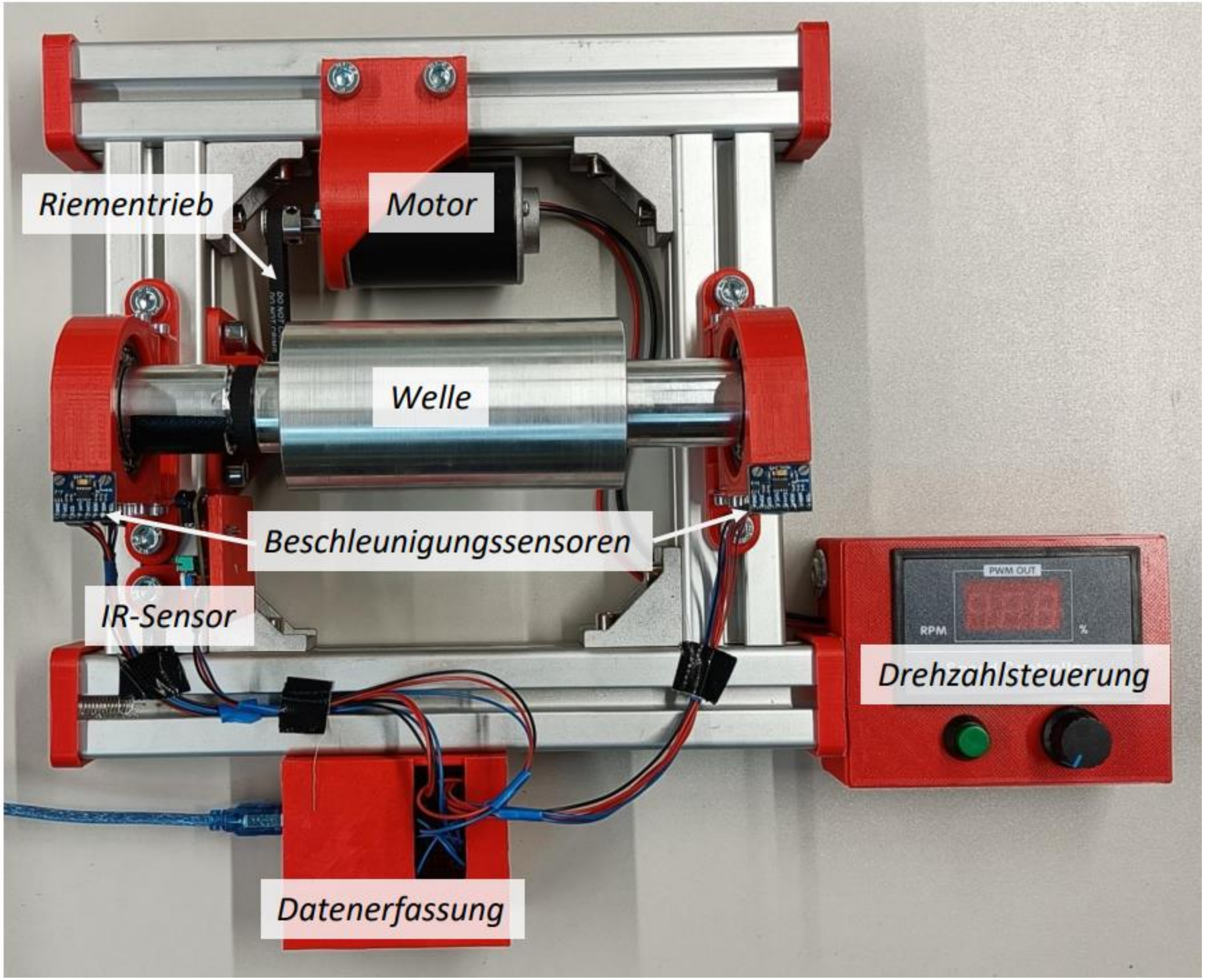
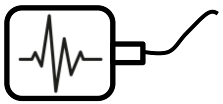
Auswuchttechnik

Übung 1: Signalerfassung/-verarbeitung

Wuchtkit

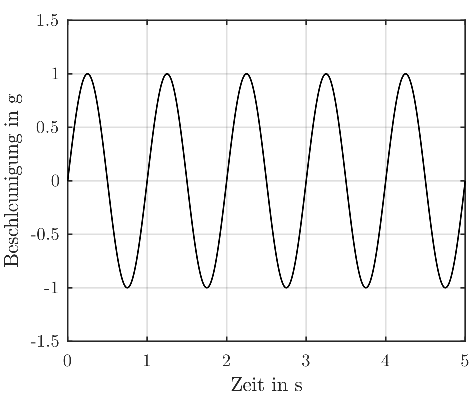

Riementrieb
Motor
Welle
Beschleunigungssensoren
IR-Sensor
Drehzahlsteuerung
PWM OUT
RPM
%
Datenerfassung

