

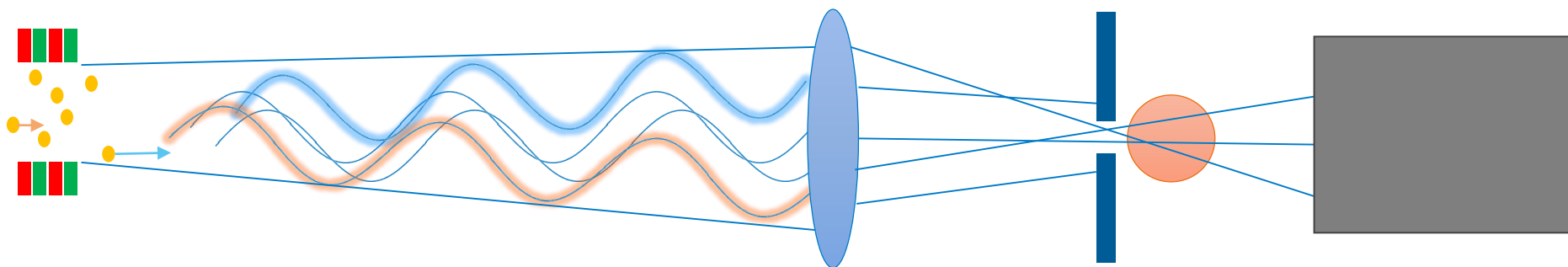
Steuerungskonzepte für PETRA IV Experimente

Patrik Wiljes
FS-PETRA / PIV WPG3.3
Hamburg, 20.06.2024

PETRA IV

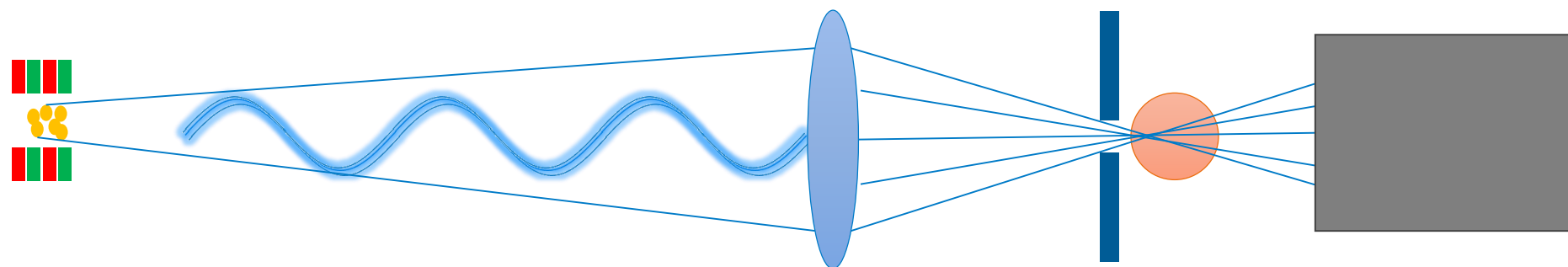
New Dimensions

PETRA III



Elektronen $\Rightarrow$ Undulator $\Rightarrow$ Röntgenstrahl $\Rightarrow$ Röntgenoptiken $\Rightarrow$ Probe $\Rightarrow$ Detektoren

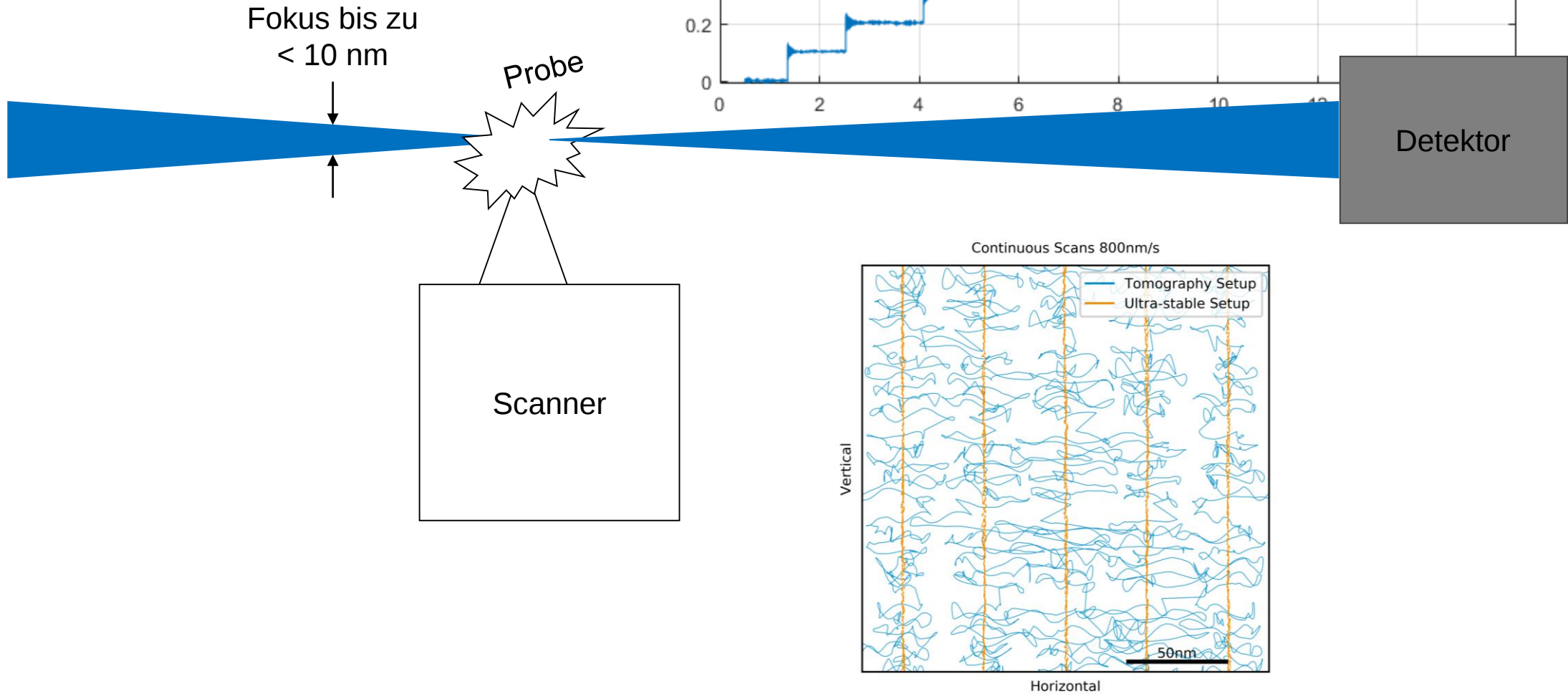
PETRA IV



*Faktor 500~1000 mehr
kohärente Photonen*

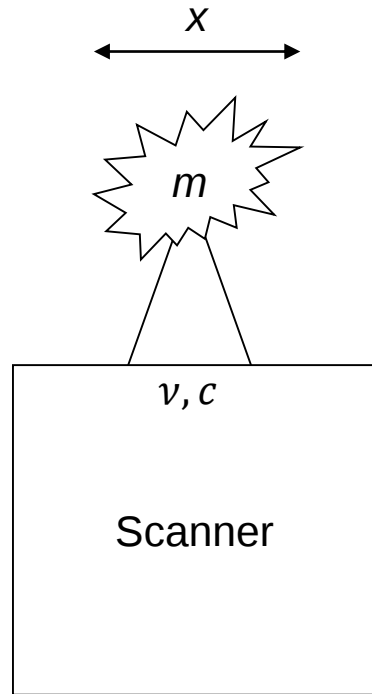
Schnellere Scans

... dank kürzerer Belichtungszeiten



Schnellere Scans

Herausforderungen



Kraft:

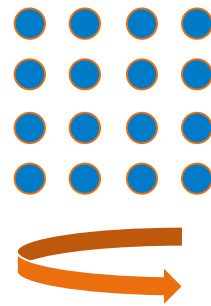
$$F = m \cdot \ddot{x} + \nu \cdot \dot{x} + c \cdot x$$

↑
Beschleunigung

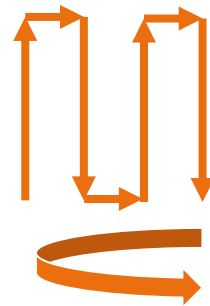
↑
Dämpfung

↑
Eigenfrequenz

Step-Scan



Continuous-Scan



Helical Scan



Begrenzter Verfahrweg



Hohe Beschleunigung



Anregung von Resonanzen



Einschwingen



Zeitverlust

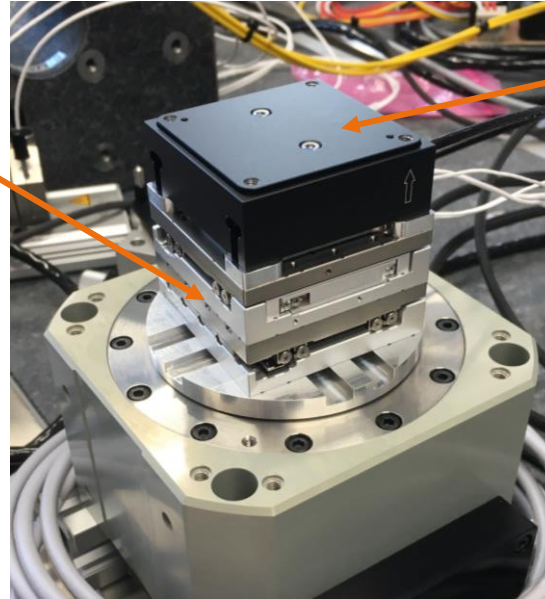
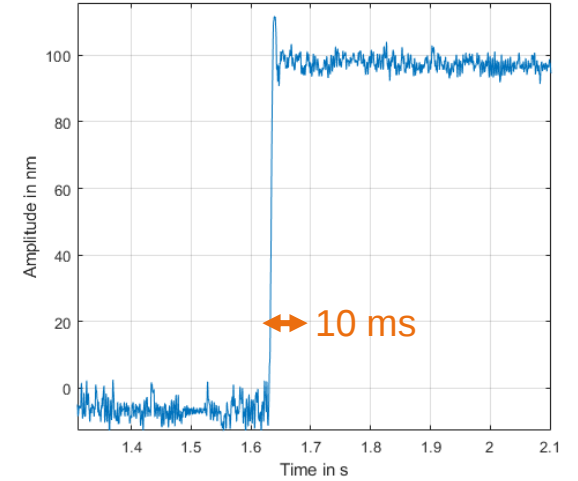
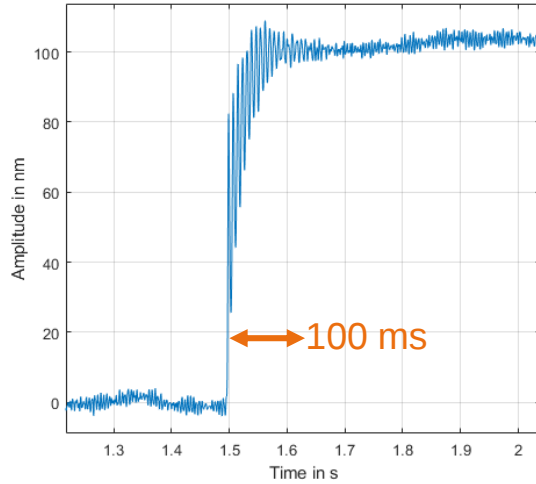


Vermeidung durch:

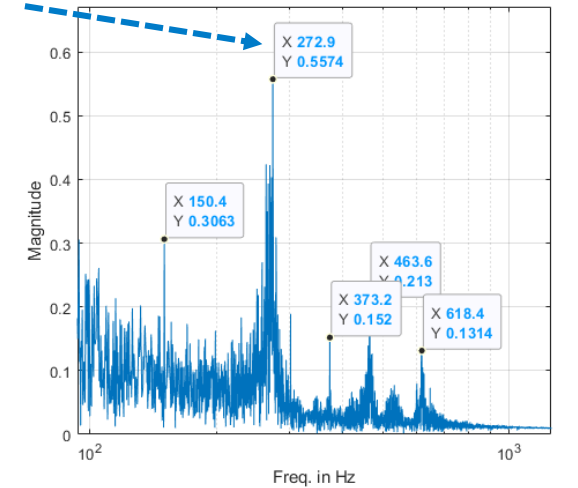
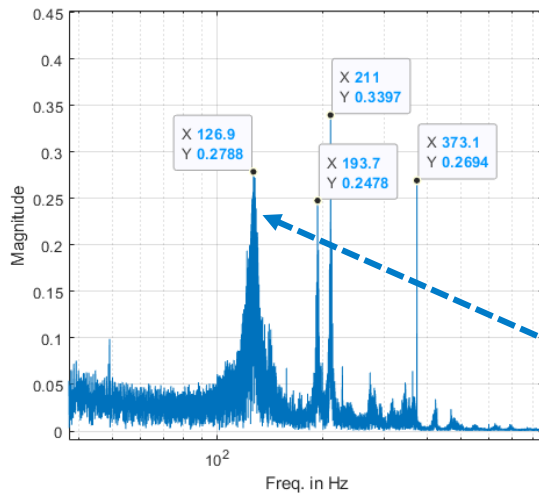
- CAD
- FEM
- Material/Fertigung
- Modellbasierte Steuerungen
- ...

Schnellere Scans

Herausforderungen

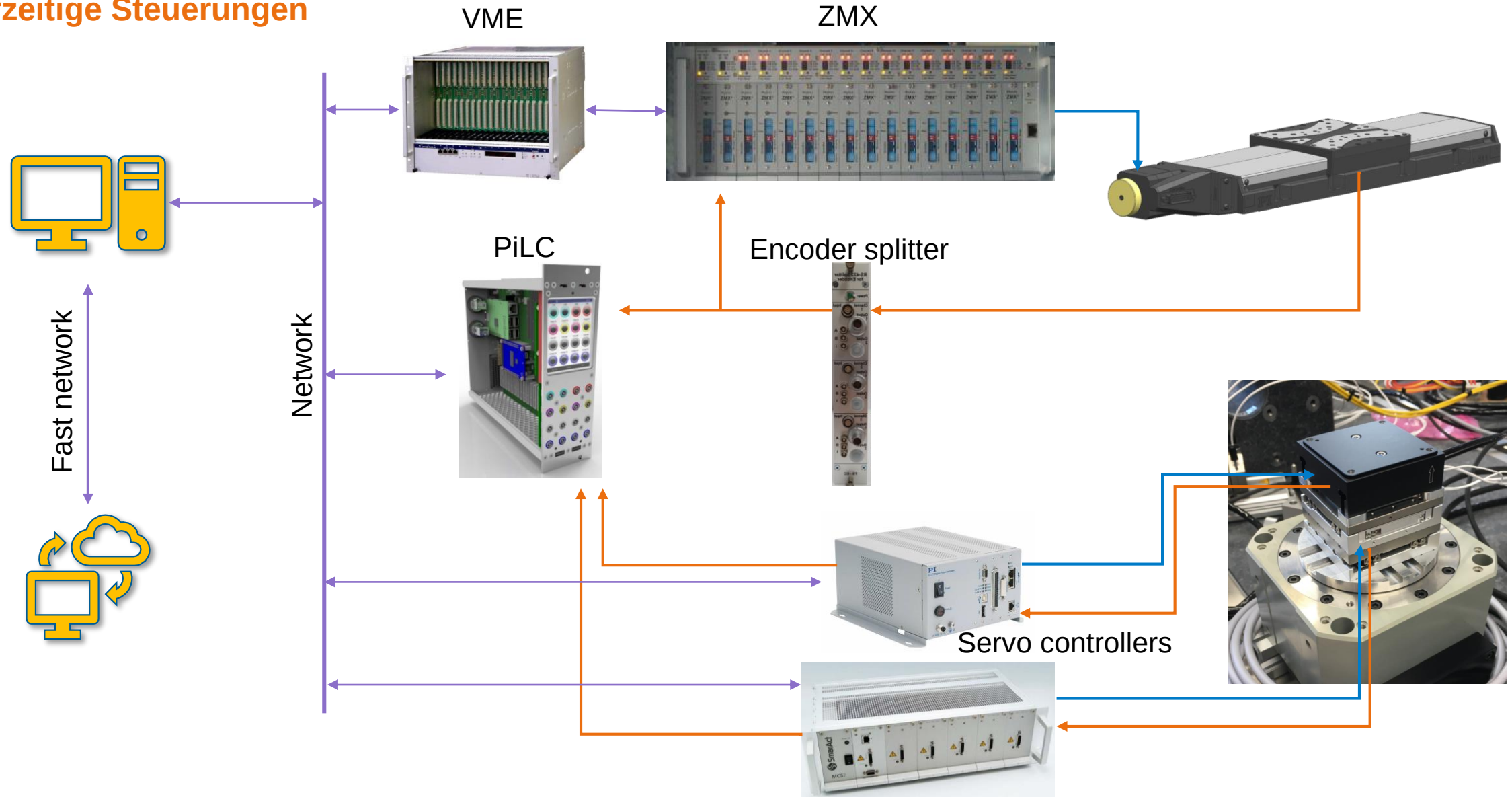


Hersteller:
270 Hz @ 30 gramm
Hier: 273 Hz



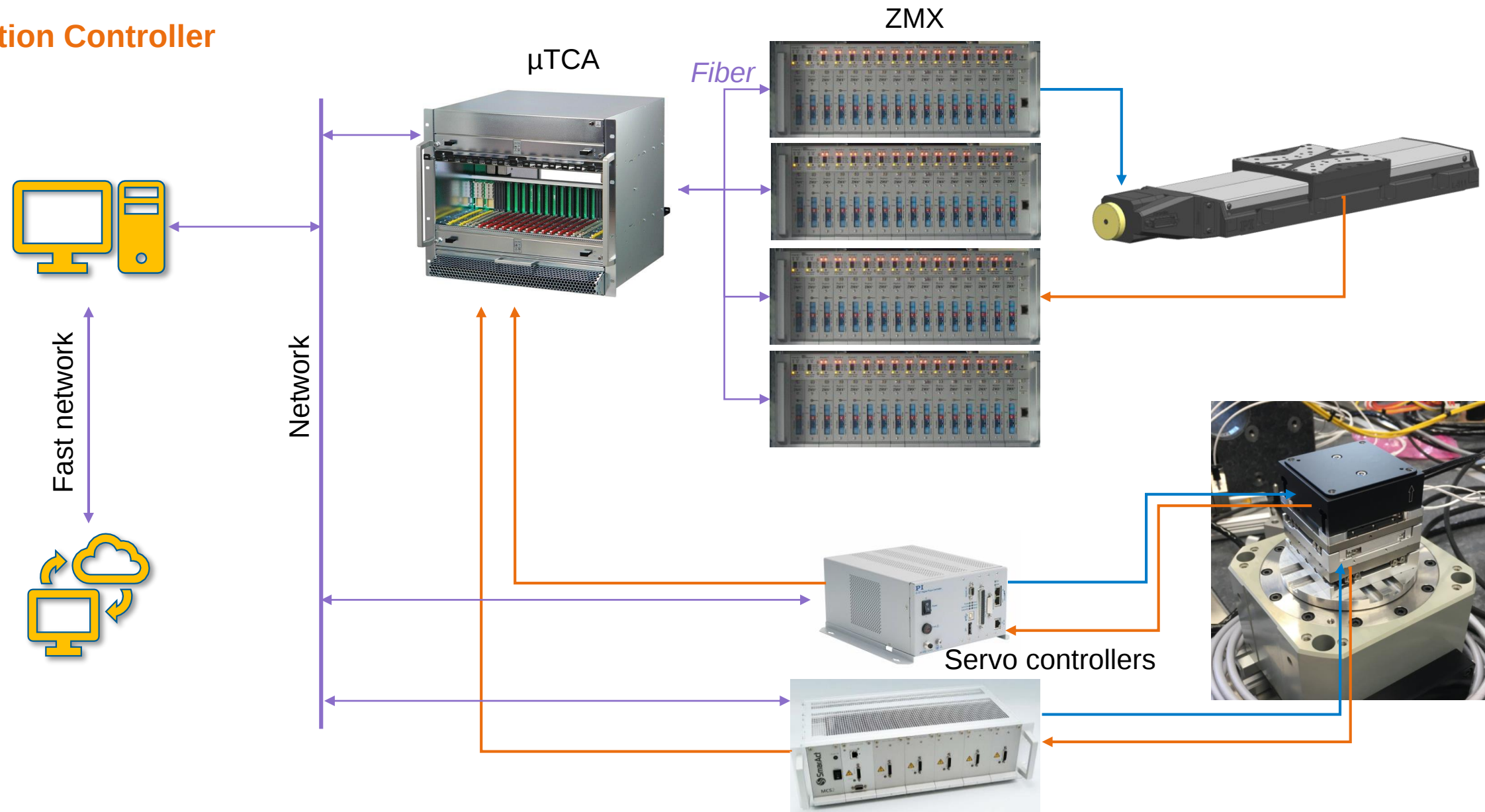
Status Quo

Derzeitige Steuerungen



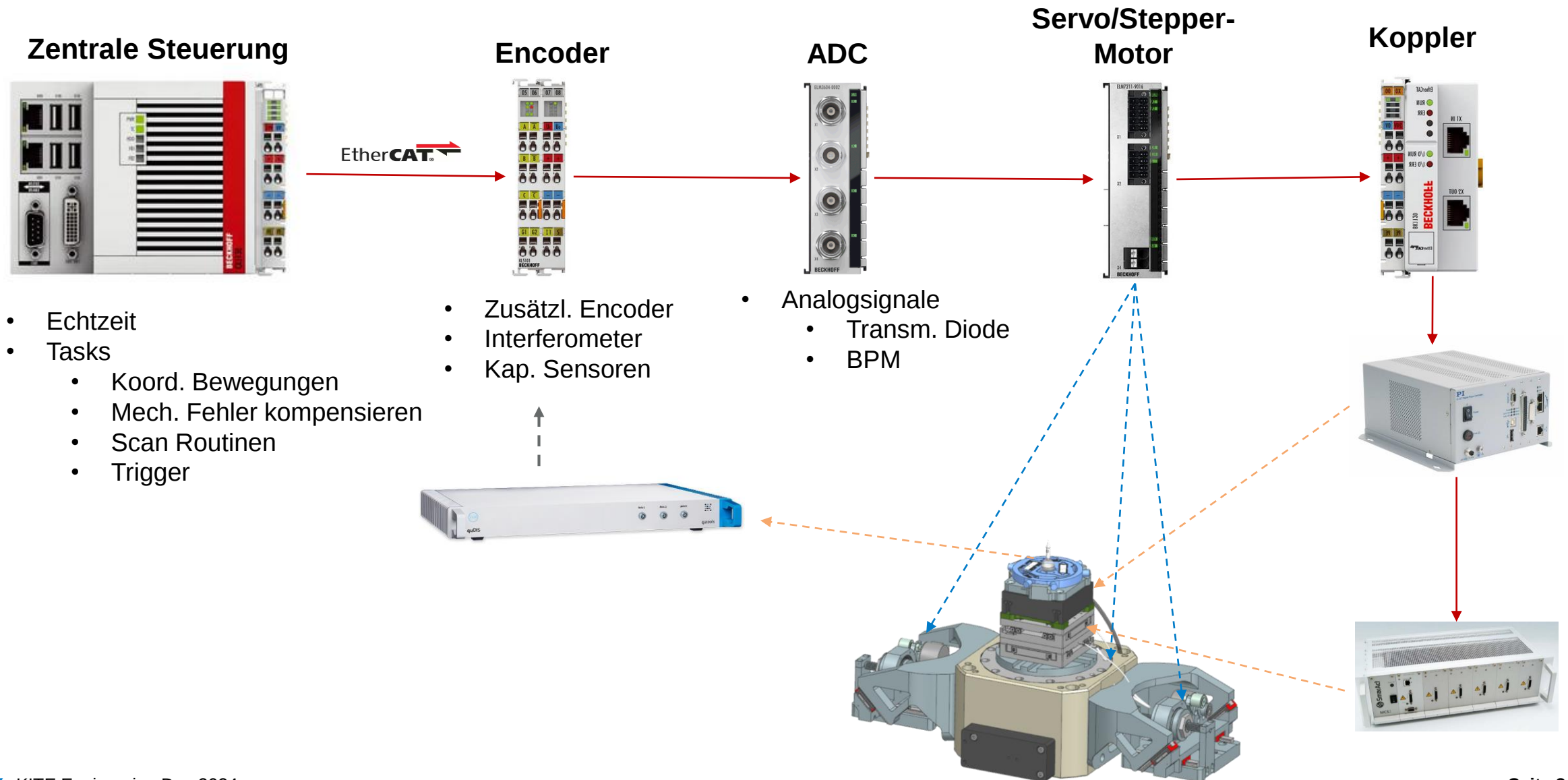
MicroTCA

Motion Controller

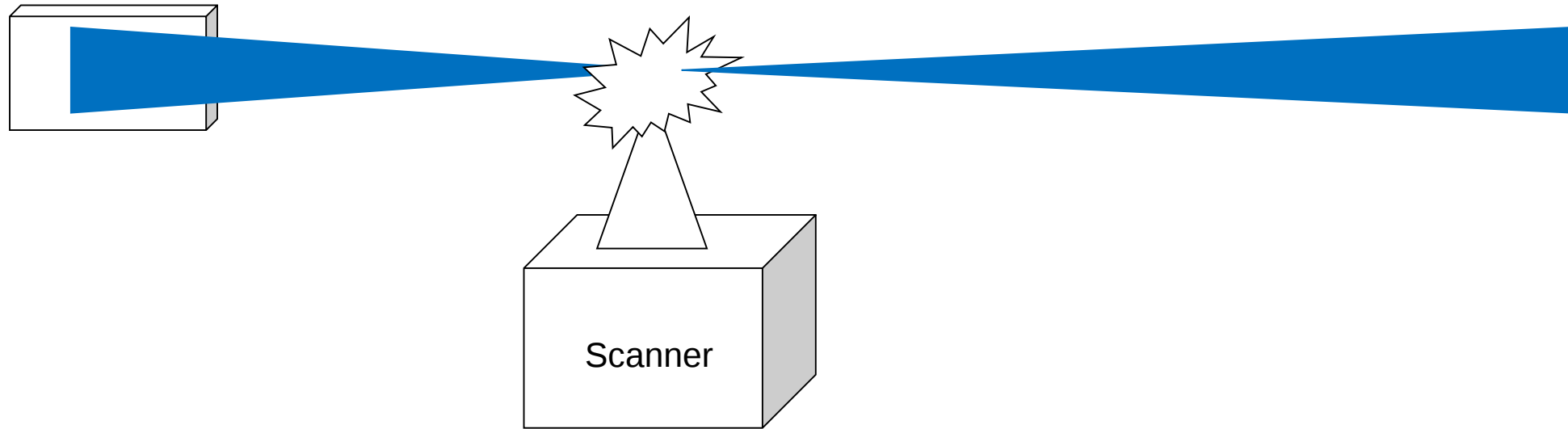


Alles unter einem Dach

Echtzeitsteuerungen



Müssen wir die Probe bewegen?

