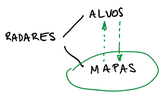
IE311-2020 1. Aula

segunda-feira, 21 de setembro de 2020 22:56

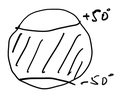
1. introdução
2. espaço-tempo
3. espaço-fase
4. geometria de iluminação
5. slant e ground range
6. antenas e rede de antenas
7. resolução em alcance
8. banda de passagem
9. teorema da amostragem
10. geometria de iluminação do OrbiSAR

1. INTRODUÇÃO



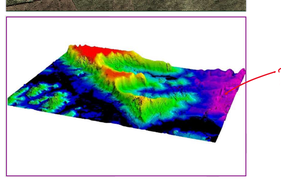
RADAR: RADIO DETECTION AND RANGING

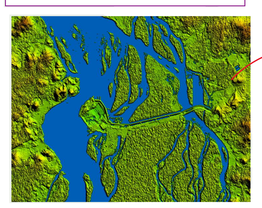
- FINAL 2ª GUERRA: DETECÇÃO DE ALVOS
  WATSON-WATT
  "CASTLES IN THE SKY" BBC
- CARL WILEY: 1951 — IMAGEM COM A TECNOLOGIA DE RADAR DE ABERTURA SINTÉTICA, SAR
- SEASAT 1970: PRIMEIRO SATÉLITE NA RANDAL SAR, NASA
- ESA EUROPEAN SPACE AGENCY: 1992: ERS-1, ERS-2, ASAR, SENTINELA
- NASA/JPL SPACE SHUTTLE SRTM: 1990-2000: TOPOGRAFIA DA TERRA EM 11 DIAS DE MISSÃO

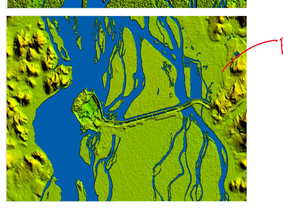


PRECISÃO ALTURA: 5-10 m
RESOLUÇÃO: 30 m

- TANDEM-X: 2005 – 2018
  PRECISÃO ALTURA: 2 m
  RESOLUÇÃO: 90 m (15 m)
- ORBISAR – EMBRAER
  2002 – HOJE
  AMAZÔNIA LEGAL: 4,5 milhões km²
  ATÉ HOJE: 1,5 milhão km²
  FALTAM: 3,0 milhões km²







1.1 BANDAS

$f \longleftrightarrow \lambda$

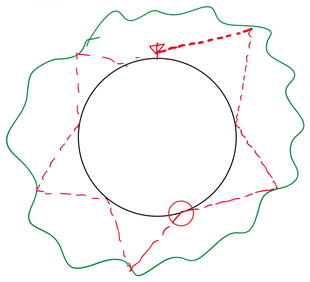
$$\boxed{\lambda = \frac{c}{f} \qquad f = \frac{c}{\lambda}} \qquad c = 300 \cdot 10^6 \ m/s$$

$f = 100\ MHz = 100 \cdot 10^6\ Hz$

$$\lambda = \frac{300 \cdot 10^6\ m/s}{100 \cdot 10^6\ Hz} = 3\ m \longleftrightarrow 100\ MHz$$

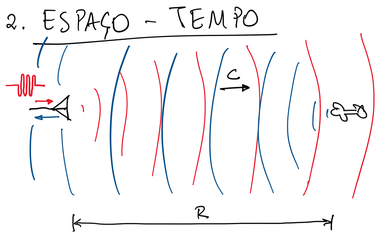
$0{,}75\ m \longleftrightarrow 400\ MHz$

6 — 20 MHz



TV SKY: 15 GHz → 2 cm

2. ESPAÇO – TEMPO



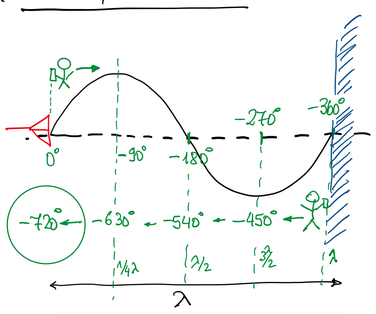
$e = v \cdot t$

$2R = c \cdot t$

$$\boxed{R = \frac{ct}{2}} \qquad \boxed{t = \frac{2R}{c}}$$

$$\boxed{1\mu s \equiv 150\ m}$$

3. ESPAÇO – FASE



$$\boxed{1\lambda \equiv -720^\circ}$$ two-way RADAR

$$\boxed{1\lambda \equiv -360^\circ}$$ one-way GNSS RADAR-BI-ESTÁTICO

RADAR MEDE A FASE COM PRECISÃO ATÉ MELHOR QUE 1°

$f = 1\ GHz \qquad \lambda = 0{,}3\ m$

$0{,}3\ m \longleftrightarrow -720^\circ$

$\frac{0{,}3}{720}\ m \longleftarrow 1^\circ$ PRECISÃO

$0{,}0005\ m \rightarrow 0{,}5\ mm$

FAIXA DE FREQUÊNCIA		IEEE BANDA	
100 kHz — 30 MHz		HF	High Frequency
30 MHz — 300 MHz		VHF	Very HF
300 – 500 MHz		P	
300 MHz — 3 GHz		UHF	Ultra HF
1 – 2 GHz	1,2 – 1,4	L	Long
2 – 4 GHz	2,7 – 3,3	S	Short
4 – 8 GHz	5,2 – 5,8	C	Compromise
8 – 12 GHz	8 – 10	X	Mix
12 – 18 GHz		Ku	Kurz under
18 – 27 GHz		K	Kurz
27 – 40 GHz		Ka	Kurz above

