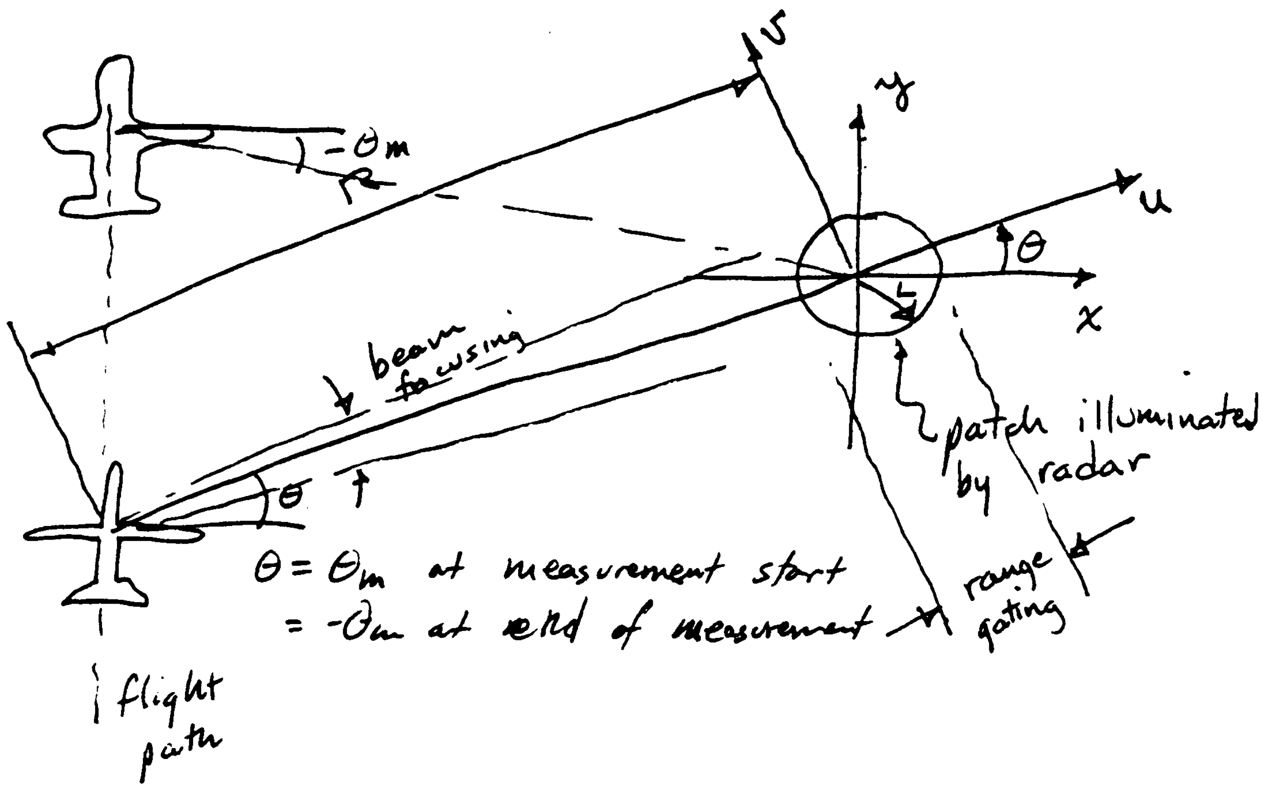
SPOTLIGHT MODE SYNTHETIC APERTURE RADAR



We assume here that height h of plane above ground is negligible compared to R.

<u>Ground reflectivity</u>:

$$g(x,y) = \underbrace{|g(x,y)|}_{\substack{\text{only fraction of incident radiation}\\ \text{is scattered back to aircraft}}} \, e^{\, i \underbrace{\angle g(x,y)}_{\substack{\text{air/target interface effects}\\ \text{target surface penetration}}}} \; \overbrace{\mathrm{circ}\left(\tfrac{x}{2L}, \tfrac{y}{2L}\right)}^{\text{illumination area}}$$

assume g(x,y) does not depend on

1) θ
2) frequency of radar wave

SAR (CONT.)