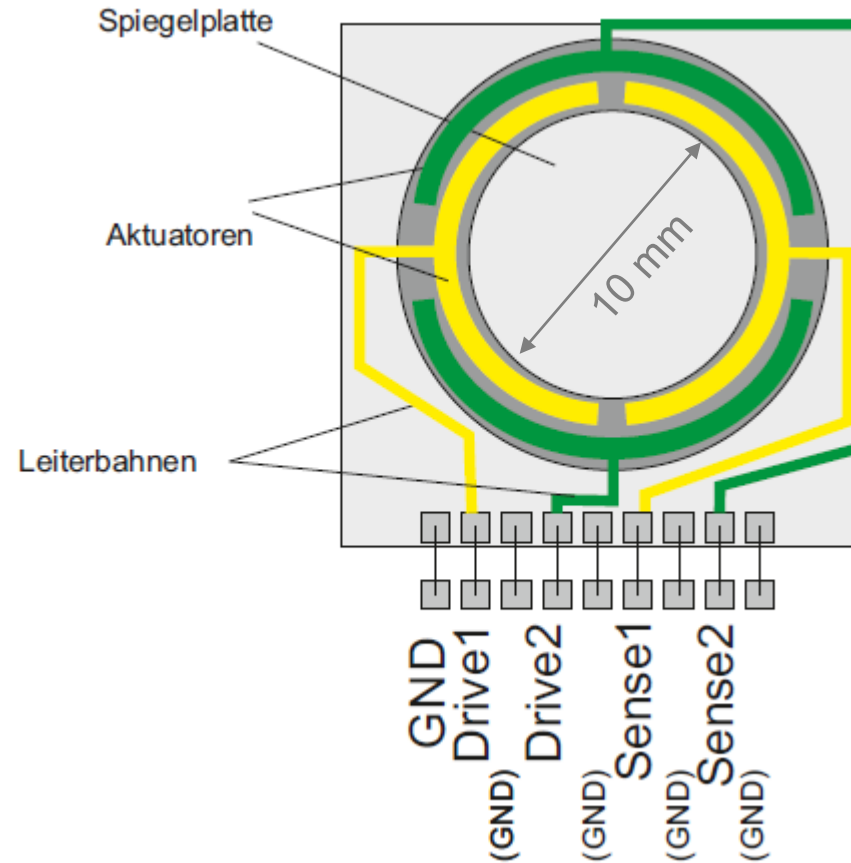


MEMS Scanner

Ein Spiegel mit integrierten Piezo Motoren

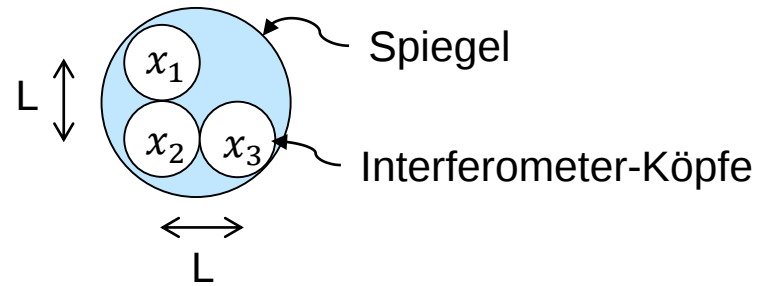


 **Fraunhofer**
ISIT



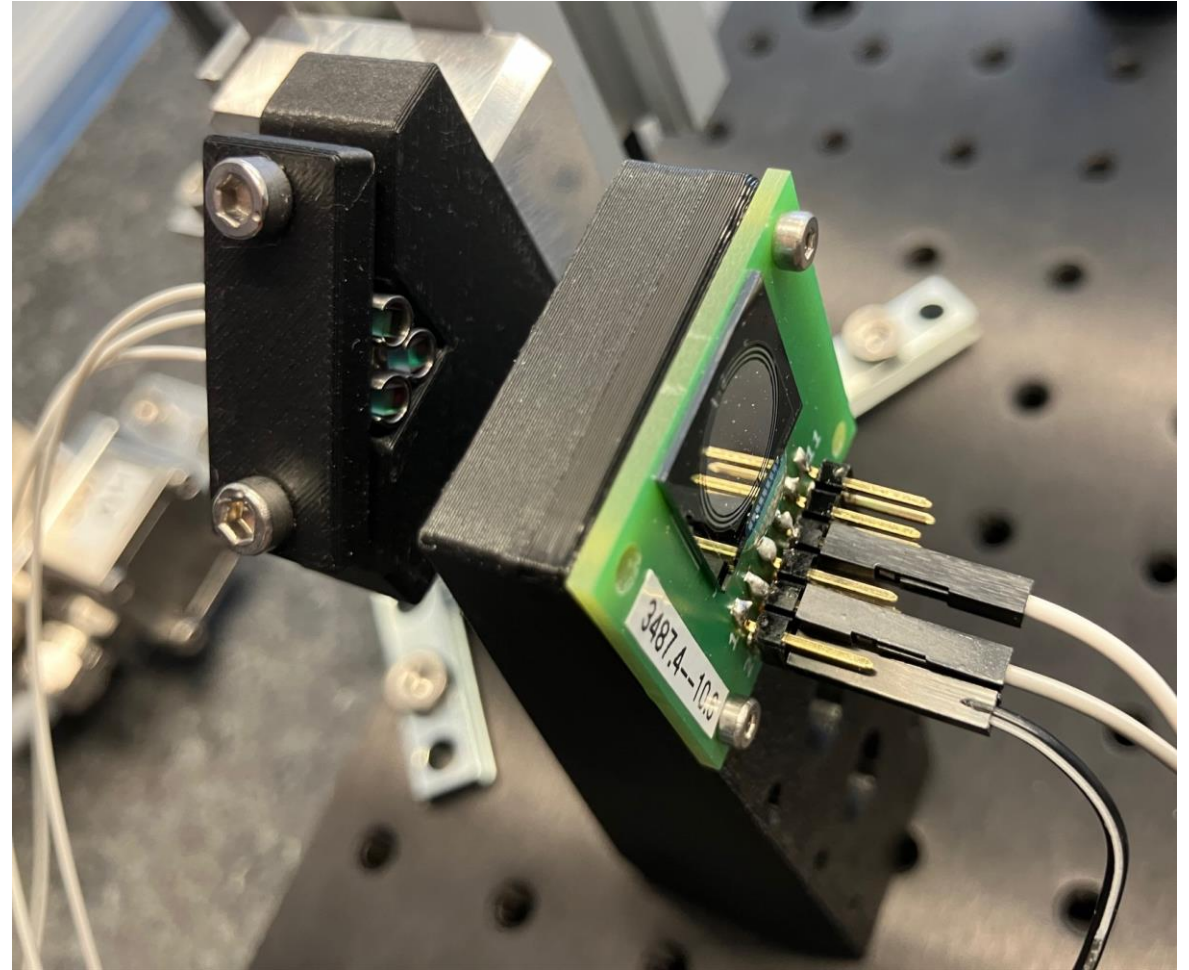
Messung der Winkel

Mit Laser-Interferometern



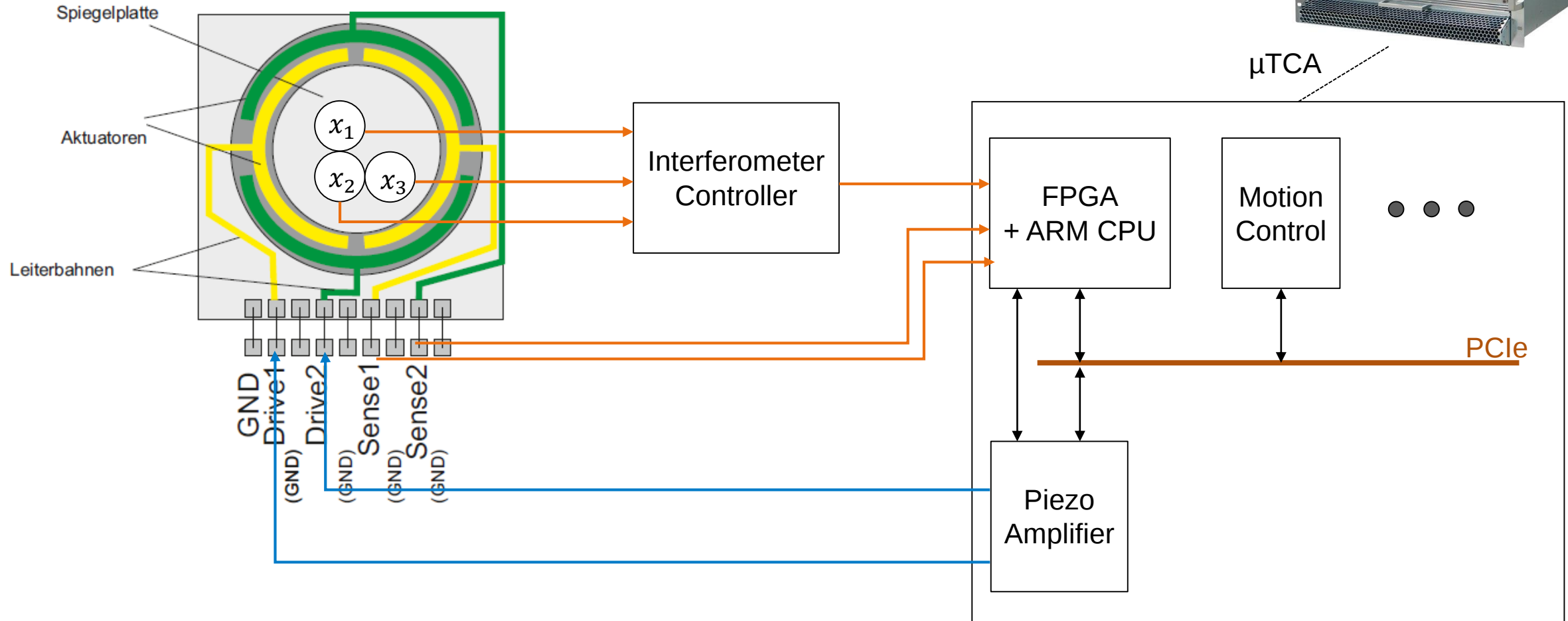
$$\alpha = \operatorname{atan}\left(\frac{x_1 - x_2}{L}\right) \cdot \frac{180^\circ}{\pi}$$

$$\beta = \operatorname{atan}\left(\frac{x_2 - x_3}{L}\right) \cdot \frac{180^\circ}{\pi}$$

