

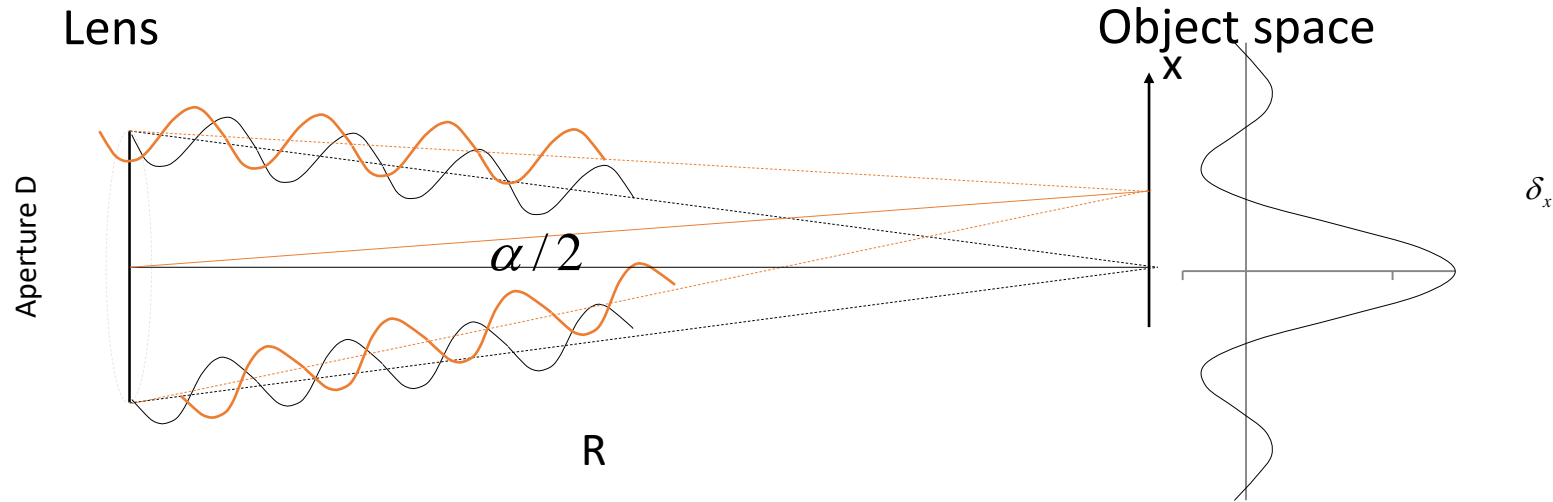
Educational Objective

- Understand the SAR imaging process and SAR instrument operation modes
- Understand the relevant parameters of SAR systems
- Understand the basic SAR scattering process
- Understand the properties of SAR images
- Know some SAR satellites and their main properties

