Experiment No. -

AIM **To analyse the effect of Doppler shift on received carrier frequency.**

Theory

In a mobile communication system, a signal experiences multipath propagation which causes rapid signal fluctuation in time called fading. There are two types of fading:

1. Large Scale Fading
2. Small Scale Fading

If there is no line of sight path &large number of multiple reflective paths between BS & MS, it is called Rayleigh fading.

If the line of sight of component is dominant between BS & MS, it is called Rician fading. There are various physical factors in the radio propagation channel influencing small scale fading like

1. Multipath propagation
2. Speed of mobile user
3. Speed of surrounding objects
4. Transmission bandwidth of signal

The relative motion between the BS & MS results in random frequency modulation due to different Doppler shift will be positive or negative depending on whether the mobile receiver is moving towards or away from the BS. Consider a MS moving with a velocity of v m/s, it receives signal from a BS, speed of MS & speed of reflecting objects can induce their own Doppler shift in the reflected wave.

Doppler shift or Doppler frequency is given by:

$$f_d = \frac{1}{\lambda_c} v_m cos\theta$$

$$\lambda c = \frac{c}{fc}$$

where, λc = wavelength of carrier signal

v_m = relative velocity of mobile

θ = angle between motion of mobile and direction of arrival of the scattered wave

1. When mobile is moving in line with the direction of received signal

θ = 0° , cos0° = 1

Maximum Doppler shift $fd_m = \frac{Vm.fc}{c}$

c= velocity of light= 3 X 10^8 m/s

f_c = carrier frequency

Received carrier frequency = $f_c + f_d$

2. If mobile user is moving towards the BS with an angle θ with transmitted signal

$$fd = \frac{1}{\lambda c} v_m \cos\theta$$

Received carrier frequency = $f_c + f_d$

3. If the mobile user is moving away from the BS with an angle θ with the transmitted signal

$$fd = \frac{1}{\lambda c} v_m \cos\theta$$

Received carrier frequency = $f_c - f_d$

Problem: In GSM mobile radio BS operating at 900 MHz. A mobile user is moving at a speed of 70 km/hr. Calculate the received carrier frequency if:
1.Mobile user moving directly away from BS.
2.Mobile user moving towards BS.
3.Mobile user moves 30^o & 60^o to the direction of arrival of transmitted signal.
4. Mobile user moves 30^o & 60^o away from the transmitted signal.

Answer the following Questions

1.What is multipath fading.
2.Explain small-scale & large-scale fading.
3.Explain coherence bandwidth

Result analysis and Conclusion: