

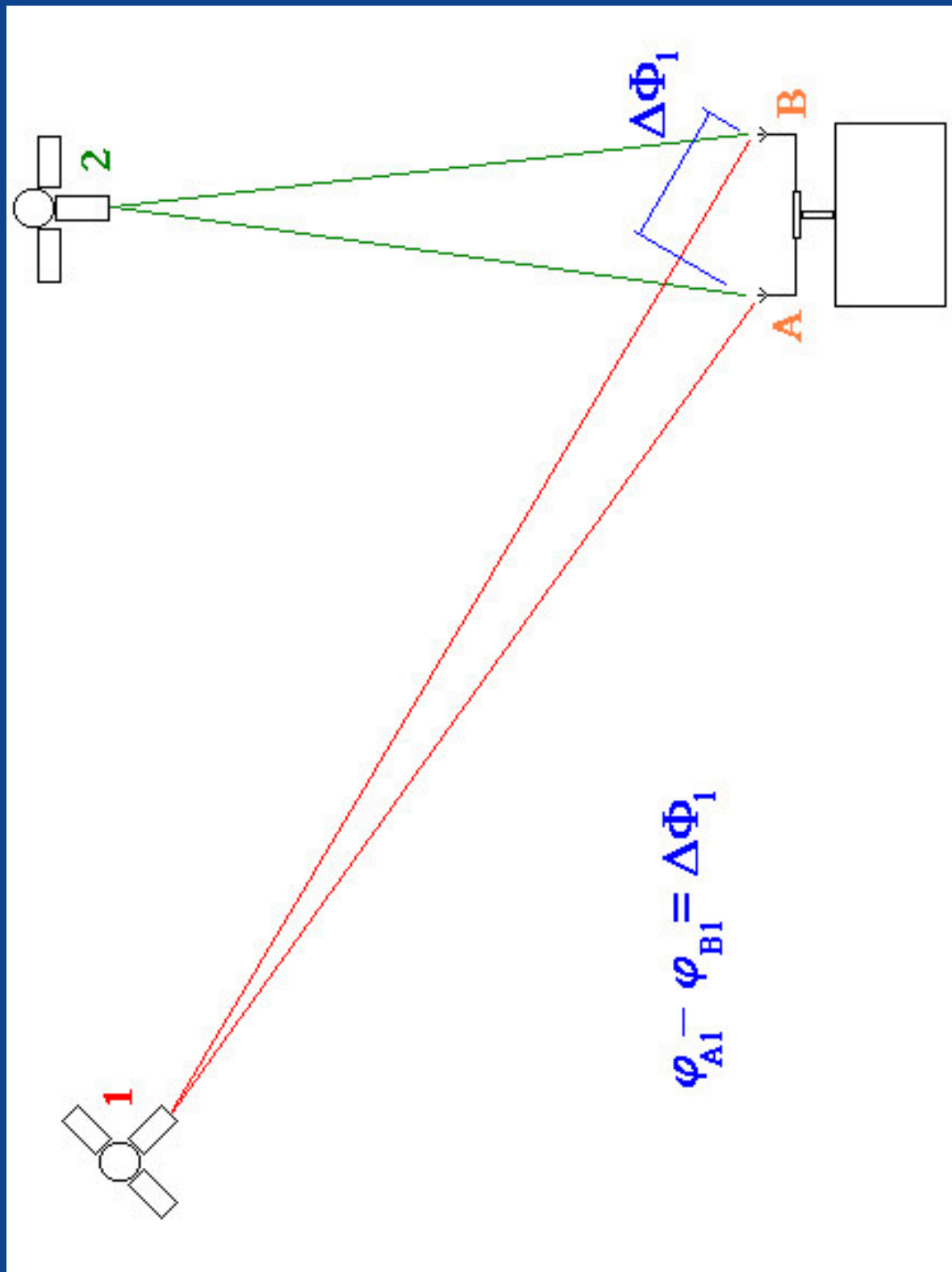
An investigation about the usage of more than one GPS antenna connected to receivers with one RF input

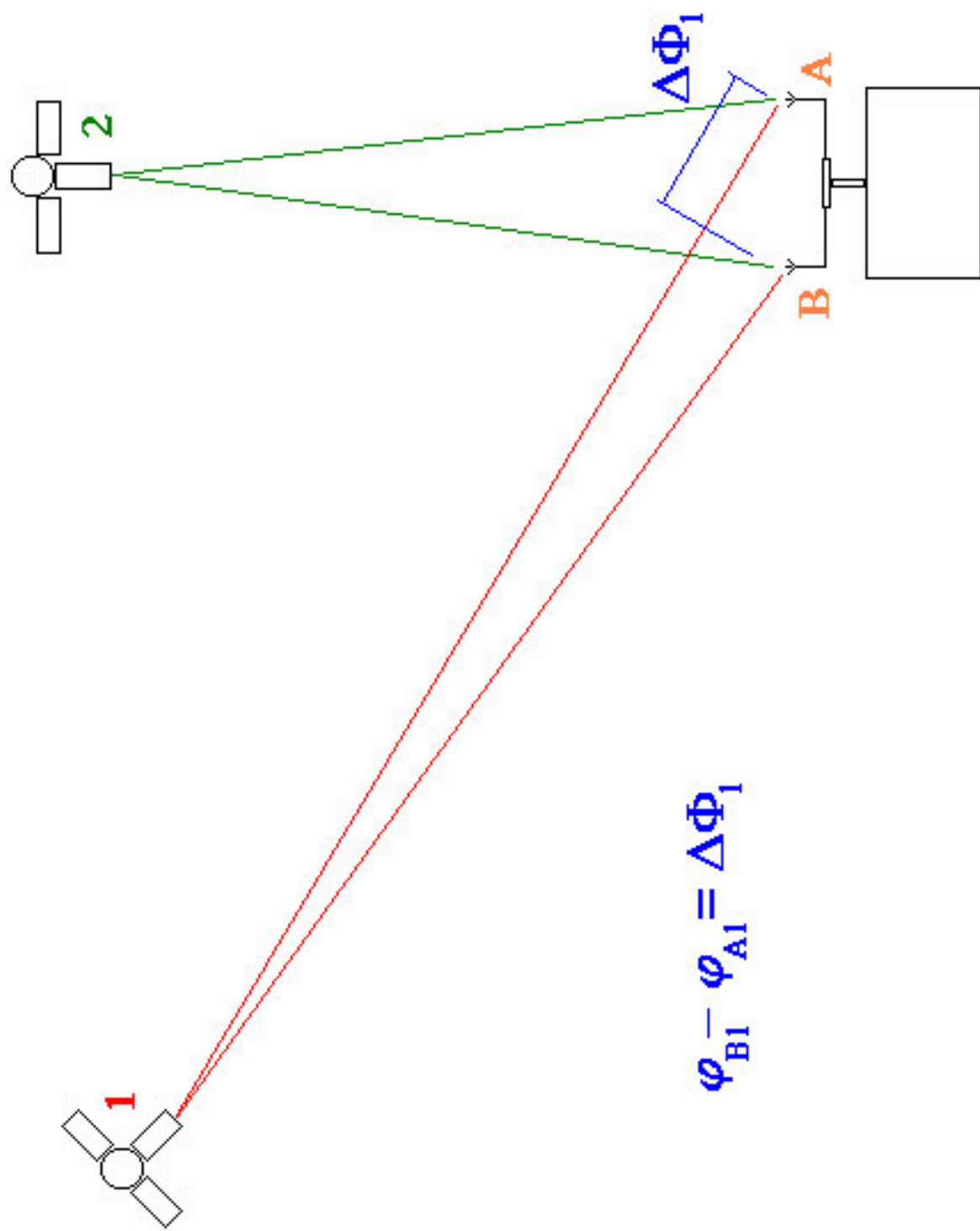
Autors:

Eduardo Bertoldi (ITA)

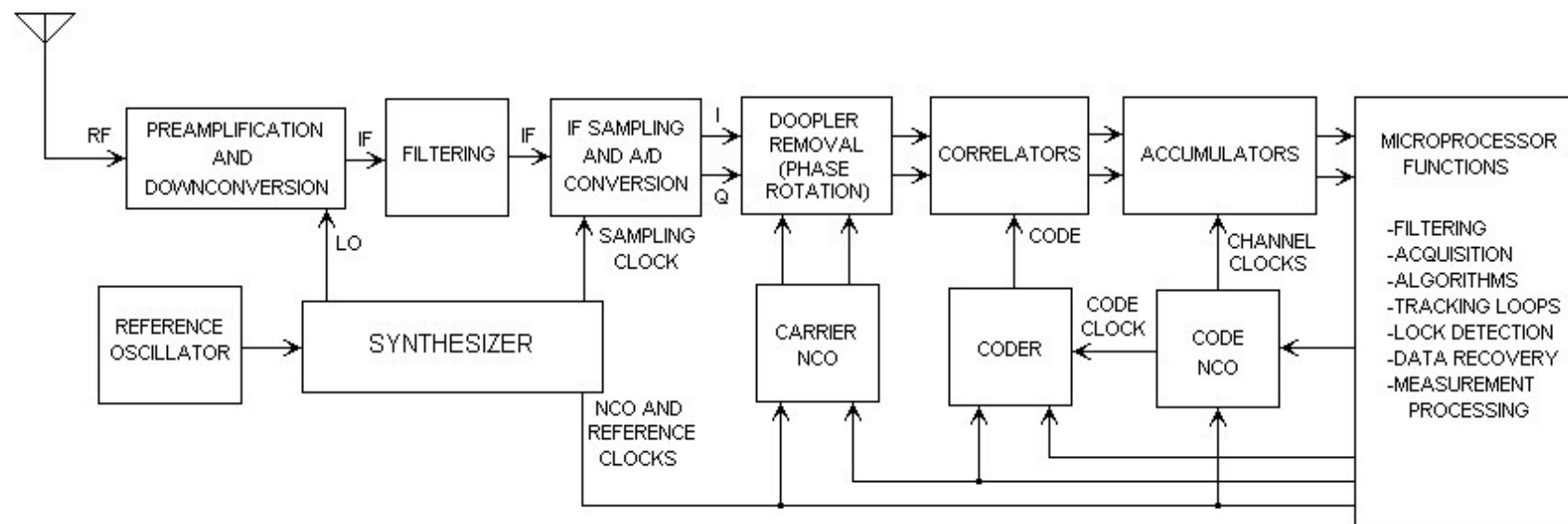
Paulo Giacomio Milani (INPE)







