Rician factor in conjunction with optical flow of bergen model

***Abstract*—Optical flow is a subsidiary of motion models and is used in line of sight Rician factor determination. In this paper we have simulated for more subtle elements of this model which helps in LOS small scale short distance communication. We have applied this motion models in deriving Rician factor and in bettering it in our paper. The optical flow equation is given by**

$$\boldsymbol{I_x u + I_y v + I_t = 0}$$

Keywords—Optical flow, Rician factor, Bergen model, LOS, fading.

I. INTRODUCTION (*LINE OF SIGHT*)

This paper deals with more subtle elements in communication and more of line of sight Rician factor determination. Measuring motion of our signals in the direction of the intensity gradient is what makes this method very efficient.

We find motion in x and y direction for this signal given by.

$$\frac{dI}{dt} = \frac{\partial I}{\partial x}\frac{\partial x}{\partial t} + \frac{\partial I}{\partial y}\frac{\partial y}{\partial t} + \frac{\partial I}{\partial t}$$

Achieving with partial derivatives of the above equation we obtain the below final equation which is mathematically the equation of a line in 2D.

$$I_x u + I_y v + I_t = 0$$

There is a kind of complexity in solving quadratic equations. Rician fading is the most widely discussed topic in this.

$$H = \sqrt{\frac{K}{1+K}}\overline{H} + \sqrt{\frac{1}{1+K}}H_\omega$$

The model asymptotes as the sum of a fixed and scattered component.

$$f(x) = \frac{2(K+1)x}{\Omega}\exp\left(-K - \frac{(K+1)x^2}{\Omega}\right) I_0\left(2\sqrt{\frac{K(K+1)}{\Omega}}x\right)$$

$$\sqrt{\frac{K}{1+K}}\overline{H}$$

Is the Line-of-Sight (LOS) component. and

$$\sqrt{\frac{1}{1+K}}H_\omega$$

Being the fading component while K being the rician factor. K is the variation of power in the direct path to the other variation in the scattered path. Line of sight fading is shown for stochastic models where fading is numerically displayed. The antenna received a large number of scattered and interfered signals, which fade away with time, the received signal becomes a very small value, therefore depending on the location of the antenna we put forward the fading theorems and fading channels. All this is categorized as singled under small scale fading.

$$K = \frac{v^2}{2\sigma^2}$$

Ohm is the power summation from all the paths given by

$$\Omega = v^2 + 2\sigma^2$$

The received power is Rice distributed function as below.

$$v^2 = \frac{K}{1+K}\Omega$$

The power is given by

$$\sigma^2 = \frac{\Omega}{2(1+k)}$$

The resulting power density function is given by

Coherent detection is one area we would like to emphasize upon. The performance of the non-coherent maximum likelihood on a fading channel bad to certain probability. For antipodal signaling, error probability is given by

$$P_e = Q\left(\frac{a}{\sqrt{N_o/2}}\right) = Q(\sqrt{2SNR})$$

The received signal to noise ratio per symbol time is $SNR = a^2/N_O$.

The function is decaying exponentially

$$Q(x) < e^{-x^2/2}$$

Final fraction is given by

$$Q(x) > \frac{1}{\sqrt{2\Pi x}}\left(1 - \frac{1}{x^2}\right)e^{-x^2/2}$$

Fading will be there but we will utilize optical flow to find the shortest path between the transmitter and the receiver by reducing interference constructively. This method will try to find for small distance changes in the x and y axis of the receiving antennas which will be the mobile device. This mobile device is simulated for optical flow. Optical flow and Bergen model is used for small and global motion respectively. When we compare detection and fading in additive white gaussian noise (AWGN), the detection problem considered in the previous section has two contrasts: the channel gains are random, and the receiver is assumed to display them.

No system is perfect and so is transmission and receiving by antennas not perfect as there is a phenomenon of fading experienced. The section deals with detection in fading channel.

The channel can be represented by the following where fading channel is h[m] Fading channel for Rayleigh channel is given by

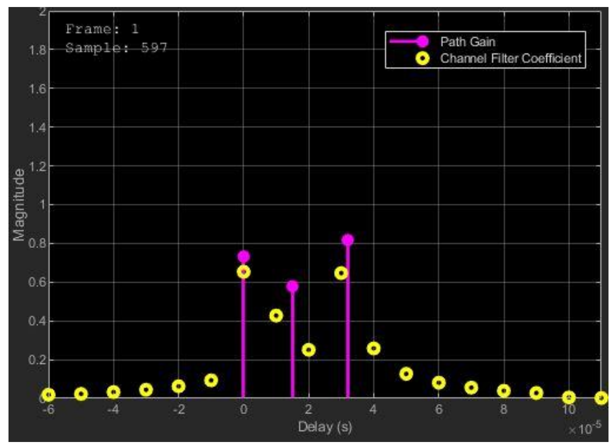
y[m]=h[m]x[m]+w[m]

This is known as non-coherent communication in which h[m] is not dependent on other fading coefficients. When a signal is transmitted at varying different frequencies, there is different fading for different frequencies. Fading coefficients are assigned similar to the above h[m] which shows about the fading channel. They assign a simple relationship between the fading channel and how much signal strength is lost. They are magnitudes of fading coefficients, a particular value of fading coefficient signifies what value of the energy of the signal in the channel transmitted is faded away. The faded coefficient is h[m]= - or + value of amplitude or any value of fading coefficient which tells how much energy is dissipated or faded during transmission.

The next section is on coherent detection which depends on the fading coefficients value and is interrelatedness with each others fading coefficients value. In this case the faded coefficients are leading to the energy dissipated which shows the fading in the channel and depends on the channel receiver having knowledge of the fading coefficient h[m], that is the receiver already knows how much energy would be dissipated.

Figure I: The plot is between the magnitude of faded coefficient and delay in seconds.

The signal is faded for faded coefficients value of 0.6 at a delay of 0s, 0.4 at a delay of 1s, 0.2 at a delay of 2s, 0.6 at a delay of 3s for value of path gain going to 0.8. Otherwise the path gain is linear in plot.



The fact is that the detection in the fading channel works at very less performance is that the channel gain is random besides there is more probability of the channel being in deep fade(where the signal strength is entirely lost).

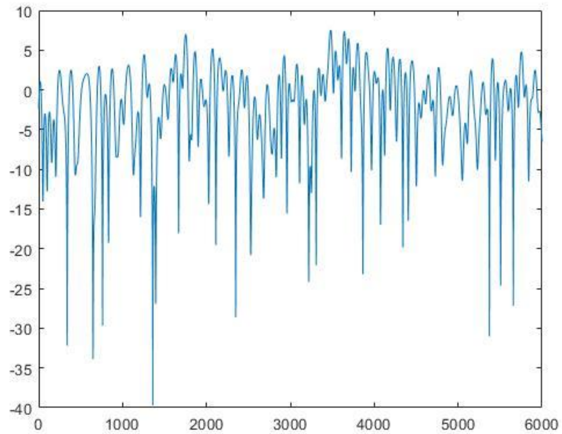
Probability of deep fade or signal losing strength compeletely is inversely proportional to SNR.

Probability of deep fade.

$$|h|^2 < \frac{1}{SNR}$$

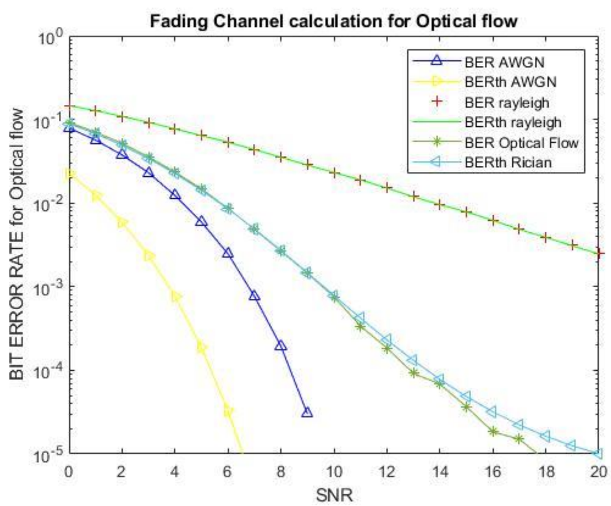
Since we experience fading more in some paths compared to other stronger paths, we want to make the same signal pass through different paths, which makes some signals to be stronger compared to some others, due to obstructions and interference which makes them weaker, This allows for success from fading which makes this method diversified.

Figure II: Gives the discrepancies in plot between faded signal and sample number.



The following is calculated for 60k samples.

Figure III: Green line for optical flow



The optical flow curve converges at close to 18 SNR.

The AWGN converges at a value of 6 and 10. Similarly Rayleigh fading occurs at different value, but rician occurs close to optical flow.The first yellow rate shows immediate fading for small values of signal to noise ratio while the other plots show persistence.

There is observed partial and whole cancellation process observed in the transmission of the signal in the above figure. We observe for various values in bit error rate to SNR for fading channel calculated above.

Conclusion: The optical flow equation was simulated for variability close to Rician fading in the above simulation in figure. Fading coefficients were studied to modify the non coherent fading characteristics which preserve and use past references of the coefficients. The efficiency and plot was close to that shown by Rician channel fading. We have very efficiently plotted for what is known as fading channel in wireless communication as a whole to point.

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