

E2 2018

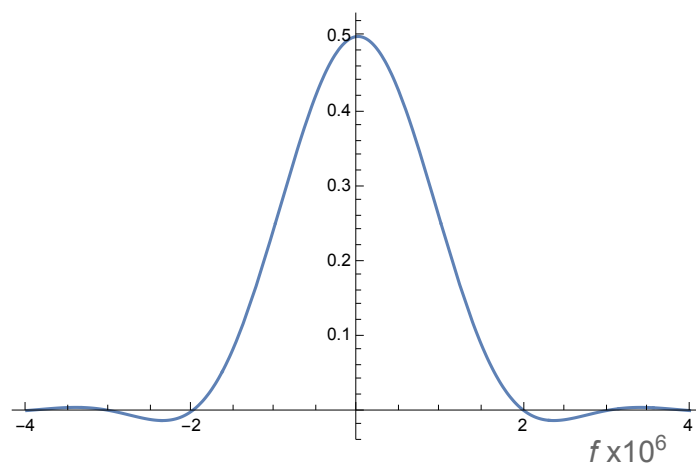
1. a) ver Introdução, slide 26; see Introduction, slide 26

b)

i) Utiliza-se um filtro com resposta impulsiva que replica o impulso em cosseno² com um atraso que o torne possível. Assumindo por simplicidade de cálculo um atraso nulo (embora, não físico), obtém-se a transformada de Fourier

Use of a matched filter corresponding to an impulse response that replicates the cosine² pulse with a physical delay. Assuming a zero delay (although non-physical) for the sake of simplicity of calculus, that the transfer function is obtained by

$$\int_{-T/4}^{T/4} \text{Cos} \left[\frac{2\pi t}{T} \right]^2 e^{-j 2\pi f t} dt, \text{ that is, } \frac{2 \sin \left[\frac{\pi f T}{2} \right]}{4 \pi f - \pi f^3 T^2}$$



Nota: a fase é proporcional ao produto da frequência pelo tempo de atraso

Note: the phase is proportional to the frequency times the time delay

ii)

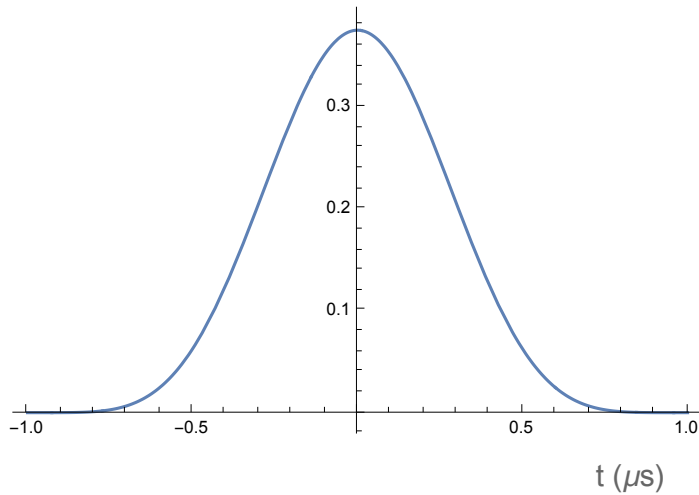
A envolvente do sinal de saída é representado pela função de autocorrelação do impulso em "cosseno²" de duração 1 μs; a duração total da resposta é 2 μs.

The output signal envelop is represented by the auto-correlation function of the cosine² pulse, of duration 1 μs. The total time duration is 2 μs.

$$\text{Clear [T]; } \int_{-T/4}^{T/4-t} \text{Cos} \left[\frac{2\pi}{T} (t + \tau) \right]^2 \text{Cos} \left[\frac{2\pi}{T} \tau \right]^2 d\tau \text{ (* } 0 < t < T/2 \text{ *)};$$

T = 2;

$$\text{Plot} \left[\frac{-2\pi (2 \text{Abs}[t] - T) (2 + \text{Cos} \left[\frac{4\pi t}{T} \right]) + 3 T \text{Sin} \left[\frac{4\pi \text{Abs}[t]}{T} \right]}{32 \pi}, \{t, -T/2, T/2\} \right]$$



;

2. a)

$$\int_0^{2\pi} \left(\int_0^\pi G(\theta, \varphi) \sin(\theta) d\theta \right) d\varphi = 4\pi, \quad G(\theta, \varphi) = G_0 f(\theta)$$

$$G_0 = \frac{2}{\int_0^\pi e^{-2.78 (\theta/\theta_B)^2} \sin(\theta) d\theta} \rightarrow 2 / 0.000342$$

Usando os valores dados no enunciado

Using the known values $G_0 = 5848 \rightarrow 37.7$ dBi

b)

Clear[θ]

Solve[$e^{-2.78 (\theta/1.5)^2} == 10^{-0.15}$ && $\theta > 0$, θ]

{{θ → 0.5287}}

Valor do squint, $\theta=0.53^\circ$ (squint angle value)

c)

PT = 75 000; GT = $10^{3.77}$; GR = $10^{2.0}$; Pmin = 10^{-10} ;

(* $\frac{Pt \lambda^2 GT GR RCS}{(4 \pi)^3 R1^2 R2^2} \geq Pmin$ *)

R1 = 15 000; R2 = 5000;

$$RCS = \frac{Pmin (4 \pi)^3 R1^2 R2^2}{PT \lambda^2 GT GR}$$

55.04

d)

Va = 270 / 3.6 (* m/s *)

75.