Tutorial

- Matlab codes

Angular Resolution of an Optical Imaging System



Diffraction limit (angle): $\alpha \approx \lambda / D$

Diffraction limit (): $\delta_x = R\alpha = R\lambda / D$

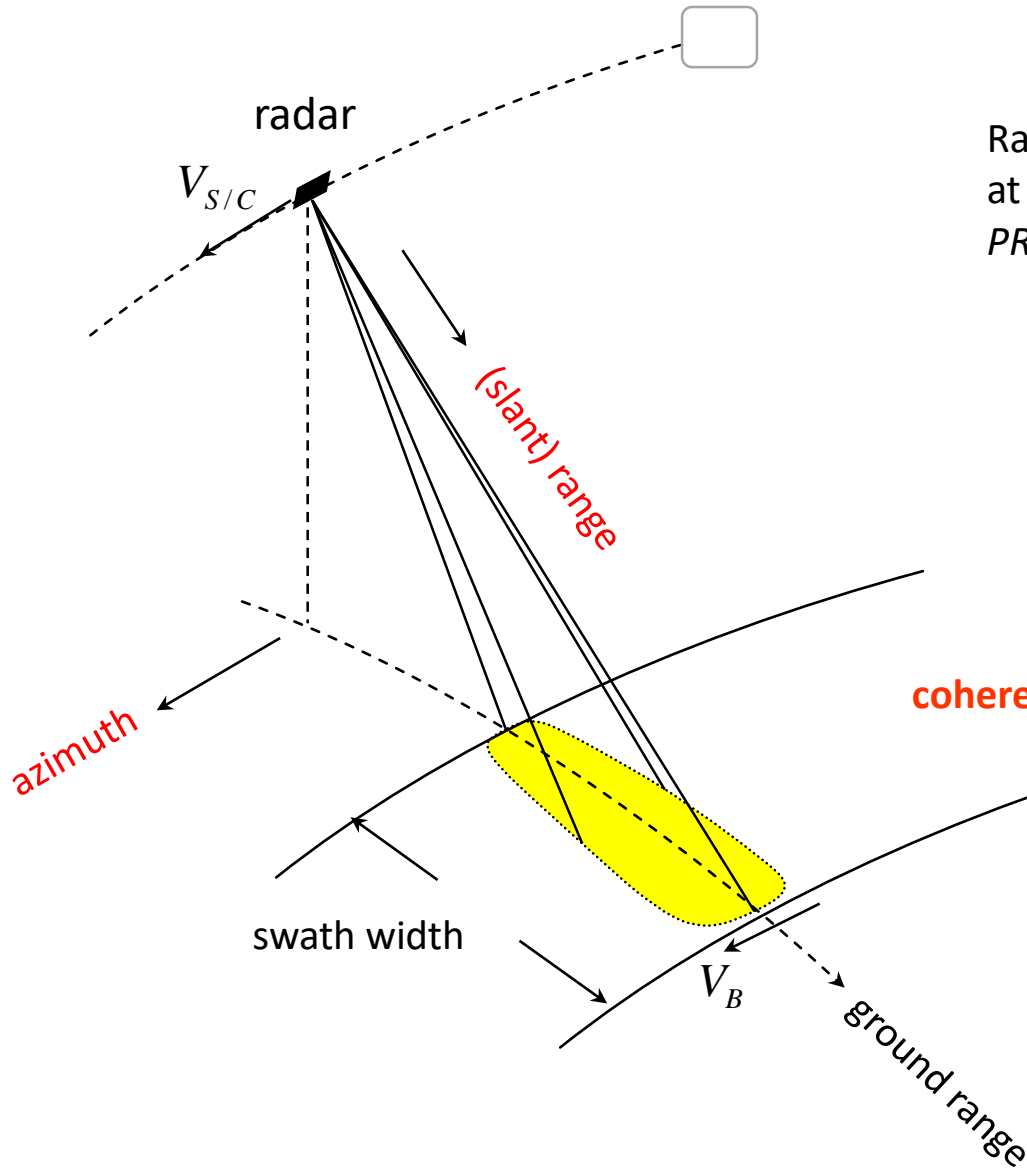
→ Diffraction limits resolution of sensors and transmitters!

Examples:

Human eye: $1000 \text{ km} * 500 \text{ nm} / 5 \text{ mm} = 100 \text{ m}$

Satellite dish antenna (Ku): $1000 \text{ km} * 2 \text{ cm} / 60 \text{ cm} = 33 \text{ km} (!)$

SAR Imaging Geometry



Radar transmits pulses and receives echoes at the rate of the pulse repetition frequency:
 $PRF \cong 1000 - 4000 \text{ Hz}$

range: radar principle = scanning at speed of light

azimuth: scanning in flight direction at V_B plus aperture synthesis (holography)