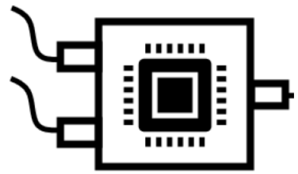
Datenerfassung



Sensor

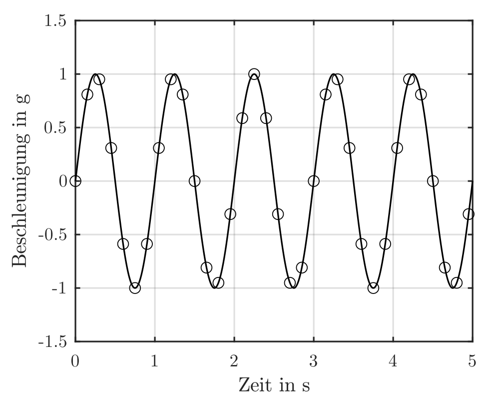
analoges Signal





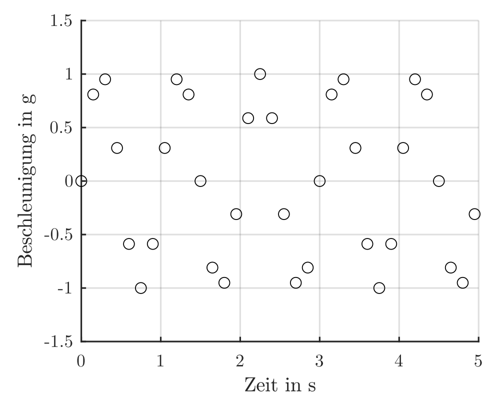
Datenerfassung
(DAQ)

Analog-Digital-Wandler
A/D-Wandler



PC

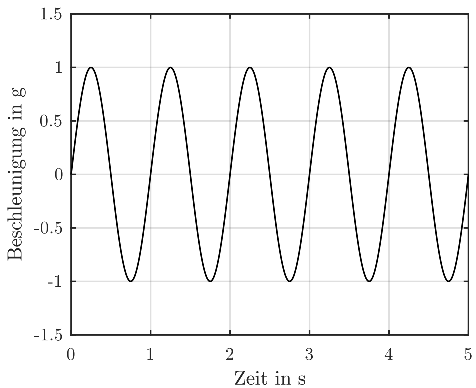
digitales Signal



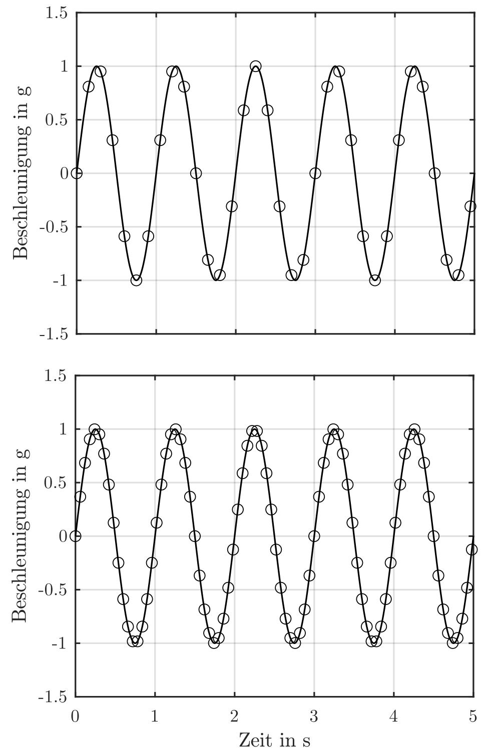
A/D-Wandler

- Auflösung in bit
  - Wie genau wird der der Wert des Signals aufgenommen?
- Abtastrate/-frequenz f_s in 1/s:
  - Wie oft wird der Wert Signals aufgenommen?

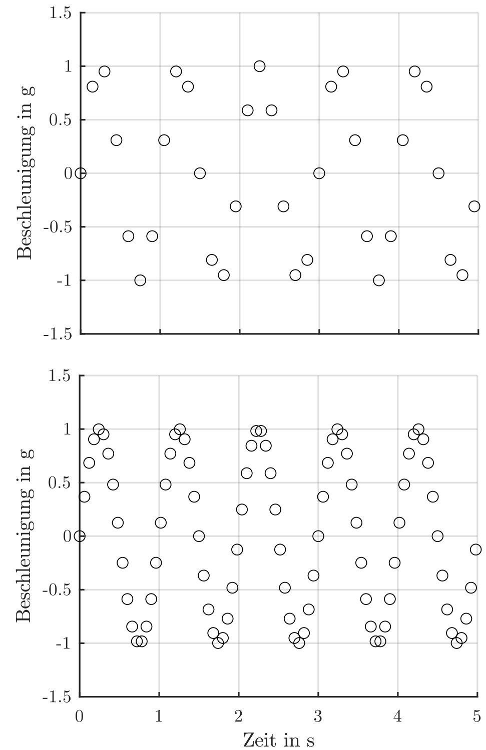
analoges Signal



A/D-Wandler



digitales Signal



Nyquist-Shannon-Abtasttheorem

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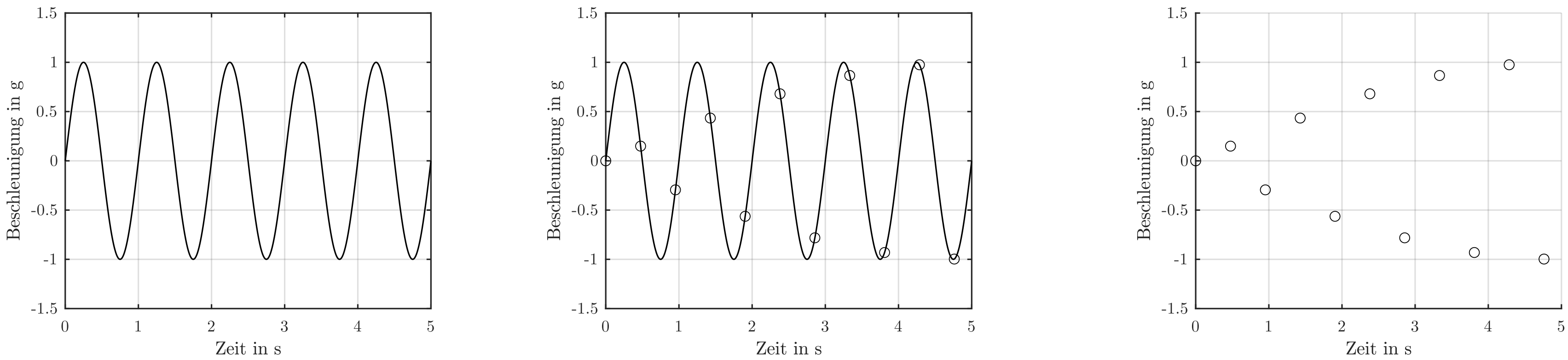
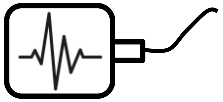
- Abtastrate/-frequent f_s in 1/s:
  - Wie oft wird der Wert Signals aufgenommen?