Velocidades cegas

Blind speeds

$$f = 6 \times 10^9; c = 3 \times 10^8; \lambda = c / f; \text{prf} = 1000;$$

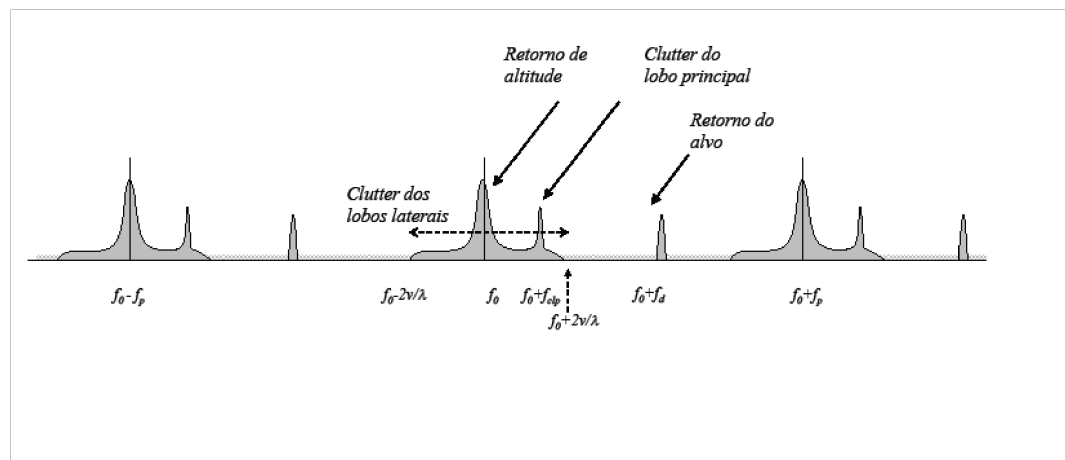
$$V_{b1} = \frac{\lambda \text{prf}}{2}$$

25

Logo, $V_a = 3 V_{b1}$, isto é, trata-se da 3ª velocidade cega. Para resolver o problema deveria utilizar-se por exemplo prf múltiplos.

Thus, $V_a = 3 V_{b1}$, that is, the 3rd blind speed. To solve the problem multiple prfs can be used, for example.

3b)



$$v_r = 600 / 3.6 (* \text{ m/s} *)$$

166.7

$$2 v_r / \lambda$$

6667.

$$v_a = 400 / 3.6 (* \text{ m/s} *)$$

111.1

$$f_p = 0000;$$

$$f_d = 2 (v_r + v_a) / \lambda$$

1.111×10^4

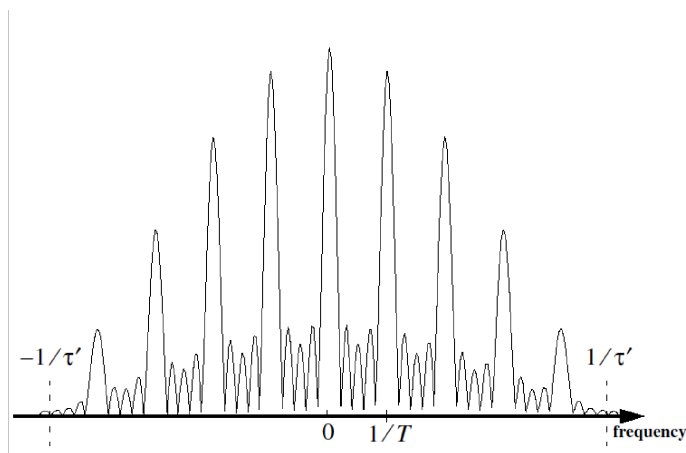
Notar que $f_d > 2v_r/\lambda$, e $f_d < f_p - 2v_r/\lambda$, permitindo distinguir o retorno do alvo em movimento, do espectro do clutter. Se f_d fosse da ordem ou inferior a ~ 11000 o retorno do alvo estaria em sobreposição com o espectro do clutter.

Note that $f_d > 2v_r/\lambda$, and $f_d < f_p - 2v_r/\lambda$, allowing to distinguish the returns from the moving target from the clutter spectrum. If f_d were of the order or less than ~ 11000 the returns from the target would be superimposed with the clutter spectrum.

4a) Sequência de 5 impulsos retangulares separados de t_2 e de duração $t_1/2$

Sequence of 5 rectangular pulses

4b)



onde T = tempo de repetição dos impulsos (t_2), e portanto $1/T=10$ kHz
 where T = pulse repetition time, thus $1/T=10$ kHz

nota/ note : $\tau' = t_1$