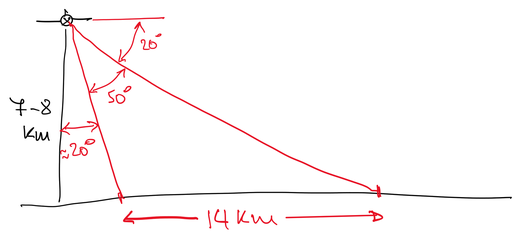
9. TEOREMA DA AMOSTRAGEM

BANDA B

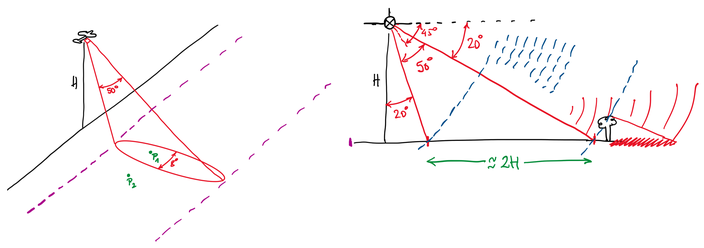
REPRESENTAÇÃO REAL: AMOSTRAGEM > 2.B

REPRESENTAÇÃO COMPLEXA: AMOSTRAGEM > B

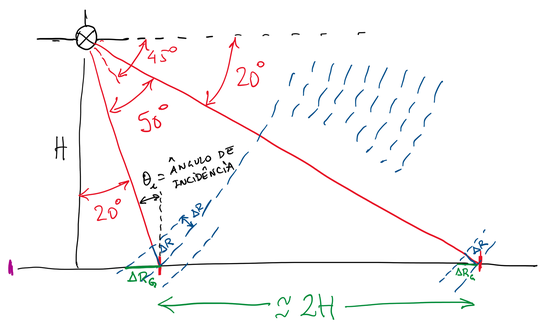
10. GEOMETRIA DE ILUMINAÇÃO DO ORBISAR



4. GEOMETRIA DE ILUMINAÇÃO



5. SLANT E GROUND RANGE



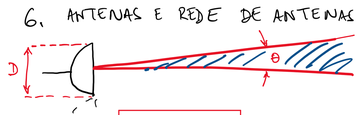
ΔR: SLANT RANGE

ΔR_G: GROUND RANGE

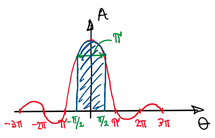
$$\Delta R_G = \frac{\Delta R}{\operatorname{sen} \theta_i}$$

$\theta_i = 20^\circ \approx \frac{1}{3}\ rad \rightarrow \Delta R_G \approx 3 \cdot \Delta R$

6. ANTENAS E REDE DE ANTENAS



$$\boxed{\theta \cong \frac{\lambda}{D}}$$



$\frac{\operatorname{sen}\theta}{\theta}$

ORBISAR: $\lambda = 0{,}03\ m$

$D_{ARMADO} = 0{,}2\ m$

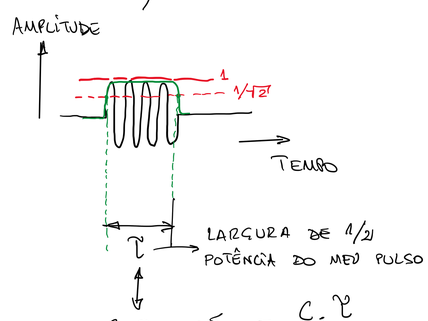
$\theta = \frac{0{,}03\ m}{0{,}2\ m} = 0{,}15\ rad \equiv \approx 8^\circ$

$180^\circ \equiv 3{,}14$

$$\boxed{57^\circ \approx 1\ rad}$$

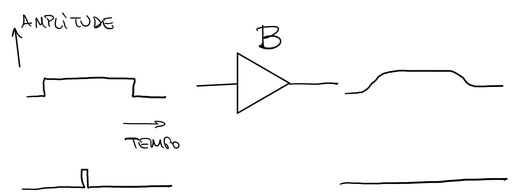
7. RESOLUÇÃO EM ALCANCE

$1\mu s \equiv 150\ m$



$$\text{RESOLUÇÃO} = \frac{c \cdot \tau}{2}$$

8. BANDA DE PASSAGEM



$$\boxed{B = \frac{1}{\tau}}$$

$$\boxed{\delta_R = 1{,}5\ m \equiv \tau = 0{,}01\mu s \equiv 100\ MHz}$$

$$\boxed{\delta_R = 150\ m \equiv \tau = 1\mu s \equiv 1\ MHz}$$