Spectrogram of Radar Signal
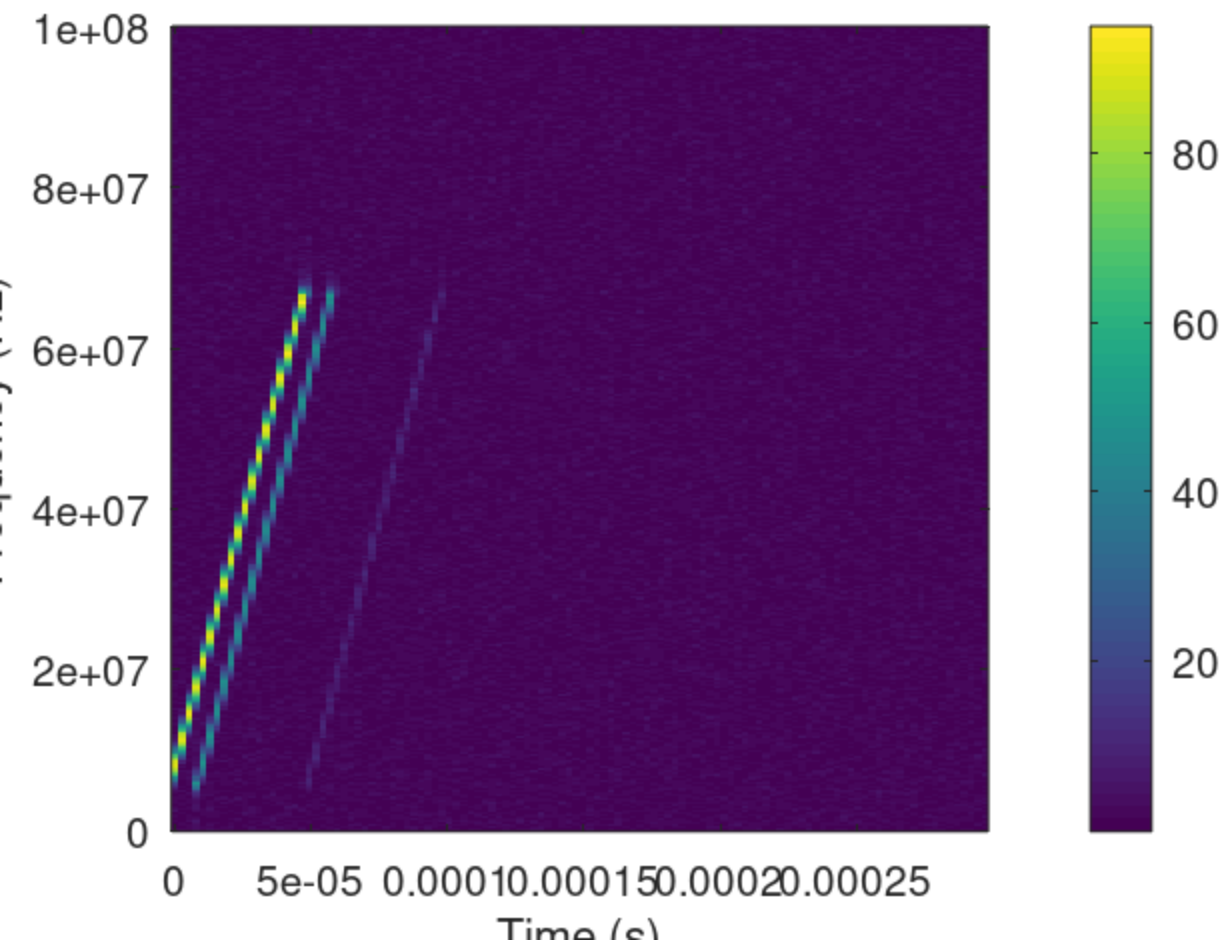
Quiz #3

①

a) $v = 300 \frac{m}{s}$

$f_t = 1\,GHz = 10^9\,Hz$

$c = 3 \cdot 10^8\,m/s$

$f_d = \dfrac{2 \cdot 300 \cdot 10^9}{3 \cdot 10^8} = 200\,Hz$

$ = 2kHz$

b) $f_d = 2kHz = 2000\,Hz$

$T = \dfrac{1}{f_d} = \dfrac{1}{2000\,Hz} = 0.5ms$

at least 0.5ms of data
required

c) $f_s = 2GHz = 2 \cdot 10^9\,Hz$

$N = f_s \cdot T = 2 \cdot 10^9 \cdot 0.0005$

$ = 1 \cdot 10^6$ samples

it could be practical but
requires high speed ADC & memory

②

a) $h = \dfrac{\Delta f}{\Delta t}$

$t = \dfrac{1}{h}\Delta f$

$R = \dfrac{c}{2}t$

$= \dfrac{c}{2} \cdot \dfrac{\Delta f}{h}$

$= \dfrac{c}{2h}\Delta f$

$\boxed{R = \dfrac{c}{2h}\Delta f}$

b) $\Delta f = 25\,MHz$

$h = 1MHz = 10^{12}\,Hz/s$

$c = 300\,m/\mu Hz = 3 \cdot 10^8\,m/s$

$R = \dfrac{3 \cdot 10^8}{2 \cdot 10^{12}} \cdot 25 \cdot 10^6$

$= \dfrac{3 \cdot 25 \cdot 10^{14}}{2 \cdot 10^{12}}$

$= \dfrac{75 \cdot 10^2}{2} = \boxed{3750m}$

④ $\Delta f = ?$ at around $50\mu s$

first echo at $\approx 60MHz$

transmitted signal $\approx 30MHz$

$\Delta f = 60 - 30 = 30MHz$

Second echo appears at $90MHz$

$\Delta f_2 \approx 90 - 30 = 60MHz$

$R = \dfrac{c}{2h}\Delta f$

$\dfrac{3 \cdot 10^8}{2 \cdot 10^{12}} \cdot 3 \cdot 10^6 = \boxed{4.5\,km}$ for first Aircraft

$\dfrac{3 \cdot 10^8}{2 \cdot 10^{12}} \cdot 60 \cdot 10^6 = \boxed{9\,km}$ for second Aircraft

Linear Image Processing

③ Written it shows 054

④ Sukhoi Su-57