FM - Bessel

Joshua Bär

OST Ostschweizer Fachhochschule

16.5.2022

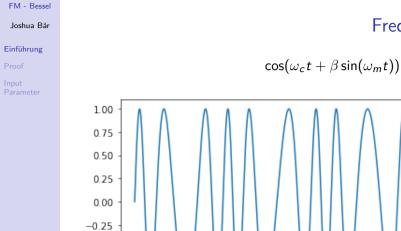
FM - Bessel

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Einführung

Frequenzmodulation

$$\cos(\omega_c t + \beta \sin(\omega_m t)) \tag{1}$$



0.02

0.04

0.06

-0.50 -0.75 -1.00

0.00

Frequenz modulation







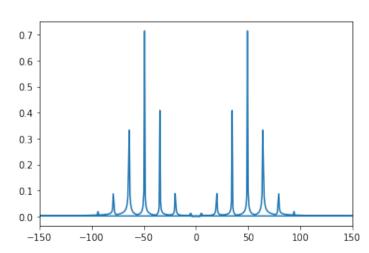
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Einführung

Frequenzmodulation

(1)

$$\cos(\omega_c t + \beta \sin(\omega_m t))$$





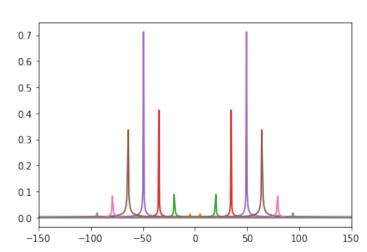
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Einführung

Frequenzmodulation

(1)

$$\cos(\omega_c t + \beta \sin(\omega_m t))$$



Einführun; Proof

$$\cos(\beta \sin \varphi) = J_0(\beta) + 2 \sum_{m=1}^{\infty} J_{2m}(\beta) \cos(2m\varphi)$$
 (2)

$$\sin(\beta \sin \varphi) = J_0(\beta) + 2 \sum_{m=1}^{\infty} J_{2m}(\beta) \cos(2m\varphi)$$
 (3)

$$J_{-n}(\beta) = (-1)^n J_n(\beta) \tag{4}$$

Bessel

Einführun

Input

$$\cos(\beta \sin \varphi) = J_0(\beta) + 2 \sum_{m=1}^{\infty} J_{2m}(\beta) \cos(2m\varphi)$$
 (2)

$$\sin(\beta \sin \varphi) = J_0(\beta) + 2\sum_{m=1}^{\infty} J_{2m}(\beta) \cos(2m\varphi)$$
 (3)

$$J_{-n}(\beta) = (-1)^n J_n(\beta) \tag{4}$$

$$\cos(A+B) = \cos(A)\cos(B) - \sin(A)\sin(B) \tag{5}$$

$$2\cos(A)\cos(B) = \cos(A-B) + \cos(A+B) \tag{6}$$

$$2\sin(A)\sin(B) = \cos(A-B) - \cos(A+B) \tag{7}$$

Einführung

Proof

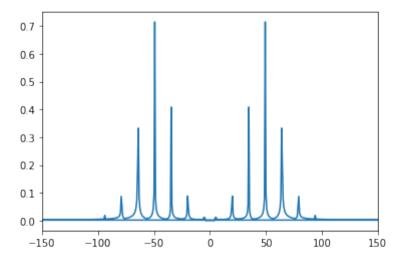
$$\cos(\omega_c t + \beta \sin(\omega_m t)) = \sum_{k=-\infty}^{\infty} J_k(\beta) \cos((\omega_c + k\omega_m)t)$$
 (8)

