Calculation for Positioning of Satellite Dish For Pointing to Geostationary Satellite

Ref: Satellite Communications Systems 2nd Edition, p46

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Define Constants

Radius of earth:	r := 6378	km
Height of Satellite above Equator:	h := 35768	km
Speed of Light:	c := 299792458	m/s

Inmarsat Satellite Data
IOR = -64.5 degrees
AORE = -15.5 degrees
AORW = -54.0 degrees

+ve when East in Longitude
-ve when West in Logitude

Parameters

Longitude of Geostationary Orbit:	$\phi_s := -15.5$	deg
Earth Station Latitude:	$\theta_e := 52$	deg
Earth Station Longitude:	$\phi_e := -2.16$	deg
Signal Frequency:	f := 1525	MHz
	$f := f \cdot 10^6$	

Define Functions

Tan with argument in degrees:	tand(x) := tan(x·deg)
Sin with argument in degrees:	sind(x) := sin(x·deg)
Cos with argument in degrees:	cosd(x) := cos(x·deg)

Calculations

$\sigma := \frac{r}{r + h}$ $\quad \sigma = 0.15133$

$\phi_{es} := \phi_e - \phi_s$ $\quad \phi_{es} = 13.34$ deg

$\beta := \text{acos}\left(\text{cosd}(\theta_e) \cdot \text{cosd}(\phi_{es})\right) \cdot \frac{1}{\text{deg}}$ $\quad \beta = 53.198$ deg

Azimuth Angle

$aa := \frac{1}{\text{deg}} \cdot \text{atan}\left(\frac{\text{tand}(\phi_{es})}{\text{sind}(\theta_e)}\right) + 180$ $\quad aa = 196.7$ degrees from true North

Elevation Angle

$$ea := \frac{1}{deg} \cdot atan\left(\frac{cosd(\beta) - \sigma}{sind(\beta)}\right)$$

ea = 29.2 degrees elevation

Slant Path

$$d := h \cdot \sqrt{1 + 0.4199 \cdot (1 - cosd(\beta))}$$

d = 38662 km

Free Space Loss

$$\lambda := \frac{c}{f}$$

λ = 0.197 m

$$fsl := 20 \cdot \log\left(\frac{4 \cdot \pi \cdot d}{\lambda}\right) + 60$$

fsl = 187.9 dB

Polarisation angle

$$Angle := \frac{1}{deg} \cdot \frac{atan(\phi_{es} \cdot deg)}{tand(\theta_e)}$$

Angle = 10.24 Degrees

-ve corresponds to clockwise rotation when facing the satellite from the ground