höchste zu messende Frequenz im Signal

Nyquist-Shannon-Abtasttheorem: $$f_s > 2 \cdot f_m$$

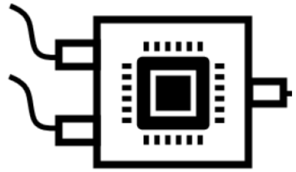
analoges Signal | A/D-Wandler | digitales Signal





Sensor

analoges Signal



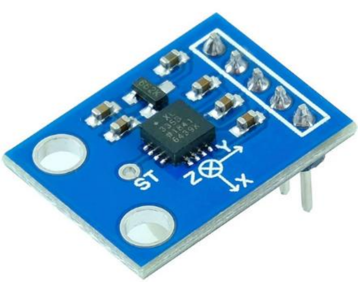
Datenerfassung
(DAQ)

Analog-Digital-Wandler
A/D-Wandler

PC

digitales Signal

ADXL 355



Arduino UNO

Laptop

Wuchtkit: Signale

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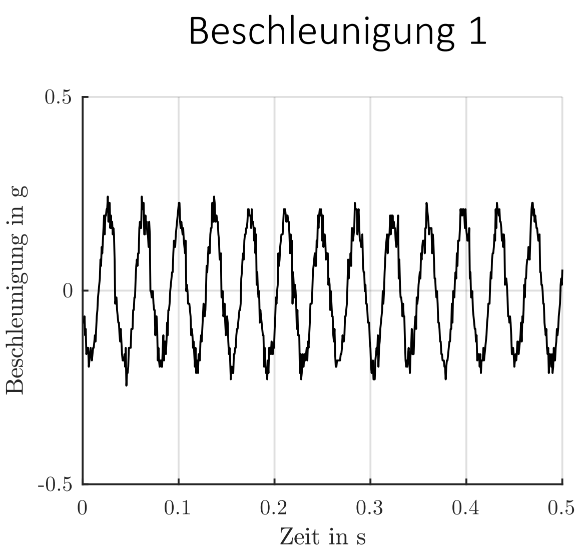