GPS RECEIVER



DLL – CODE DISCRIMINATOR

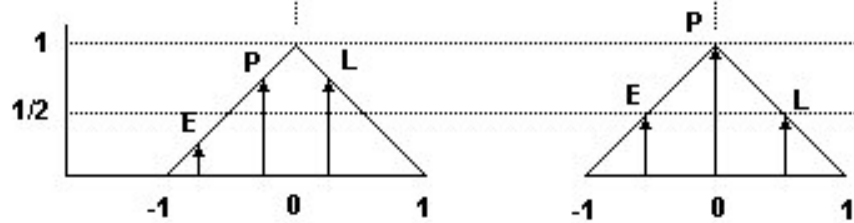
Incoming signal

Replica signals

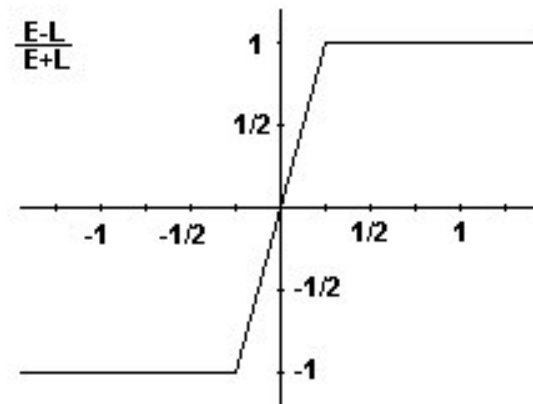
Early

Prompt

Late



Normalized correlator output



Normalized correlator output error



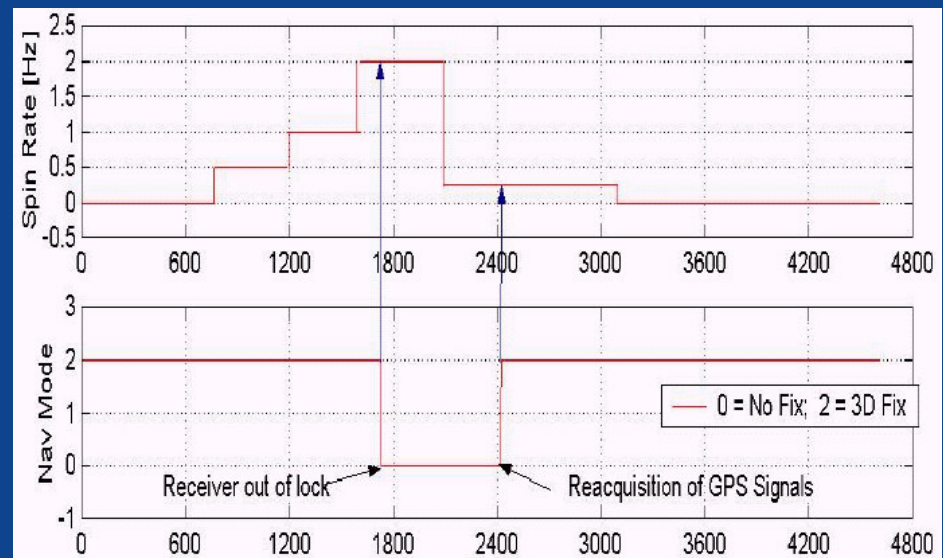
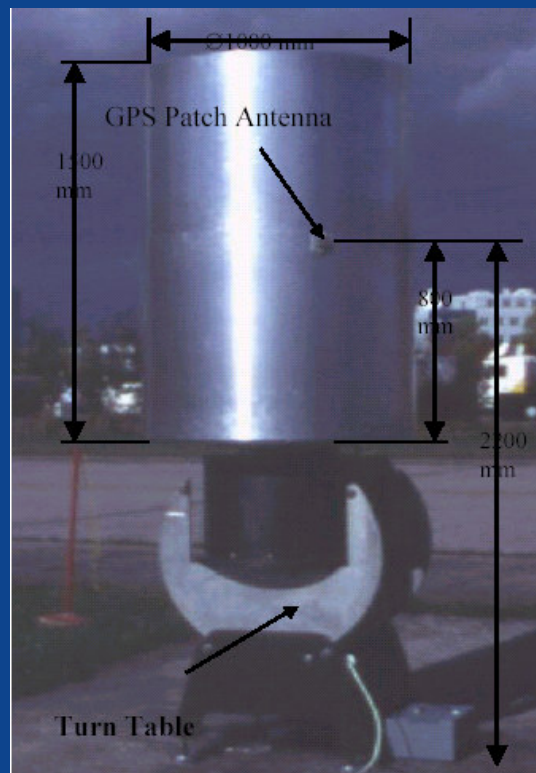
LOOP FILTERS