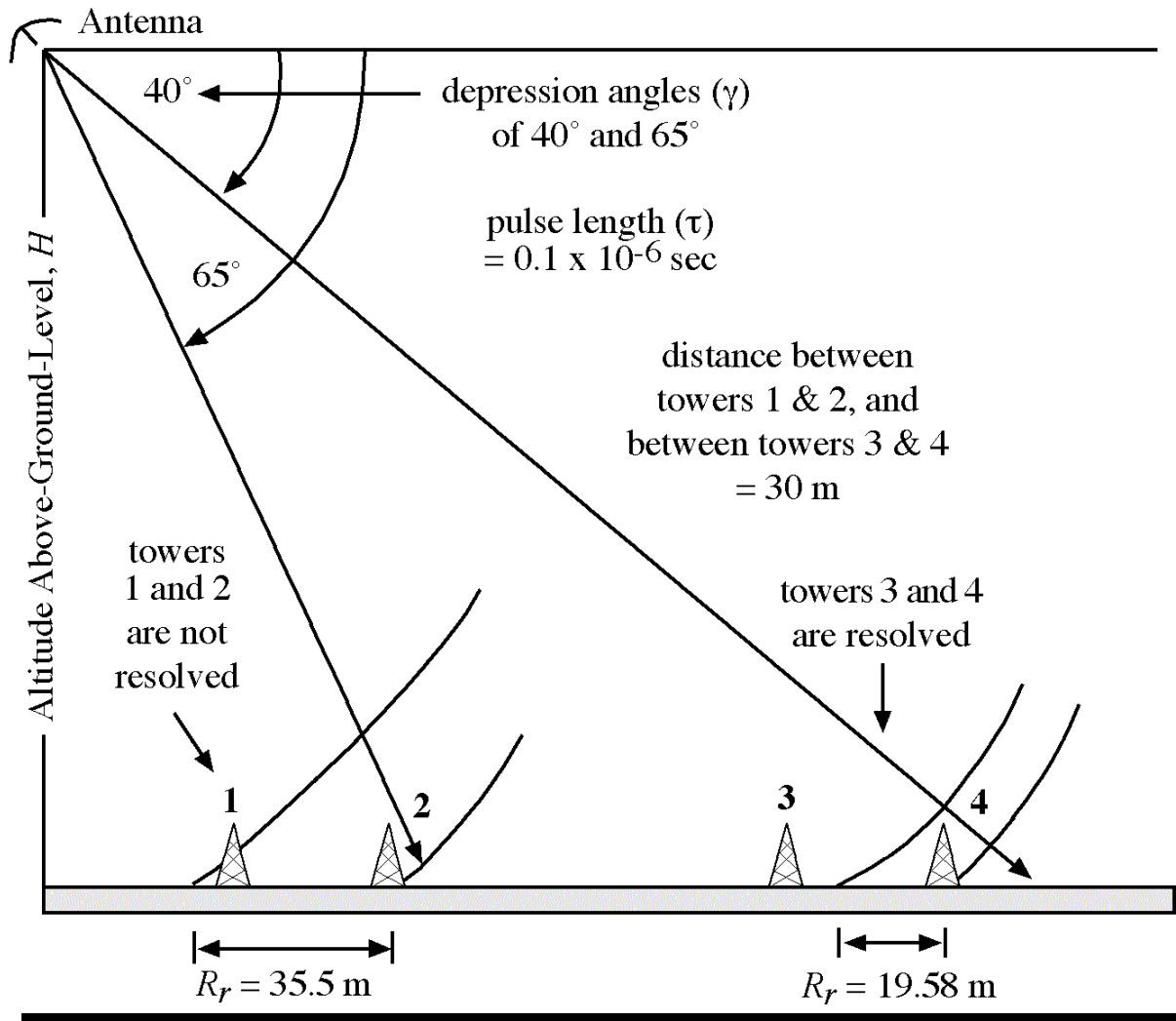
coherent imaging: complex-valued pixels contain amplitude (brightness) and **phase** information

for this lecture: straight flight path

$$\Rightarrow V_{S/C} = V_B = V$$

Range Resolution

$$R_r = \frac{\tau c}{2 \cos \gamma} = \frac{\text{pulse length} \times \text{speed of light}}{2 \cos(\text{depression angle})}$$