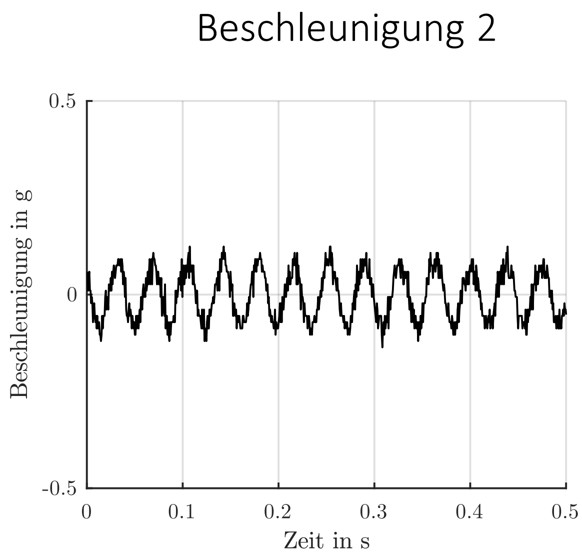

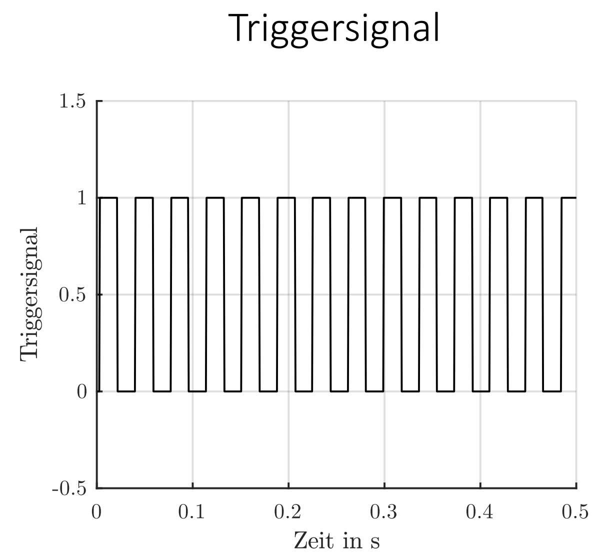

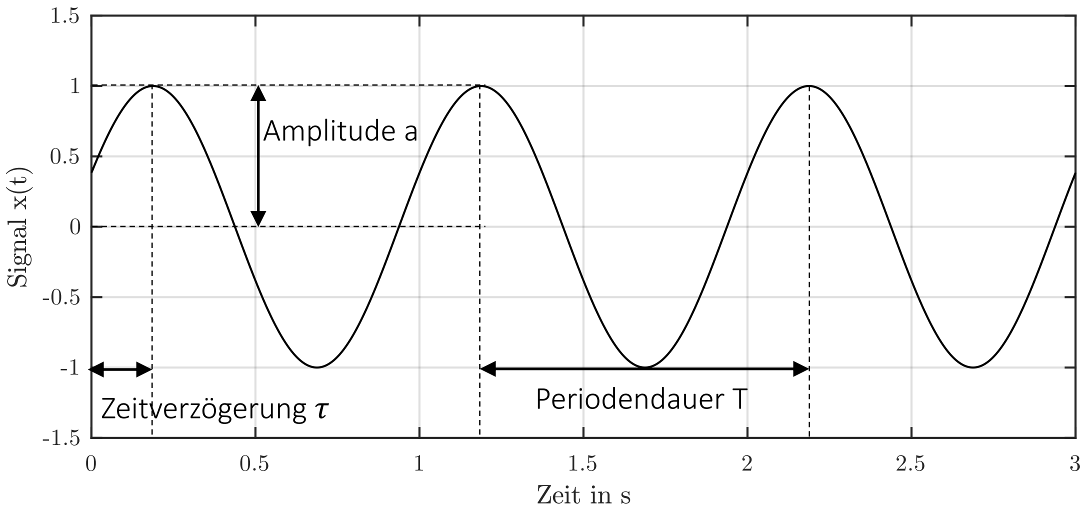

Frequenz: $f = 1/T$

Kreisfrequenz: $\omega = 2\pi f$

Nullphasenwinkel: $\varphi = \left(1 - \frac{\tau}{T}\right) \cdot 2\pi$

Harmonische Schwingung:

$$x(t) = a \cdot \cos(\omega t + \varphi)$$

Fourier-Transformation

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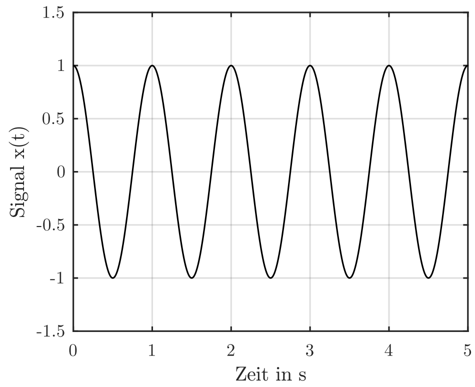
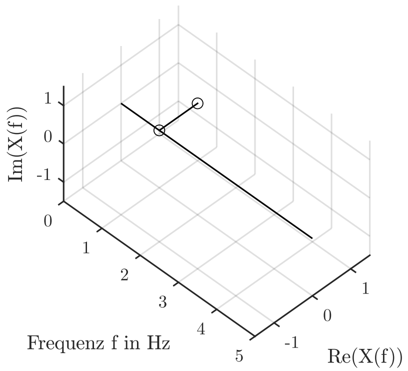
- Fourier-Transformation eines periodischen Signals

Zeitsignal $x(t)$

Frequenzsprektrum $X(f)$

Kosinus

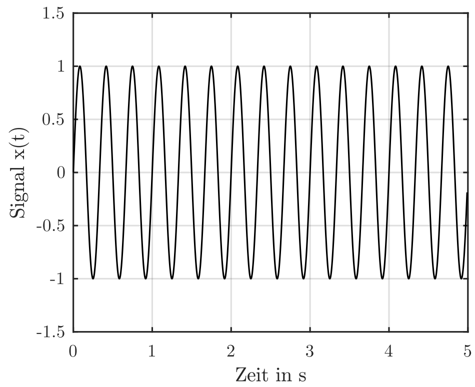


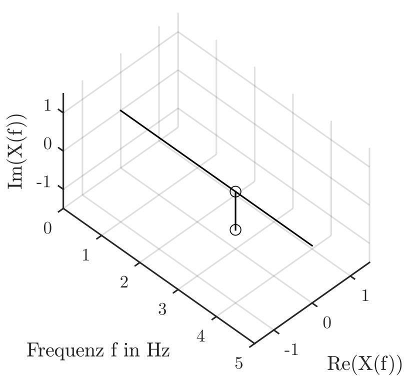


Fourier-Transformation

$\mathcal{F}$

Sinus



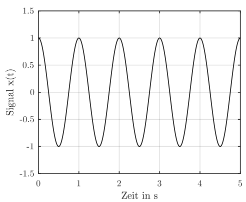


Fourier-Transformation

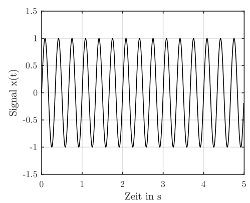
- Fourier-Transformation eines periodischen Signals