Loop Order	Noise Bandwidth B_n (Hz)	Typical Filter Values	Steady-State Error
First	$\frac{\omega_0}{4}$	ω_0 $B_n = 0.25\omega_0$	$\frac{(dR/dt)}{\omega_0}$
Second	$\frac{\omega_0(1+a_2^2)}{4a_2}$	ω_0^2 $a_2\omega_0 = 1.414\omega_0$ $B_n = 0.53\omega_0$	$\frac{(d^2R/dt^2)}{\omega_0^2}$
Third	$\frac{\omega_0(a_3b_3^2 + a_3^2 - b_3)}{4(a_3b_3 - 1)}$	ω_0^3 $a_3\omega_0^2 = 1.1\omega_0^2$ $b_3\omega_0 = 2.4\omega_0$ $B_n = 0.7845\omega_0$	$\frac{(d^3R/dt^3)}{\omega_0^3}$



SAMPLES

DLR - EXPERIMENT

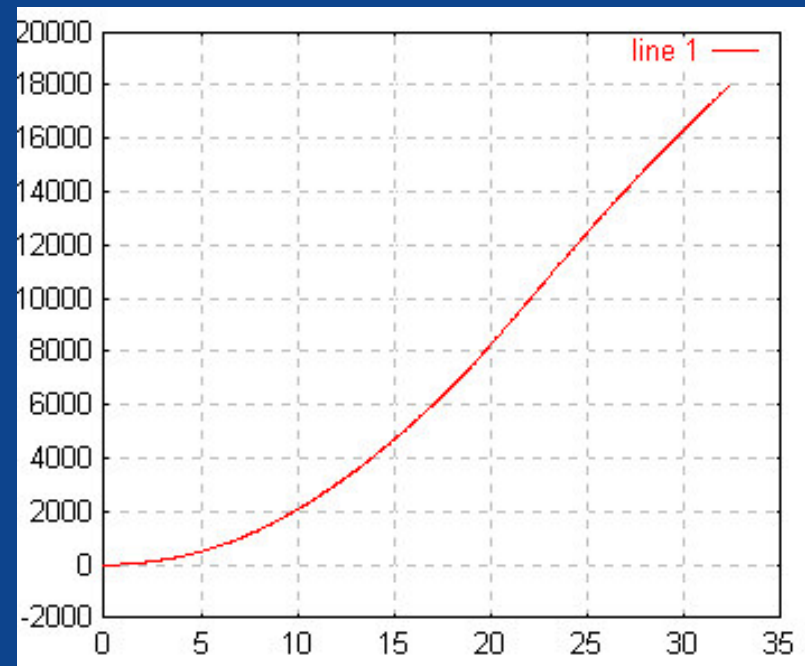


SAMPLES

PSO - EXPERIMENT



HEIGHT [m]



TIME [s]



INPE - EXPERIMENT



RESULTS

Dados do experimento para $r=2m$ e $f=20rpm$



Total nb of SUs visible = 10

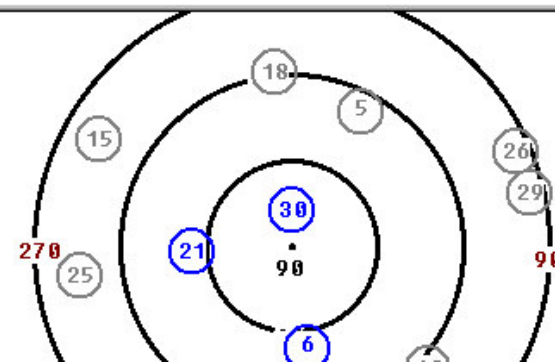
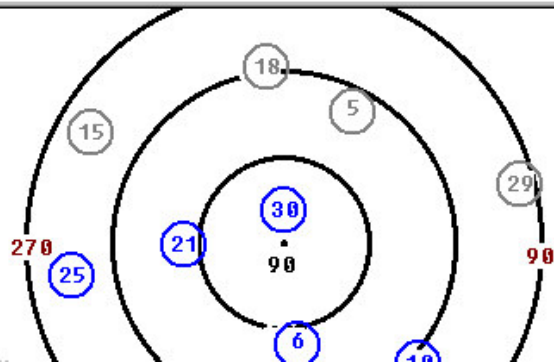
SU No	Status	Azimuth (deg.)	Elevation (Deg.)	SNR
30	Use by Nav	358	78	50
21	Use by Nav	269	55	50
6	Use by Nav	172	54	49
5	In View	28	38	0
18	In View	354	28	0
10	Use by Nav	132	27	38
17	In View	141	19	0
25	Use by Nav	261	15	39
15	In View	300	12	0
29	In View	76	5	0