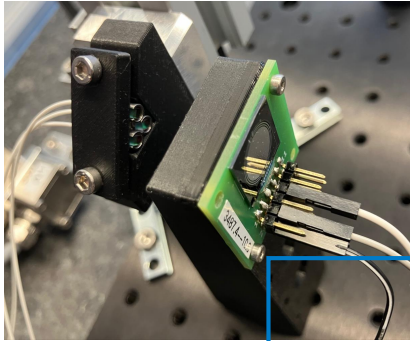


MEMS Scanner

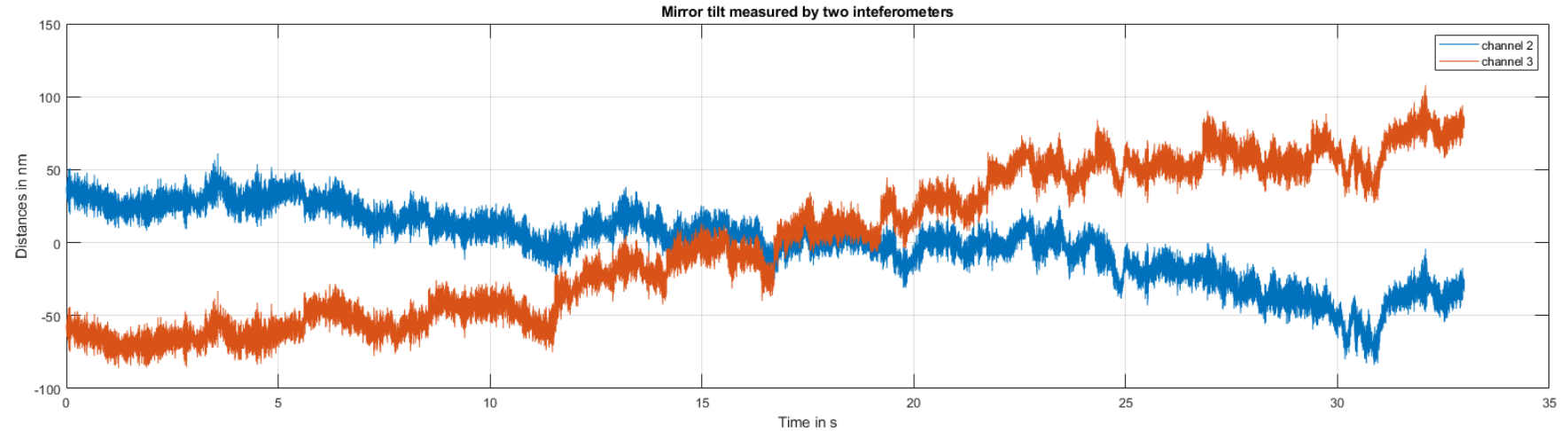
Ein Spiegel mit integrierten Piezo Motoren



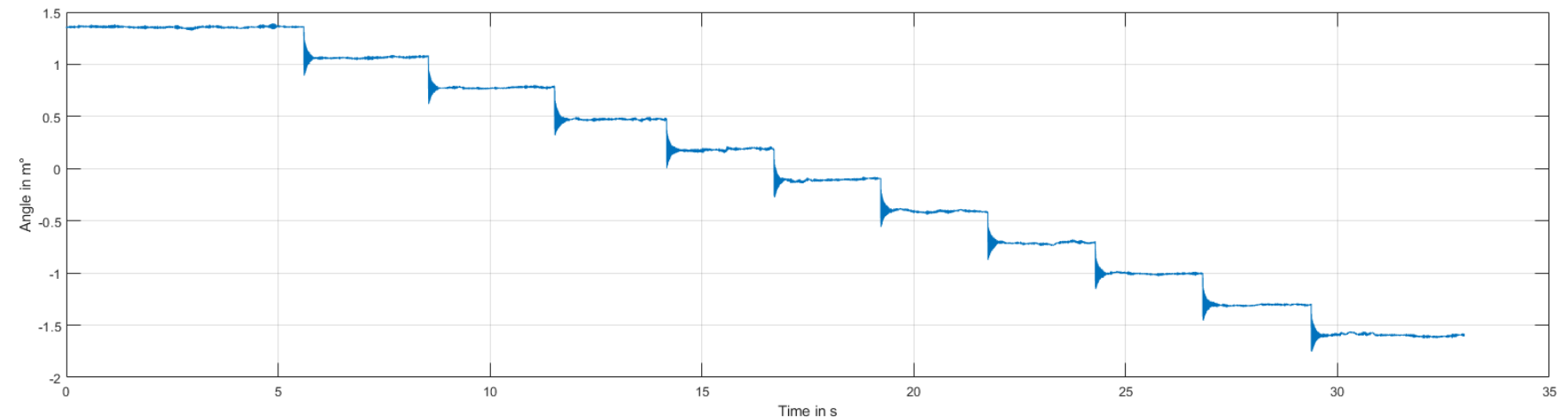
1D-Stepscan



$$\alpha = \operatorname{atan}\left(\frac{x_2 - x_3}{L}\right) \cdot \frac{180^\circ}{\pi}$$

