Friquency Offset Estimation

1. Maximum likelyhood mathod

1) In a multicarrier system there is a dissimilarity of the oscillators used at the transmitter and receiver which causes a ofset in the carrier friquency.Due to this at the receiver end when the signal is demodulated, we get a very high bit rate error.
   To overcome this eror ML stimation is used and ML carrier frequency estimater

$$\triangle f = \frac{1}{2\pi T_s} \frac{\sum_{k=1}^{M} ImR(k)}{\sum_{k=1}^{M} kReR(k)} \tag{1}$$

   Where the △f is the frquency offsetT_s is the sampeling interval.
2) R(k) denotes the estimated autocorrelation of the sequence r_k.

$$R(k) = \frac{1}{N-K} \sum_{i=k+1}^{M} r_i r_{i-k}^{*} \tag{2}$$

   $r_k$is the sampled signal which can be represnted as →

$$r_k = e^{j2\pi \triangle f T_s + \theta} + v_k \tag{3}$$

   $1 \leq k \leq N$
   v_k is the compex noise.

$$\sum_{k=1}^{M} ImR(k) = Marg \sum_{k=1}^{M} R(k) \tag{4}$$

$$\sum_{k=1}^{M} kReR(k) = M \frac{M+1}{2} \tag{5}$$

3) Thus total no of the quation used are 5.

2. Simulation for frequency estimation

Simulation shows that symbols with a constant offset frequency are transferred through a wirless comunication channel.At the receiver end this offset frequency is estimated with the ML mwthode.Process is repated for the different value of the signal's amplitude A.

In ML estimation r_k is the received signal and R(k) represents the autocorelation of the r_k. If the length of the incomming signal is N then R(k)will be →

$$\sum_{i=k+1}^{M} r_i r_{i-k}^{*} \tag{6}$$

When the value of the k is near to the N then it gives a poor estimate of the autocorilation of r_k so we use values of k lower than N to discard the unrelible autocorrelation estimates.Using the taylor series expansion of the frequency estimator we aproximate and get the final equation as→

$$\triangle f = \frac{1}{2\pi T_s} \frac{\sum_{k=1}^{M} ImR(k)}{\sum_{k=1}^{M} kReR(k)} \tag{7}$$

3. Observation

For different value of m and for fix length of simlen simulaton is performed.From $m = 5$ to $m = 50$ is taken for different graphs where simlen is 50 and frequency is 50K.

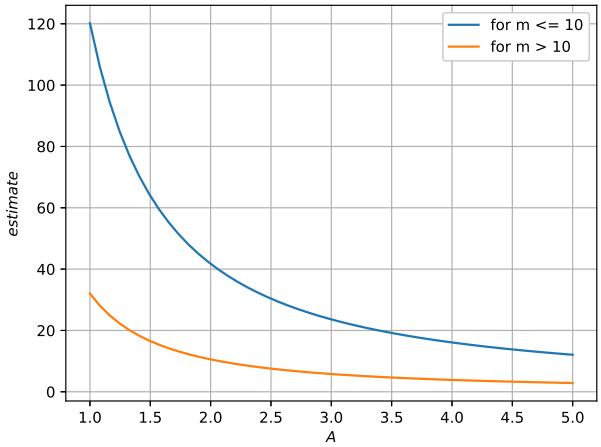

Fig. 1: comaprision of graph of offset friquency for different M

table for the variables and values used in the code

Perameter	**Value**
Symbol length	1ns
Frame length	50 ns
Frequency offset	50KHz
Corelation index	20
Bandwidth	2.5MHz
Bit duration	-
Amplitude	1 - 5 V
Modem	Multicarrier sysem
No of subcarriers	50
Bit rate	-
Modulation	-

TABLE II: List of variable

4. Conclusion

In this simulation frequency and simlen is constant and M varies from 5 to 50. For m≤10 the value of estimate variable varies from 10 to 400 and everage is 120 for A = 1 as shown in graph. For m≥10 the value of the estimate variable varies from 0.2 to 70 and average is 35 for A = 1.thus in short we can say that for the smaler value of M error is large than that of for larger M.