Dados do experimento para $r=2m$ e $f=30rpm$



Total nb of SUs visible = 11

SU No	Status	Azimuth (deg.)	Elevation (Deg.)	SNR
30	Use by Nav	359	77	51
21	Use by Nav	267	55	49
6	Use by Nav	171	54	49
5	In View	27	37	0
18	In View	354	29	0
10	In View	132	26	0
17	In View	140	18	0
25	In View	262	15	0
15	In View	299	13	0
29	In View	77	5	0
26	In View	67	5	0



LOSE OF LOCK

ONE ANTENNA

#Satellite	r [cm]	w [rpm]	Elevation [degree]
15	80	50	47
21	80	50	37
16	80	50	35
18	80	60	50
16	120	40	33
21	120	45	35
15	120	50	48
18	120	50	45
21	160	30	33
16	160	30	30
15	160	40	49
18	160	40	41
22	160	50	69
3	200	30	46
18	200	30	36
21	200	30	31
15	200	40	50
22	200	50	64

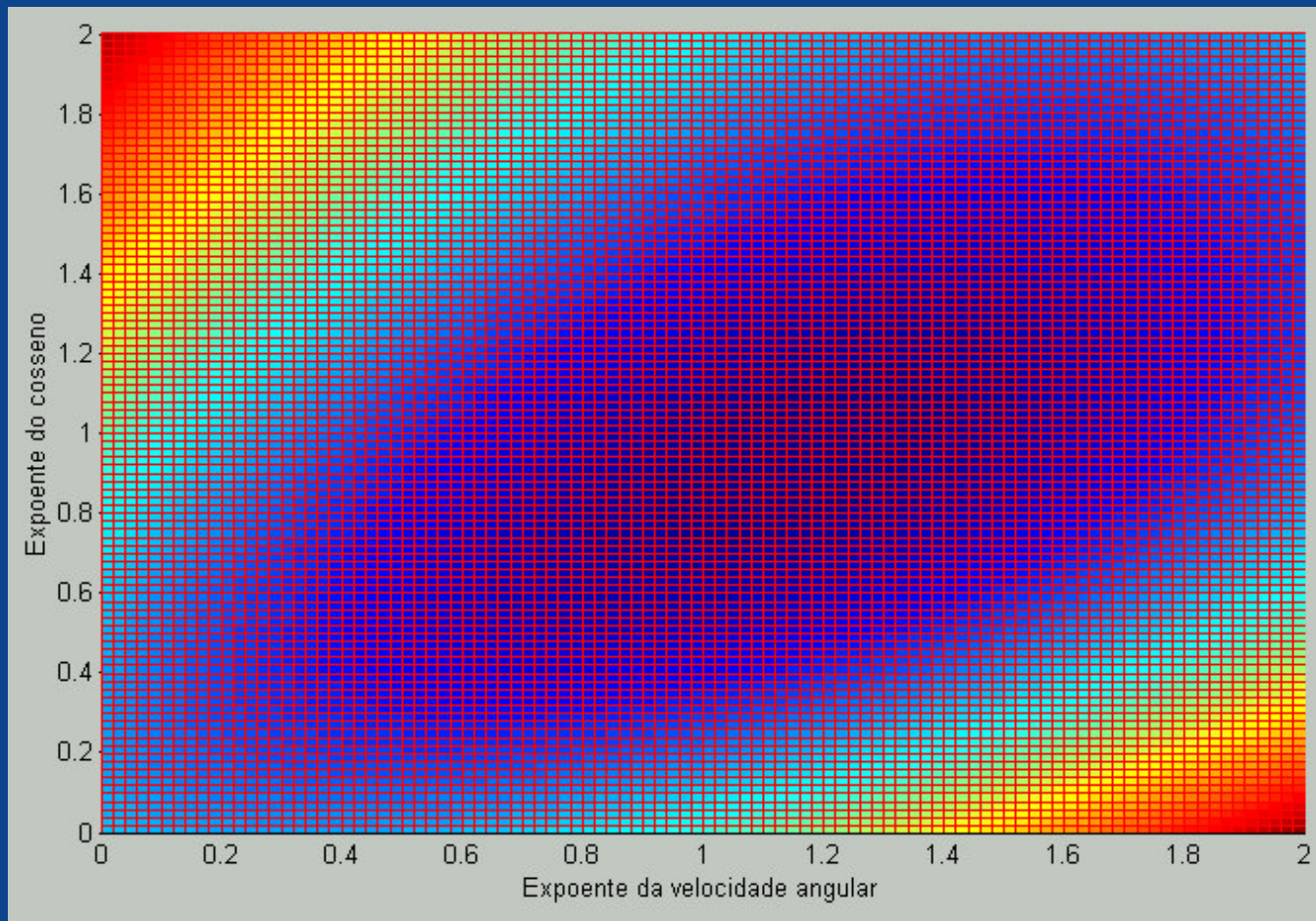
TWO ANTENNAS

#Satellite	r [cm]	w [rpm]	Elevation [degree]
21	40	50	23
16	40	50	15
21	80	20	21
21	120	10	19
22	120	20	42
3	120	50	62
15	120	50	53
21	160	10	16
15	160	20	52
22	160	20	39
3	160	30	61
14	160	50	75
19	200	15	45
22	200	15	35
21	200	15	14
15	200	20	51
22	200	25	35
14	200	40	72