FM - Bessel

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Einführung

Proof

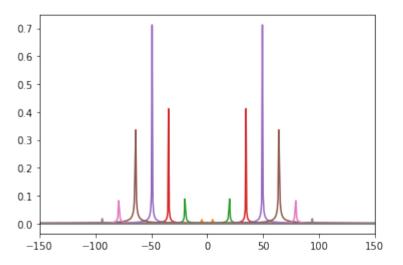


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Einführung

Proof

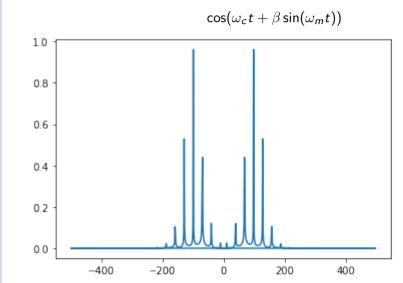


Träger-Frequenz Parameter

(9)

Einführung

Limamani



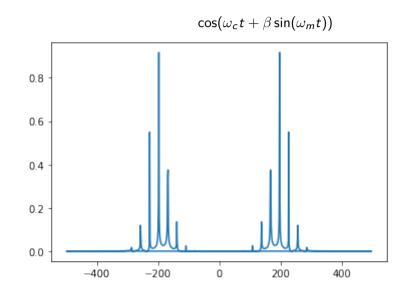


Träger-Frequenz Parameter

(9)

Einführung

Proof



Träger-Frequenz Parameter

(9)

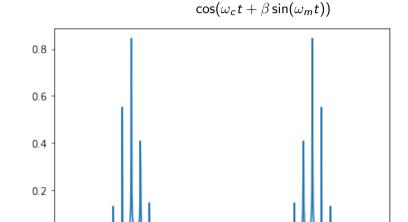
Einführung

Input Parameter

0.0

-400

-200



200

400



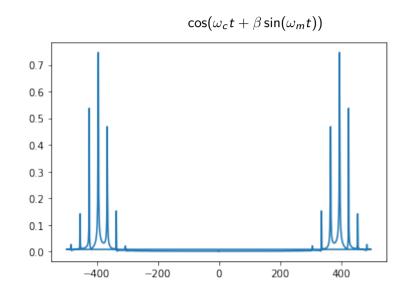
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Träger-Frequenz Parameter

(9)

Einführung

Proof

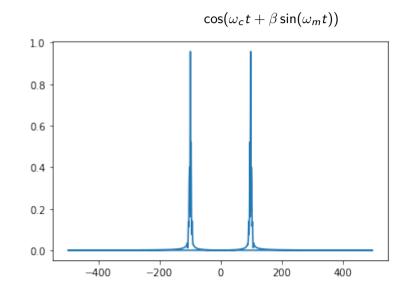




(10)

Einführung

Proof

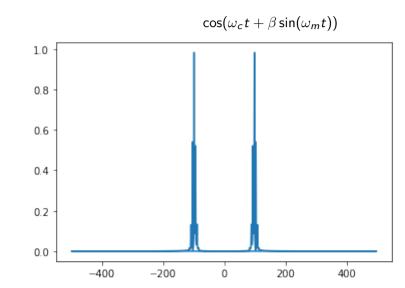




(10)

Einführung

Proof

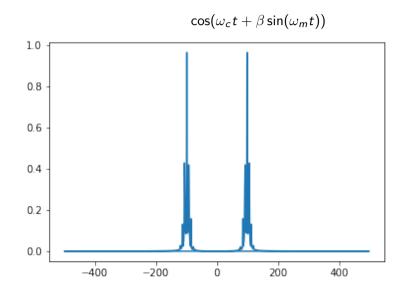




(10)

Einführung

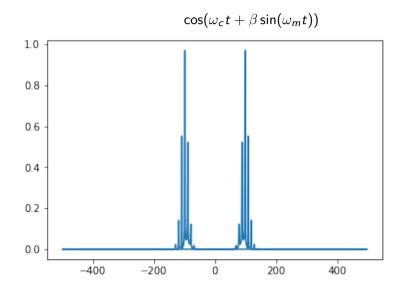
Proof



(10)

