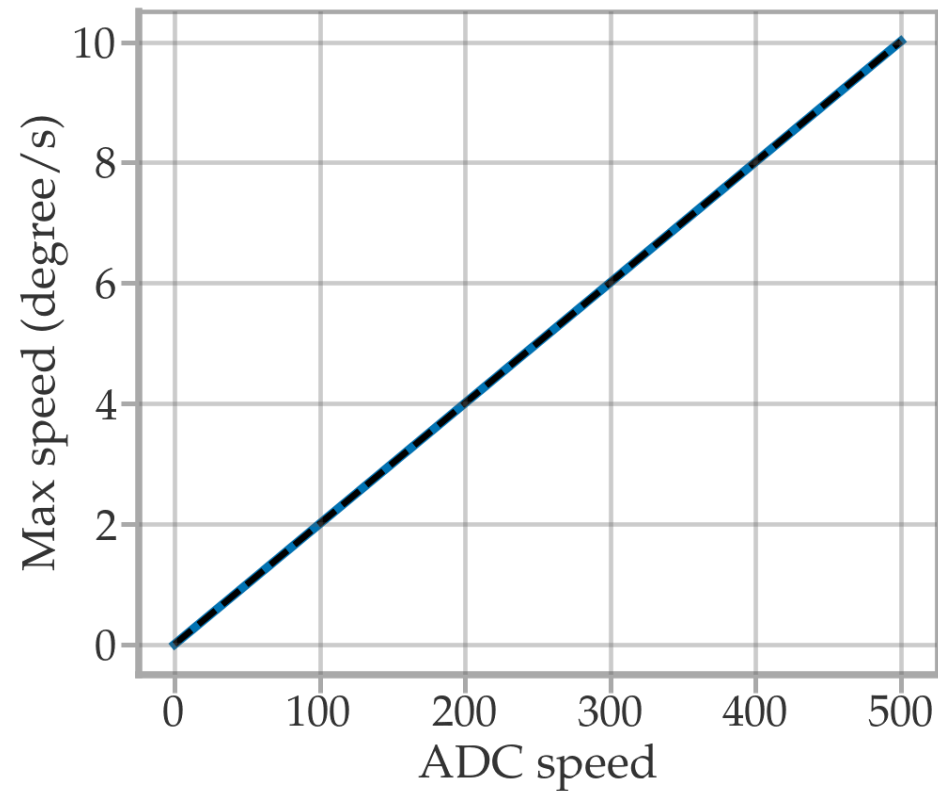
Acceleration slope ( °/s² / ADC)	Acceleration const ( °/s² )
17.753 ± 0.023	-28.16 ± 0.27

# Rot-Axis (4)

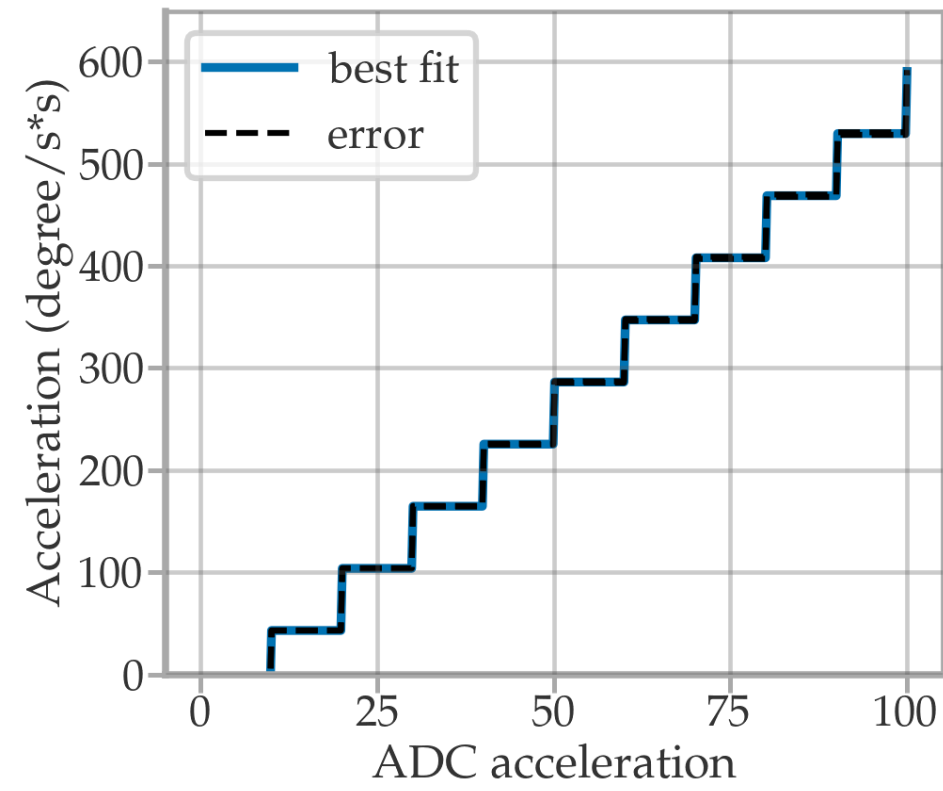
0° 1° 10° 20° 30°



# Rot-Axis (4)



Speed slope (°/s / ADC)	Speed const (°/s)
$(20.0254 \pm 0.0002)e-3$	$(-1.447 \pm 0.013)e-3$



Acceleration slope (°/s² / ADC)	Acceleration const (°/s²)
$(6.082 \pm 0.016)$	$-17.83 \pm 0.20$