Zeitsignal $x(t)$

Frequenzsprektrum $\mathrm{X}(f)$

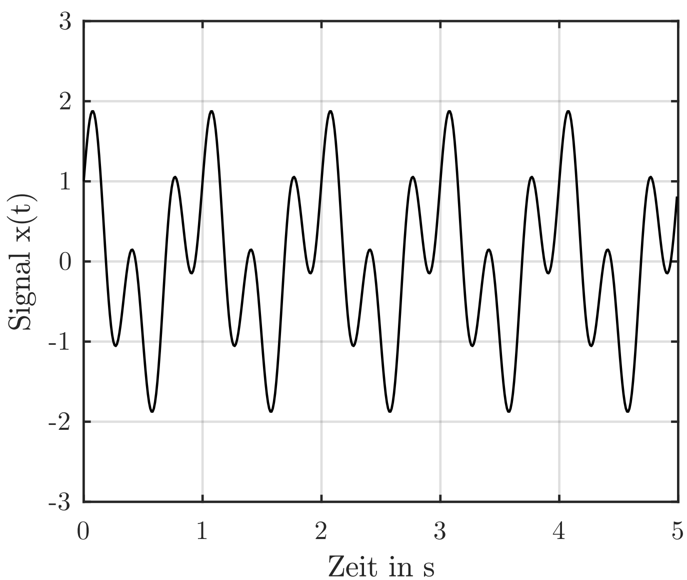


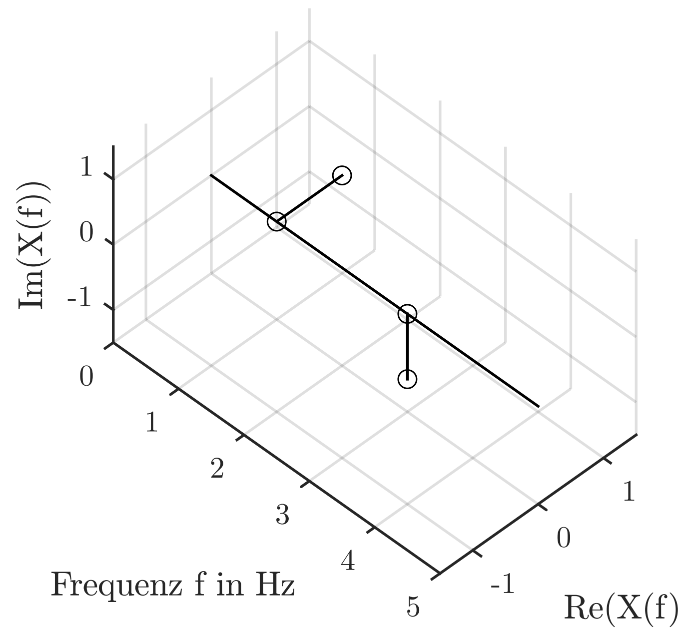
+



Fourier-Transformation

$\mathcal{F}$





Fourier-Transformation

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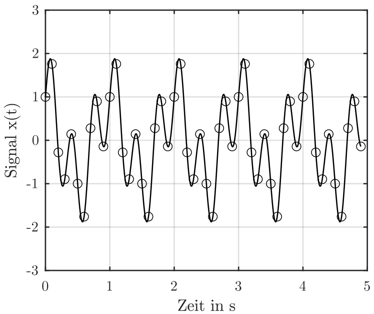
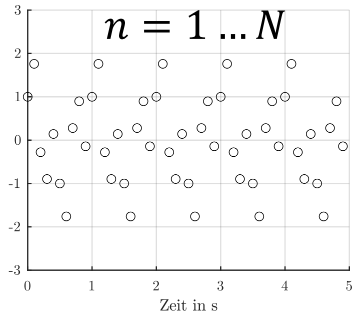
- Annäherung: Diskrete Fourier-Transformation (DFT)
- Algorithmus: Fast Fourier-Transformation (FFT)

Analoges Signal x(t)

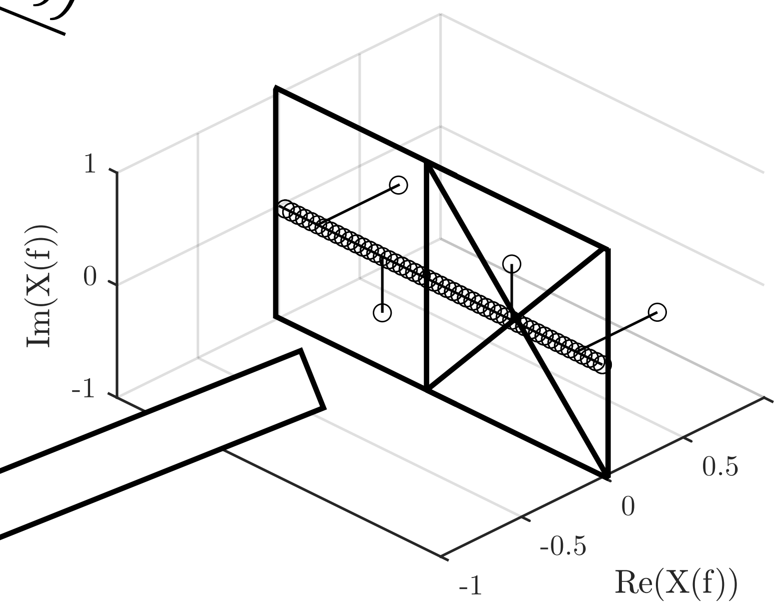


Digitales Signal x(n)

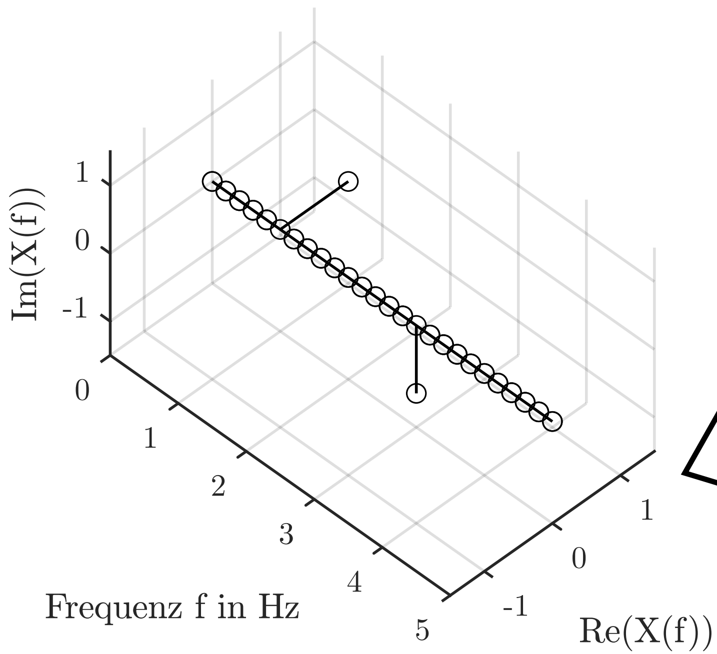


$$\frac{fft(x(n))}{N}$$

Doppelseitiges Frequenzspektrum



$\cdot\, 2$



Vorgehen: Daten aus ISIS

- Daten zum einlesen in Matlab über ISIS herunterladen.