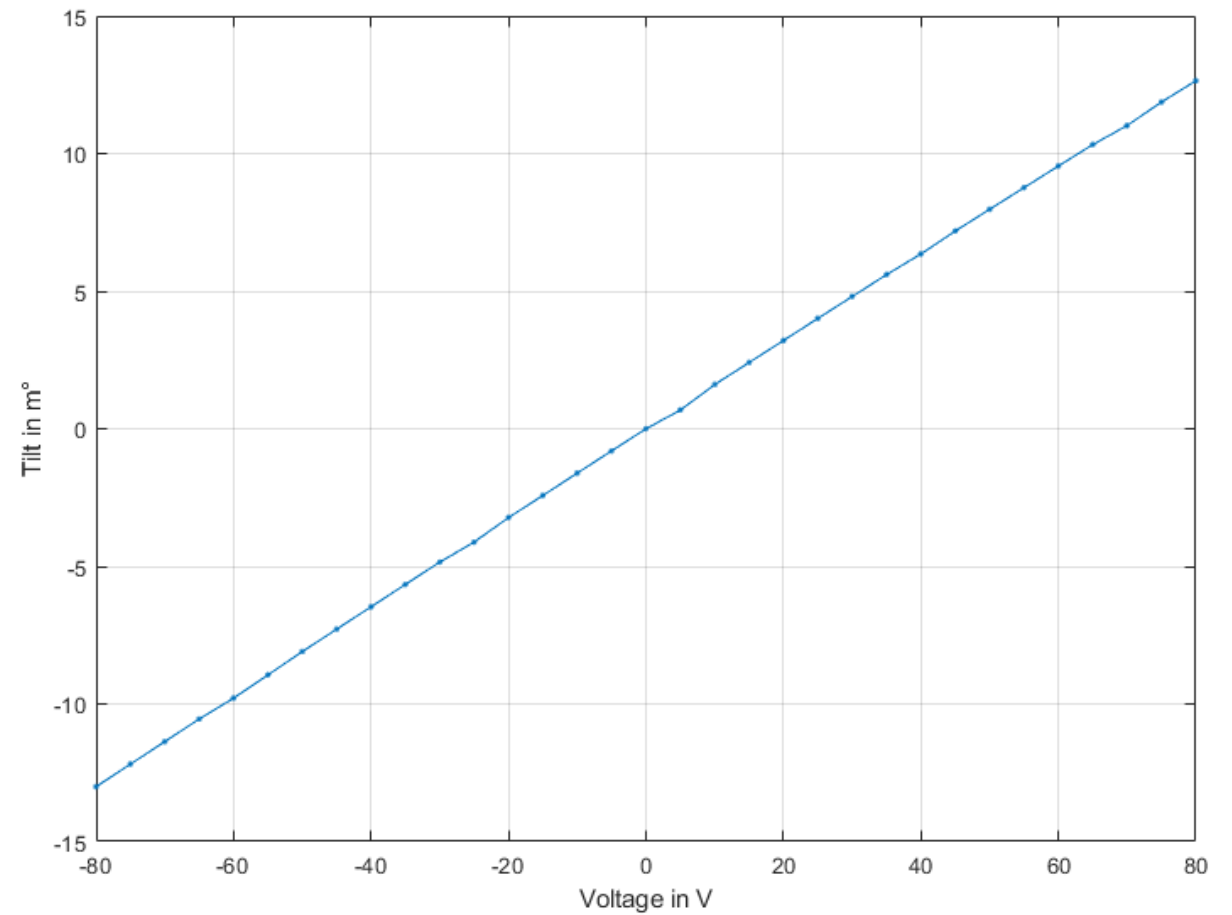
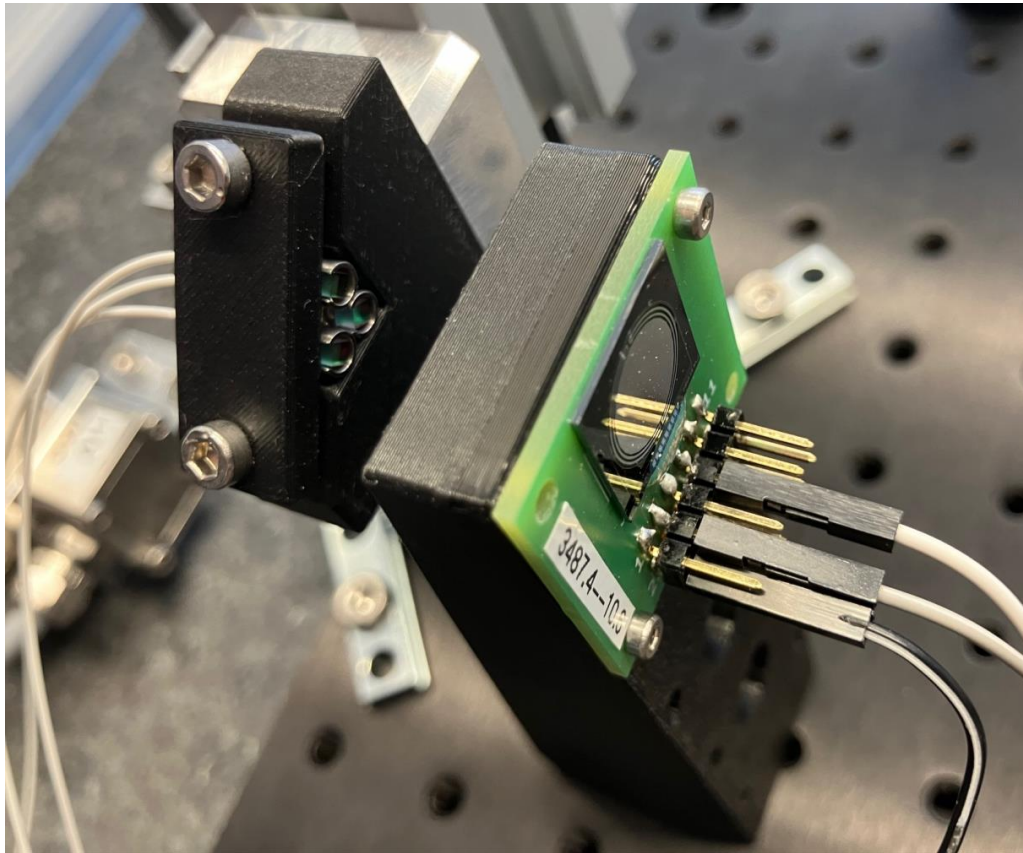