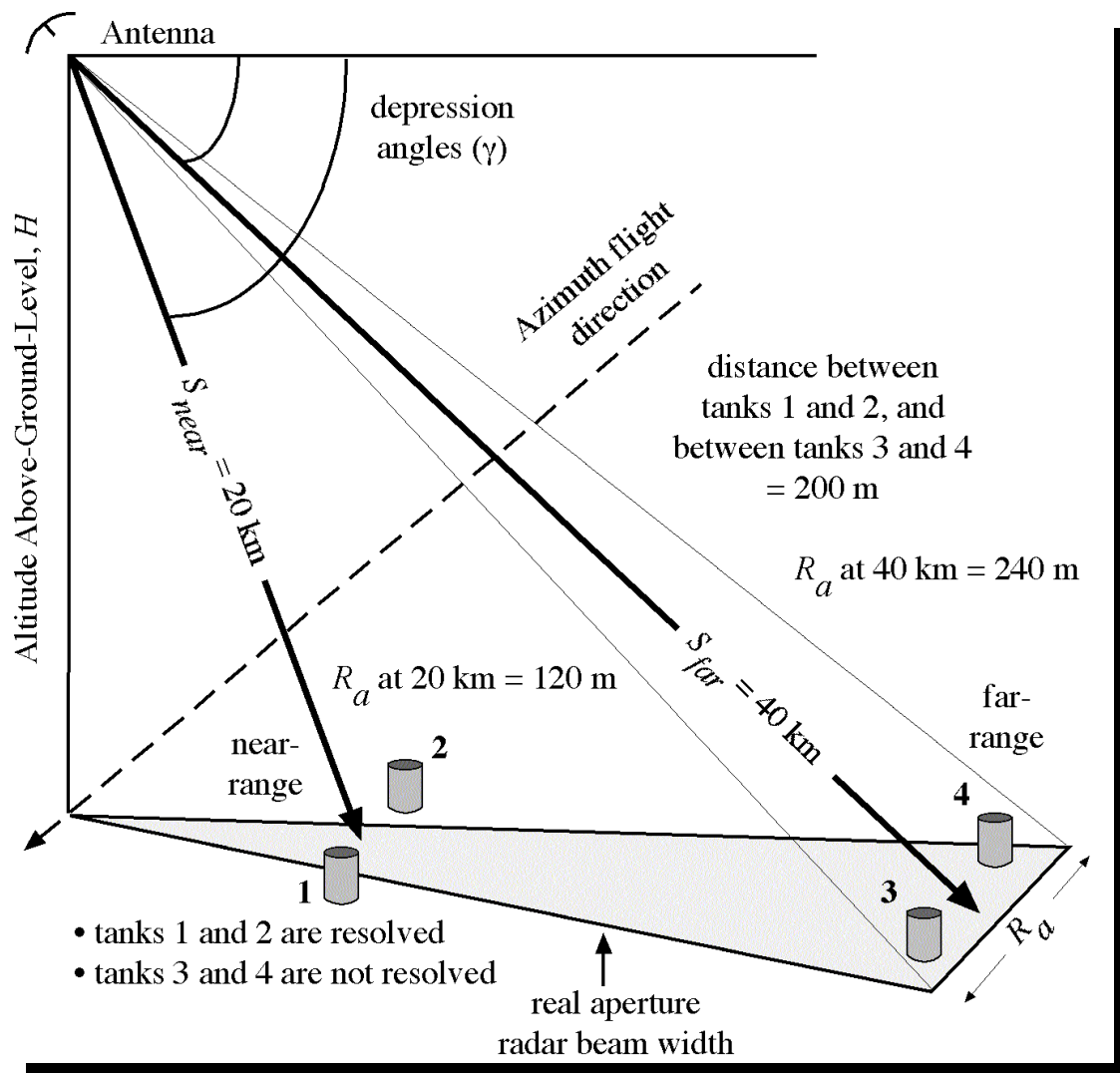


Calculate R_r

Azimuth Resolution

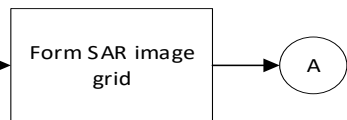
$$R_a = \frac{S \times \lambda}{L}$$

slant range \times wavelength
 antenna length

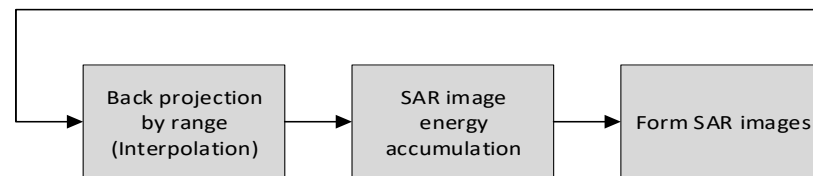
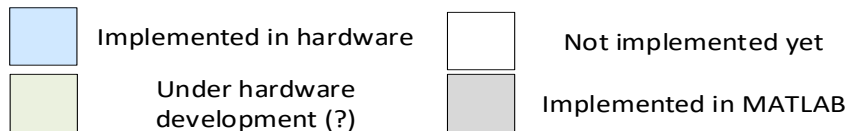
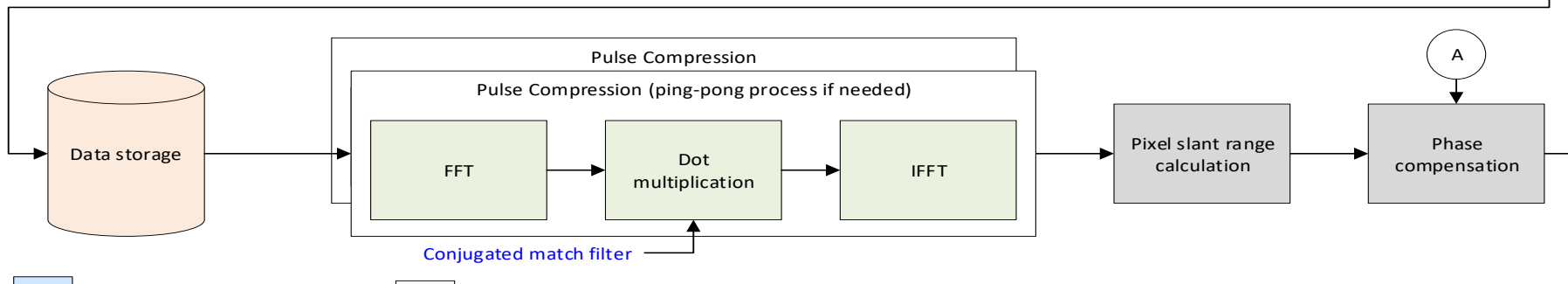
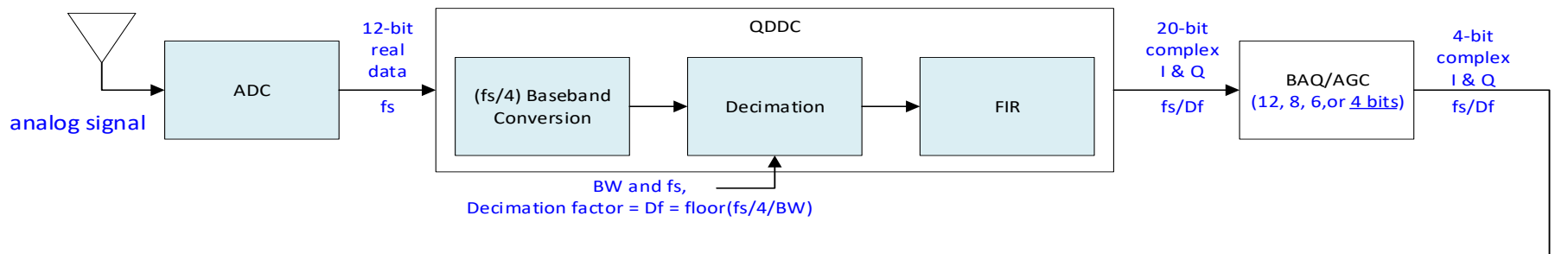


BP SAR Functional Block Diagram

SAR image parameters:
 SAR image center: (Rc, Xc, Zc)
 Range (ΔR) and X-range (ΔX) length
 Range(dR) and X-range (dX) resolution
 TX waveform bandwidth (BW)
 Sampling rate (fs)
 PRF
 Navigation (lat, lon, and alt)



Back Projection SAR Functional Block Diagram



		Back Projection SAR Functional Block Diagram			
		SIZE	FSCM NO	DWG NO BPSAR-001	REV 01
DRAWN Charles Hsu	ISSUED 1/17/2016	SCALE 1 : 1	SHEET 1 OF 1		