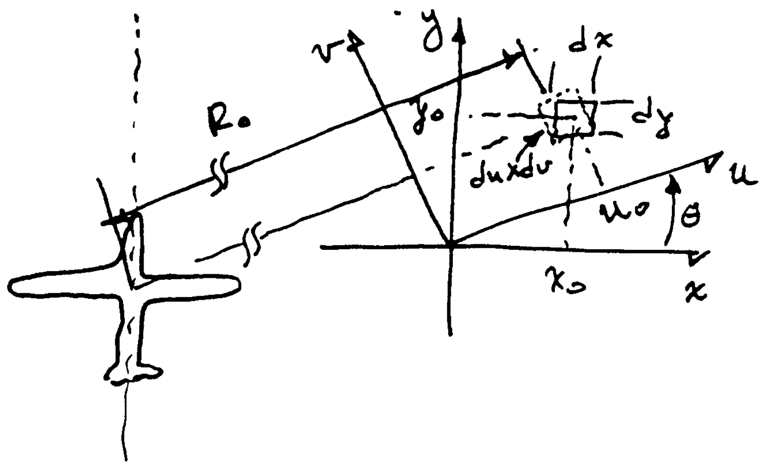
Transmitted signal:

linear FM chirp pulse $\mathrm{Re}\{s(t)\}$ where

$$s(t) = e^{i(\omega_0 t + \alpha t^2)} \mathrm{rect}(t/T)$$

(ω_0: RF carrier; α: FM rate/2)

Return signal from differential area at (x_0, y_0)



$$r_0(t) = A(R_0)\,\mathrm{Re}\left\{ g(x_0, y_0)\, s\left(t - \frac{2R_0}{c}\right)\right\} dx\,dy$$

($A(R_0)$: propagation attenuation; $g(x_0, y_0)$: reflectivity; $\frac{2R_0}{c}$: round trip delay)

Return signal from all differential areas at distance R_0 from aircraft assuming $R \gg L$

$$r_1(t) = \left[\int r_0(t)\, dv\right] du \Big|_{u=u_0}$$

SAR (CONT.)

$$r_1(t) = A(R_o)\, \mathrm{Re}\left\{ \underbrace{\left[\int g(x_o, y_o)\, dv\right]}_{p_\theta(u_o)} s\left(t - \frac{2R_o}{c}\right) du \right\}$$

<u>Return signal from entire illuminated patch</u>

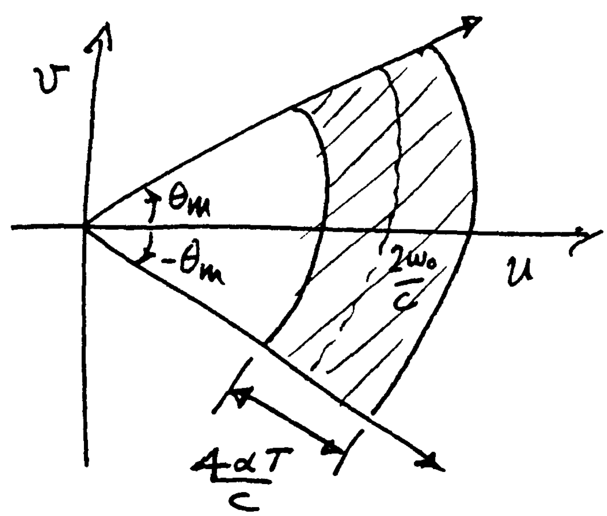
For $R \gg L$, $A(R_o) \approx A$. $R_o = R_\cdot + u$

$$\therefore \quad r_\theta(t) = \mathrm{Re}\left\{ \int p_\theta(u)\, s\left(t - \frac{2(R+u)}{c}\right) du \right\}$$

After processing at receiver, have:

$$C_\theta(t) = \frac{A}{2} P_\theta\left[\frac{2}{c}(\omega_o + 2\alpha(t - \tau_o))\right] \mathrm{rect}\left[(t - \tau_o)/T\right]$$

We thus obtain following measurement:



SAR (CONT.)

Comparison between SAR & CAT

	CAT	SAR
Direction of line integral	parallel to propagation	perpendicular to propagation
Quantity measured at each look angle	p_θ	P_θ
Band	Wide	Narrow