a- Beschleunigung in g

tr- IR-Signal (0 oder 1)

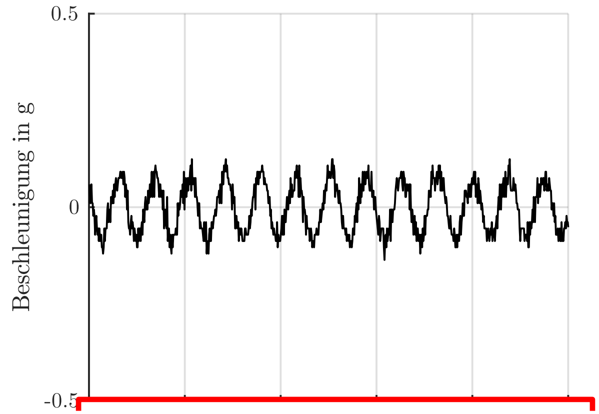
t- Zeit für Erfassung der Datenpunkte in μs

$$daten = \begin{bmatrix} a_{1.1} & a_{2.1} & tr_1 & t_1 \\ \vdots & \vdots & \vdots & \vdots \\ a_{1.n} & a_{2.n} & tr_n & t_n \end{bmatrix}$$

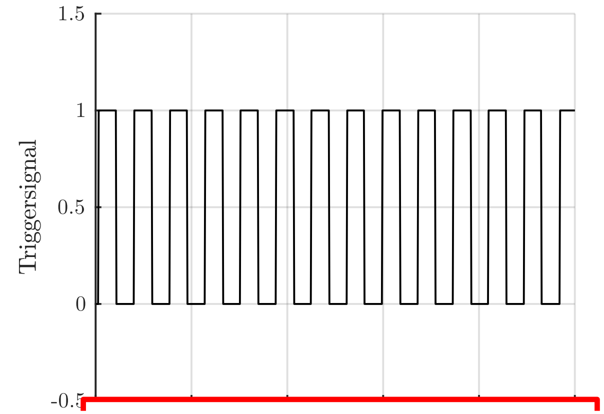
Umrechnen in Zeitachse und Messfrequenz

Beschleunigung 1

Beschleunigung 2

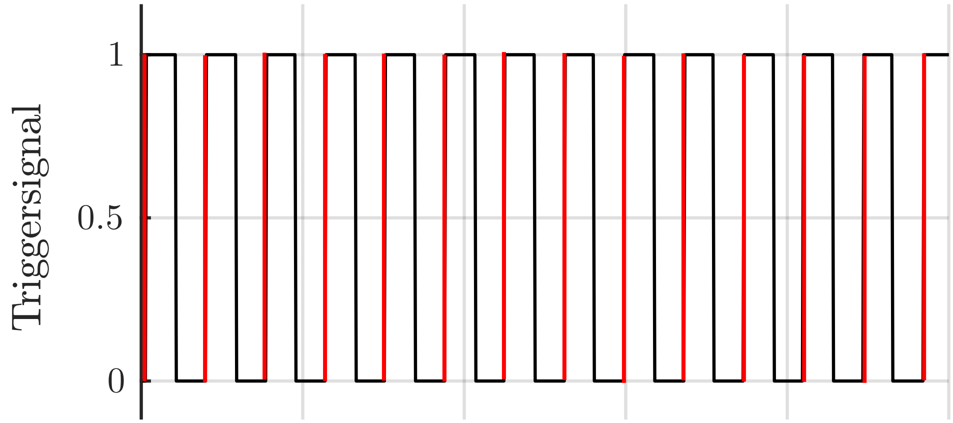


Triggersignal

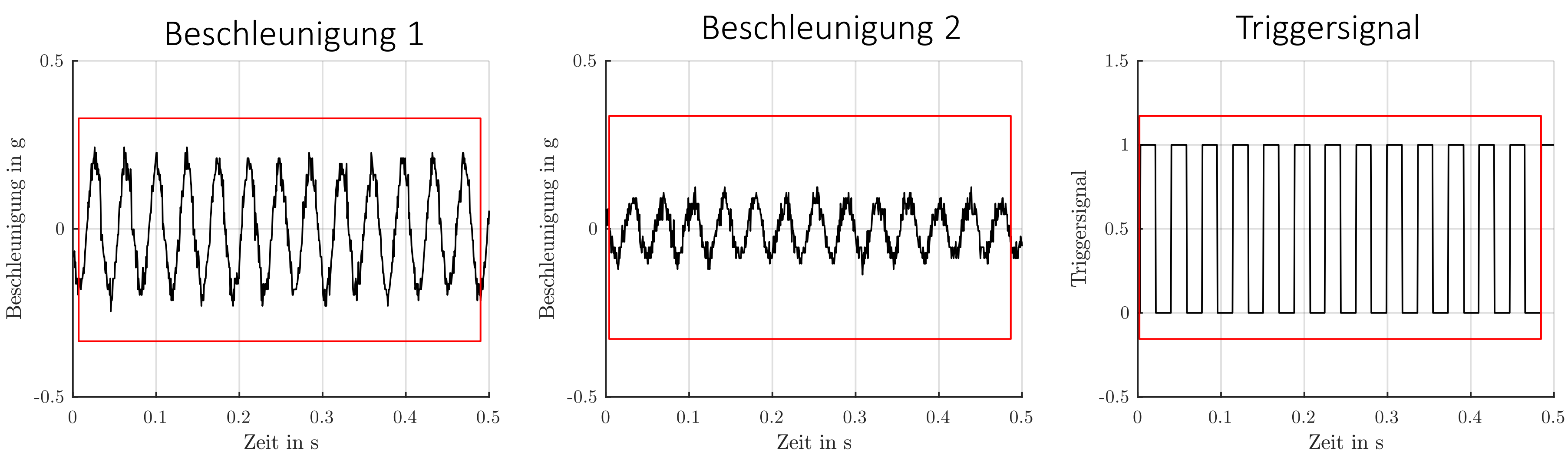


Vorgehen: Signal zuschneiden

- Steigende Flanken des Triggersignals identifizieren.