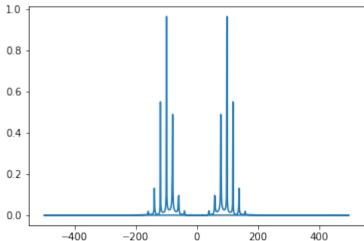
Einführung

Proof



Einführung

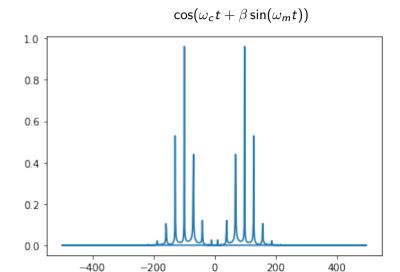




(10)

Einführung

Einrunrung

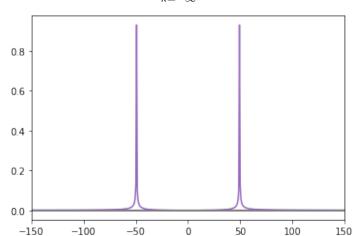


Beta Parameter

Einführung

Input Parameter $\sum_{k=-\infty}^{\infty} J_k(\beta) \cos((\omega_c + k\omega_m)t)$

(11)



Beta Parameter

(11)

Einführung

Proof

Input Parameter

0.8

0.6

0.4

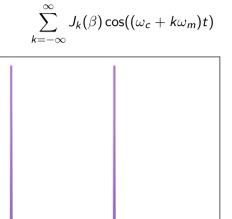
0.2

0.0

-150

-100

-50



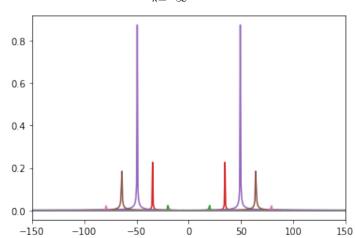
50

100

150

Einführung

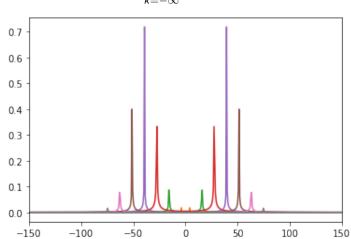
Input Parameter $\sum_{k=-\infty}^{\infty} J_k(\beta) \cos((\omega_c + k\omega_m)t)$ (11)



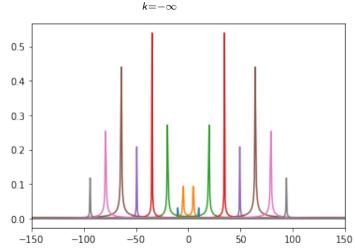
Beta Parameter

Einführung

$$\sum_{k=-\infty}^{\infty} J_k(\beta) \cos((\omega_c + k\omega_m)t)$$
 (11)

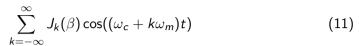


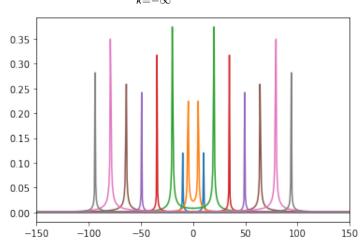
$$\sum_{k=1}^{\infty} J_k(\beta) \cos((\omega_c + k\omega_m)t)$$
 (11)



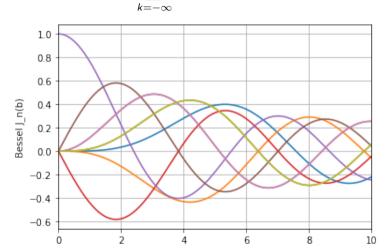
Etu. Chianna

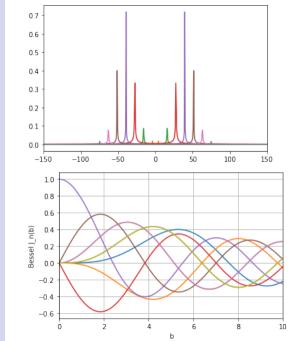
Einführung





$$\sum_{k=0}^{\infty} J_k(\beta) \cos((\omega_c + k\omega_m)t)$$
 (11)





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Einführung