Temperatur-Driften für alle Sensoren gleich → Kompensation



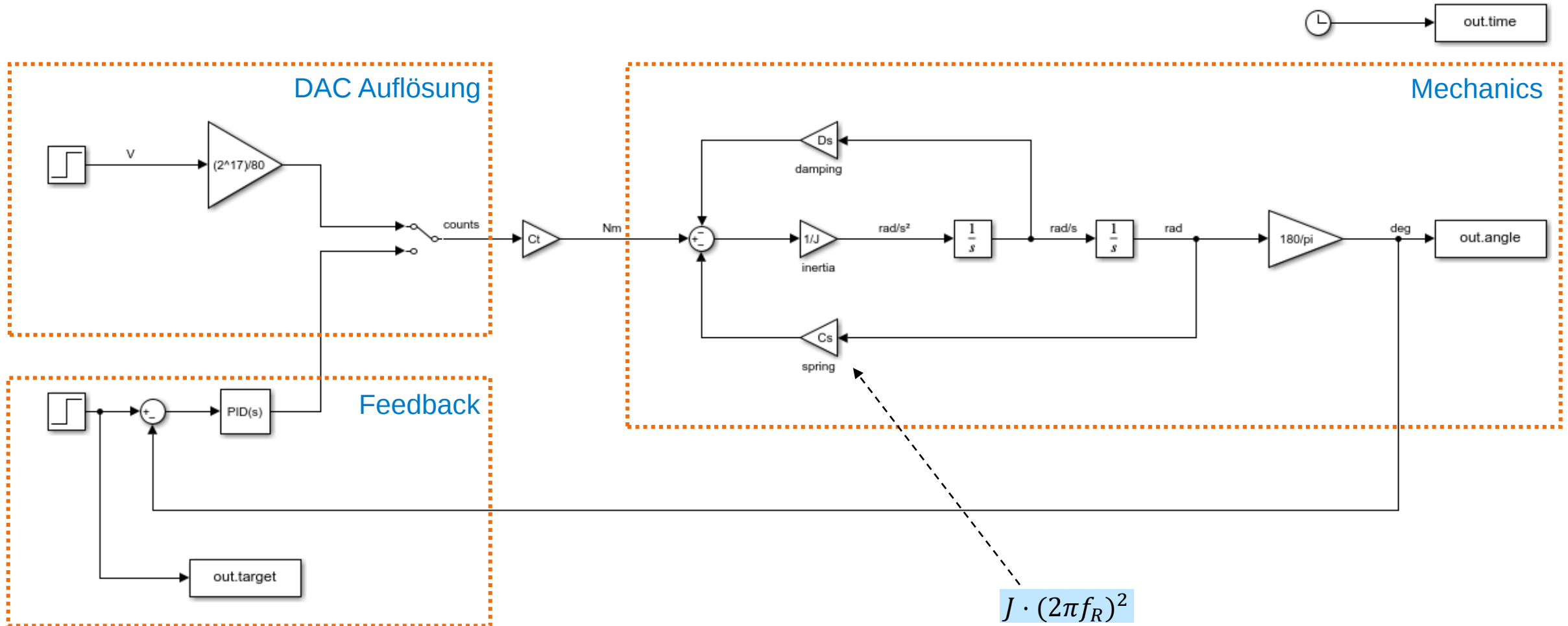
MEMS Scanner

Ein Spiegel mit integrierten Piezo Motoren



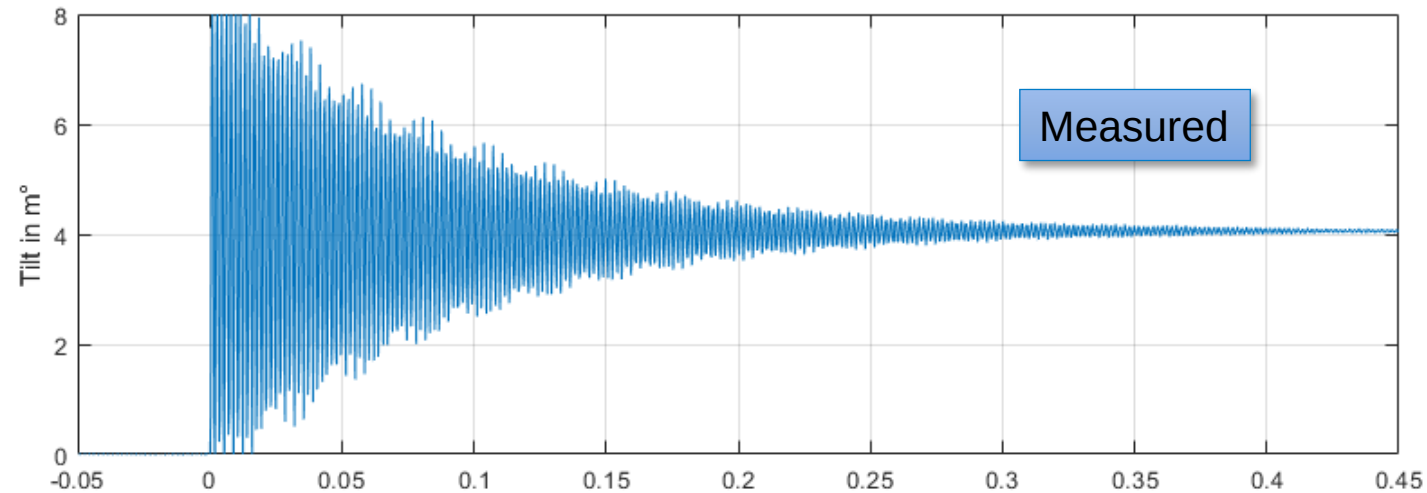
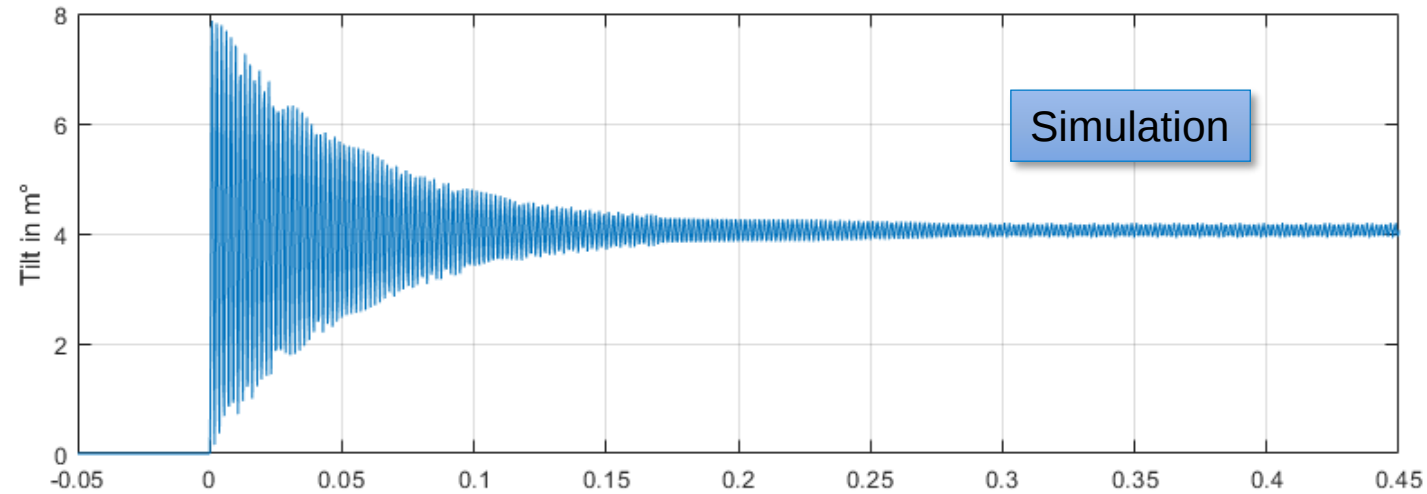
Simulation

Matlab/Simulink

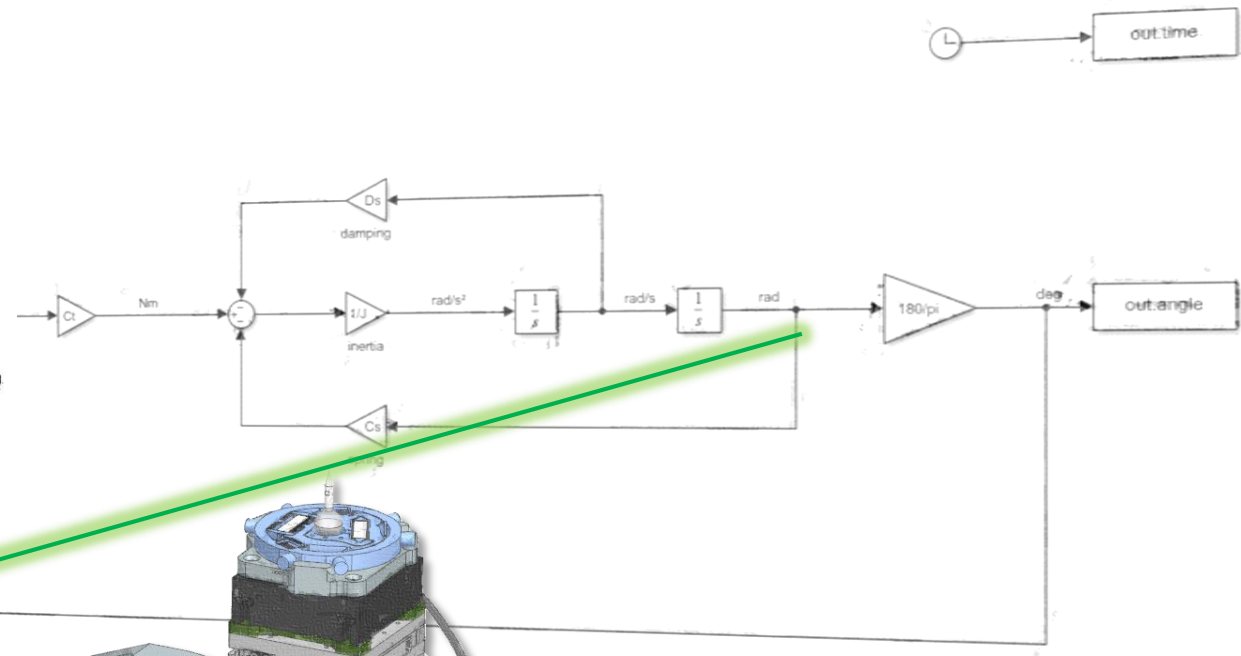


Simulation

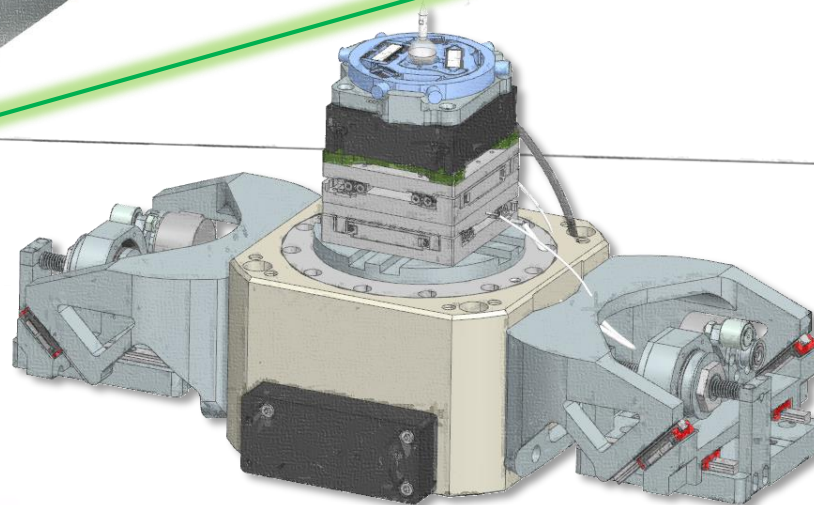
Matlab/Simulink



Vielen Dank



out.target



Kontakt

Deutsches Elektronen-
Synchrotron DESY

www.desy.de

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