- Alle 3 Signale an der ersten und letzten steigenden Flanke abschneiden



Vorgehen: Fourier-Transormation

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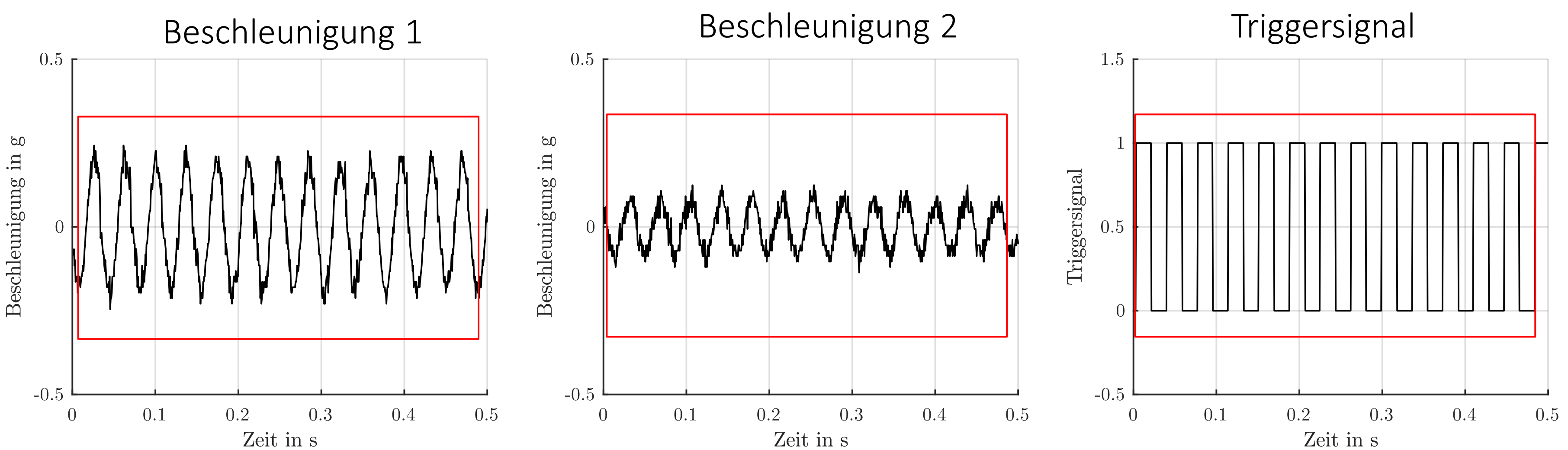
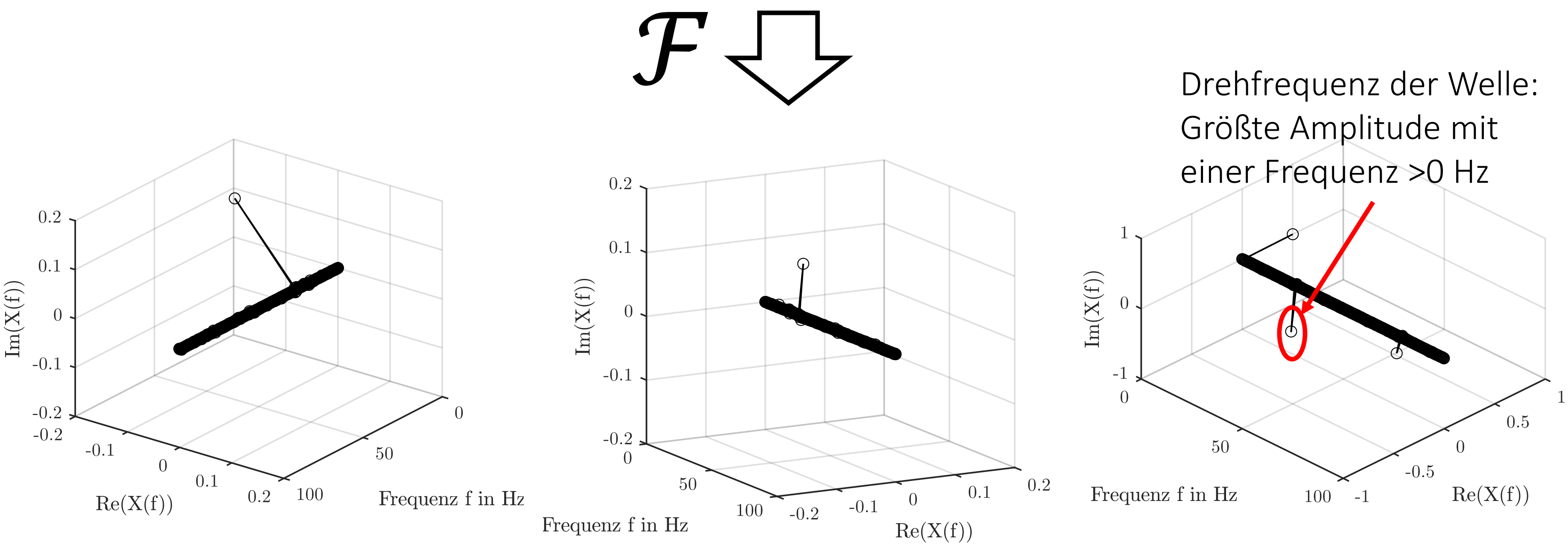
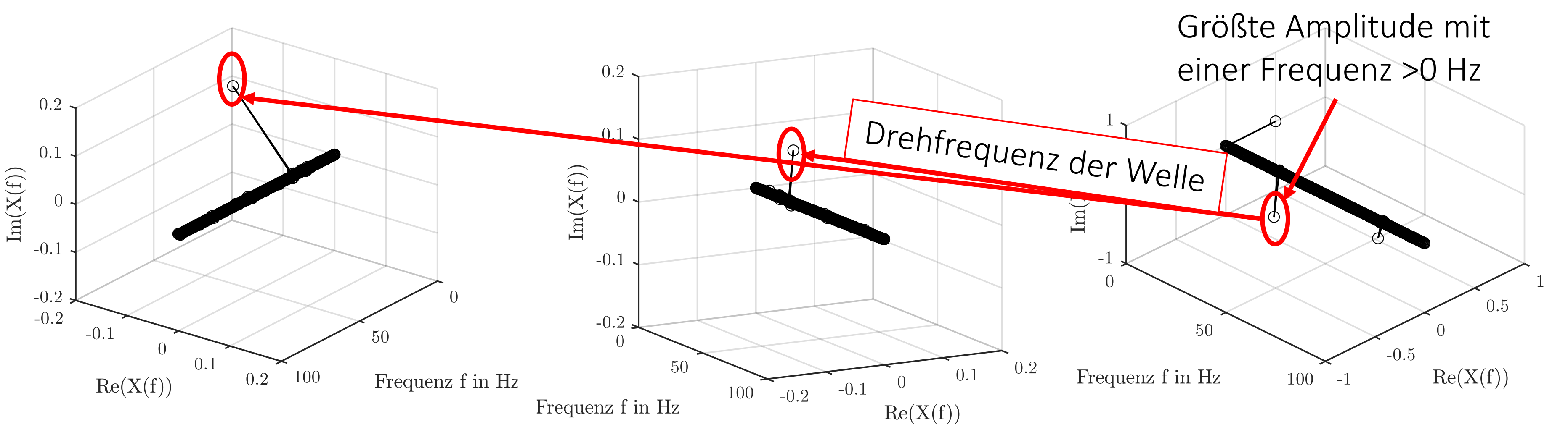