HYPOTHESIS

$$F = r\omega^x \cos^y \theta$$



THRESHOLD

$$y = 1 \rightarrow \bar{x} \cong 1$$

Velocity Dynamic Stress

One antenna

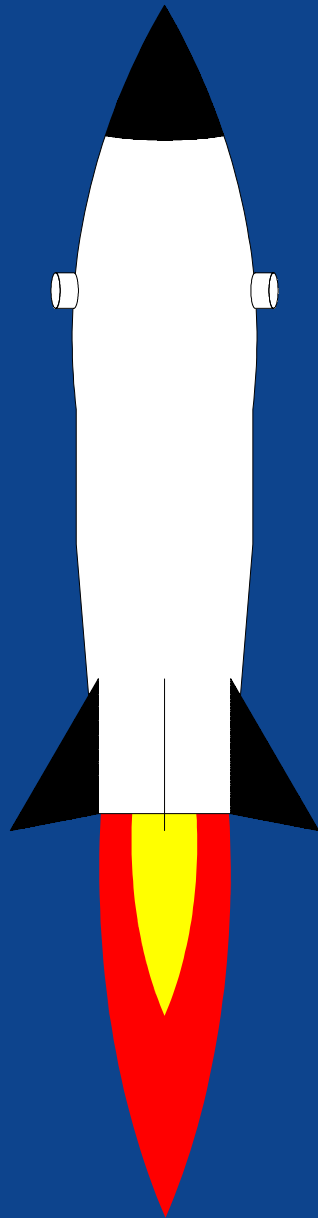
$$r\omega \cos \theta < 3.9[m/s]$$

Two antennas

$$r\omega \cos \theta < 2.2[m/s]$$



APPROACH

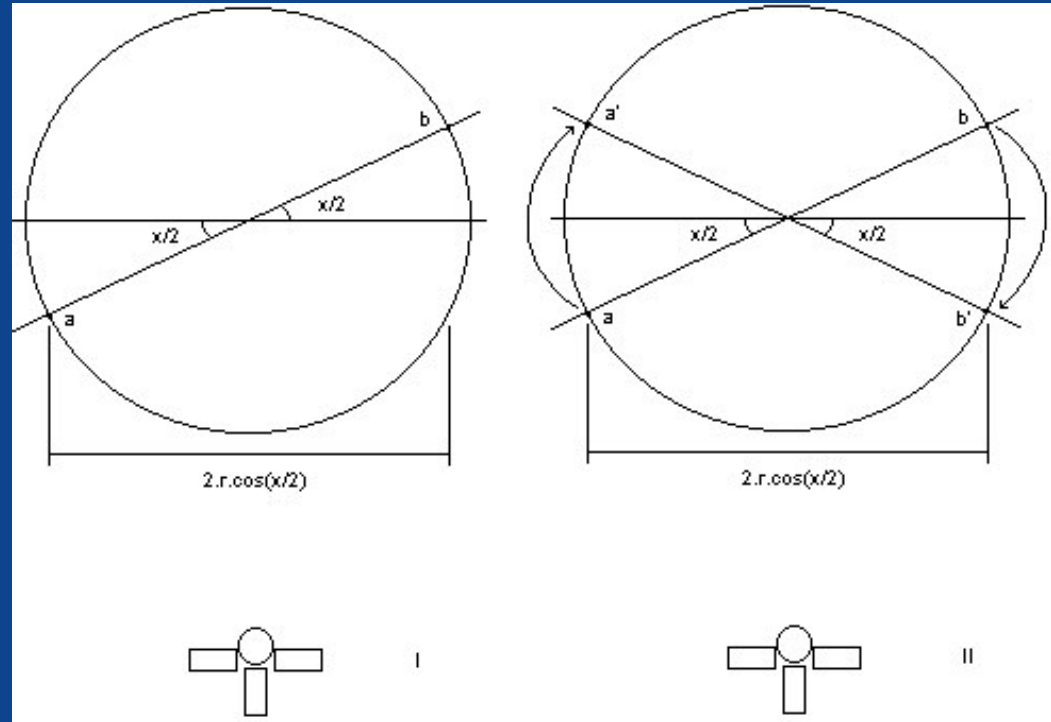