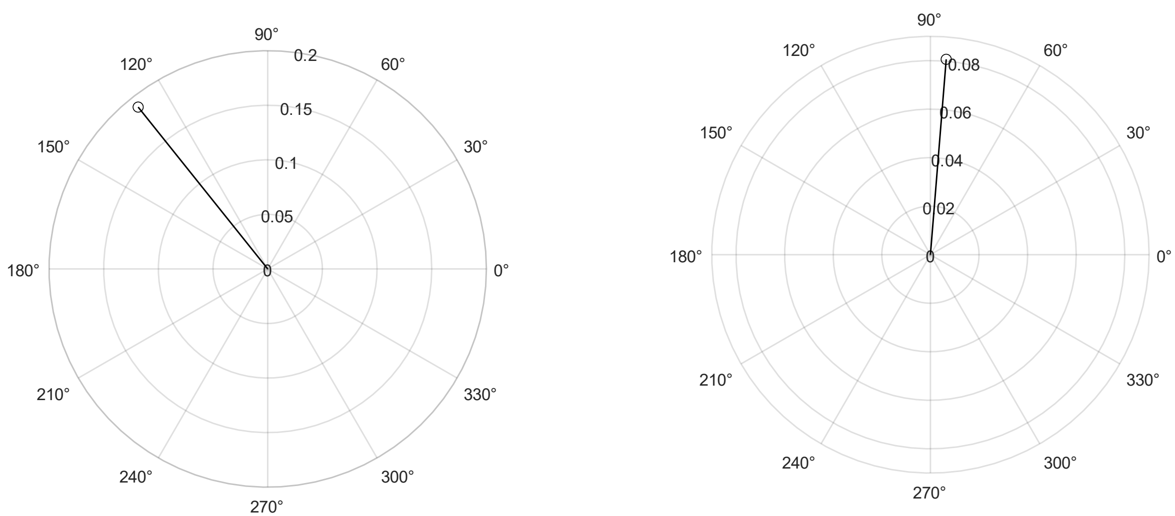




Drehfrequenz der Welle: Größte Amplitude mit einer Frequenz >0 Hz

Isolierung der drehfrequenten Schwingung





Ergebnis:

Eine komplexe Zahl pro Beschleunigungssignal zur Beschreibung der drehzahlfrequenten Schwingung