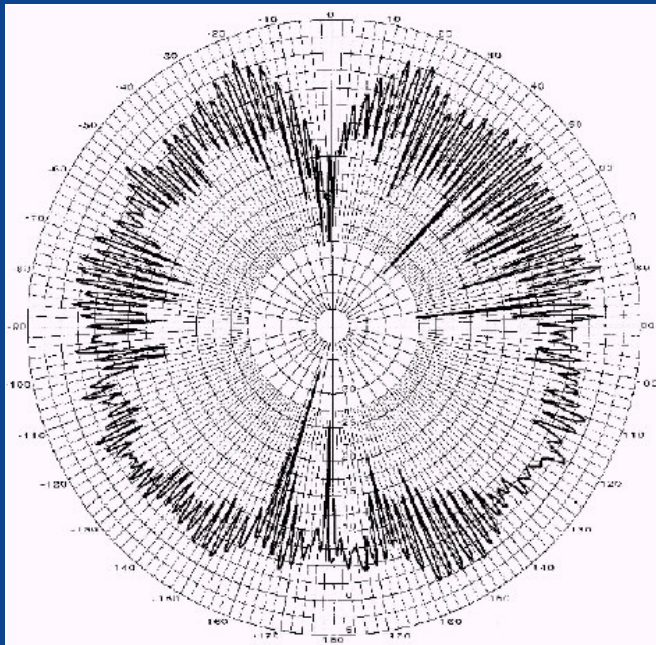


**THE TWO ANTENNAS DON'T
PERCEIVE THE SAME
SIGNAL AT THE SAME TIME**



APPROACH

Irradiation Diagram



Phase Center Moviment



PHASE CENTER MOVIMENT

$$v_y \cong 0,99r\varpi \cos \theta$$

$$a_y \cong -3,69r\varpi^2 \cos \theta$$

$$j_y \cong -4,81r\varpi^3 \cos \theta$$

