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Title: A Proposal of Slot Pattern on Uplink and Downlink
Document for: Proposal of Slot Pattern for channel estimation

Abstract

This document proposes a new slot pattern for channel estimation on uplink DPCCH, downlink DPCCH and SCPCH. Simulations based on the proposed slot pattern and our channel estimation method show that the performance of Rake receiver is greatly improved compared to that using the old ones.

Proposal

In 3GPP RAN S1.14, as shown in Fig. 1, pilot bits are time multiplexed with data bits in uplink DPCCH, downlink DPCCH and SCPCH , which make coherent detection possible. But since pilot bits are not continuously transmitted, channel parameters of the data part can not be directly estimated, but have to rely on the channel estimation of the pilot part using proper algorithms. For example, it can be obtained from linear interpolation [1]. Unfortunately, the channel parameters of data part can not be estimated accurately under high velocity conditions. Recently, we have proposed a second-order interpolation based on Weighted-Least-Mean-Square method and found that the bit error ratio (BER) performance of the receiver is greatly improved especially in high velocity cases when $E_b/N_0 > 1dB$. But for the case with $E_b/N_0 < 1dB$, the receiver performance is still not satisfying. In order to improve the performance for high velocity and low signal to noise ratio (SNR) cases, we proposed a new slot pattern, as shown in Fig. 2. Simulations show that the receiver performance is greatly improved despite of the mobile velocity and E_b/N_0 with the usage of our proposed slot pattern and channel estimation method.

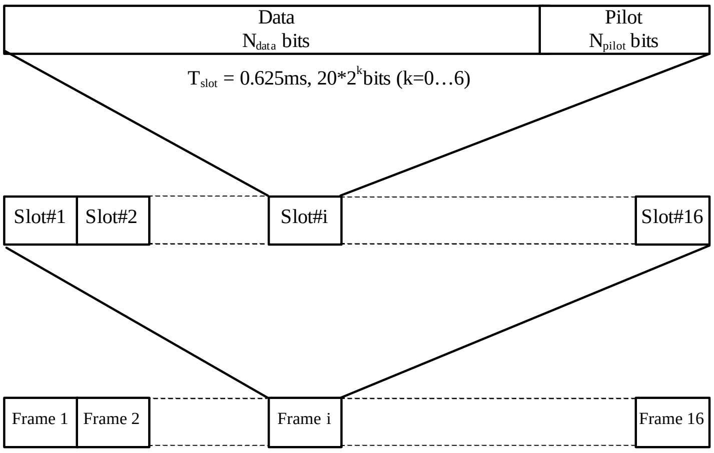

Fig.1 Current Frame Structure

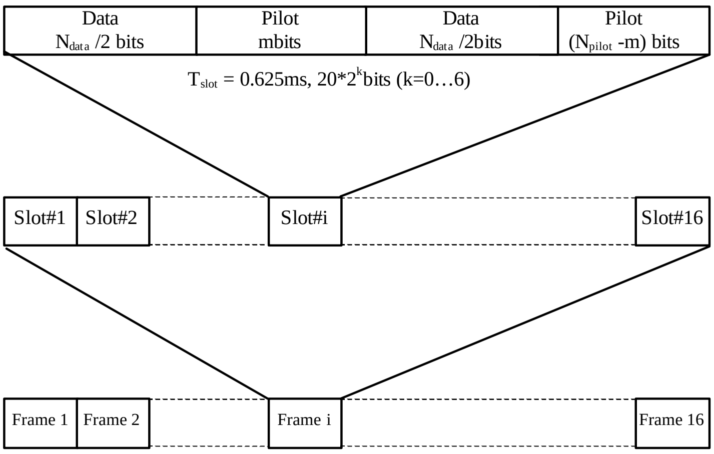

Fig. 2 Proposed Slot and Frame Structure

The new slot pattern is shown in Fig.2.The total number of pilot bits in one slot is N_{pilot} . We split the pilot bits into two parts: one with m pilot bits in the middle, and the other with (N_{pilot}-m) at the end of each slot, but the total number of pilot bits remains unchanged.

Channel Estimation Method

The channel estimation method we use is 2nd order interpolation based on Weighted-Least-Mean-Square method. The channel parameters estimated by the pilot symbols at the end of two successive slots and that of the middle pilot symbols of the slot are used to calulate the coefficients. The square error are weighted. The weighting factor at the middle of the slot is α and the weighting factors at the end of two slots are β, where

$$b = \frac{1-a}{2(N_{Pilot} - m)}$$

Simulation Results

We have performed some simulations. The simulation parameters are as follows.

Chip Rate	4.096Mchip/s
Symbol Rate	64ksymbol/s
Modulation	QPSK
Multi-path Fading	6-path Rayleigh(M.1225 Vehicular A)
Channel Coding	Convolutional coding (R=1/3, K=9) Soft-decision Viterbi Decoding
Deversity Path	3 paths
N_{pilot}	8
m	2
Interleaver Block Size	32x96 bits

Fig. 3 are the BER results as a function of α at speed 150Km/h, with different. E_b / N_0 .

Fig. 4 are the BER results as a function of α at speed 250Km/h, with different. E_b / N_0 .

Fig .5 are the BER results as a function of α at speed 400Km/h, with different. E_b / N_0 .

Fig. 6 shows the BER results as a function of E_b / N_0 with α=0.1, at different mobile velocity.

Note that α=0 corresponds to the case using old version of slot pattern.

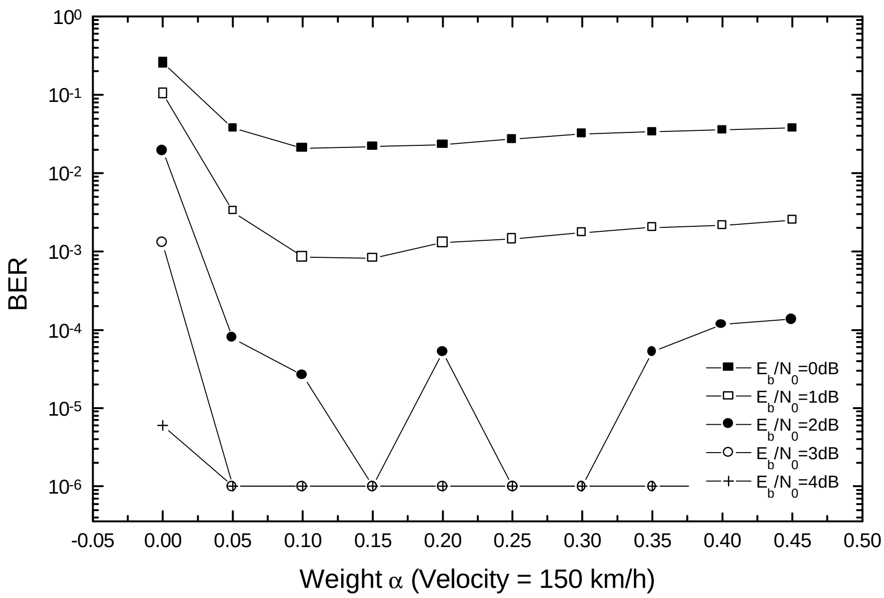

Fig3.Receiver Performance at Velocity of 150 km/h

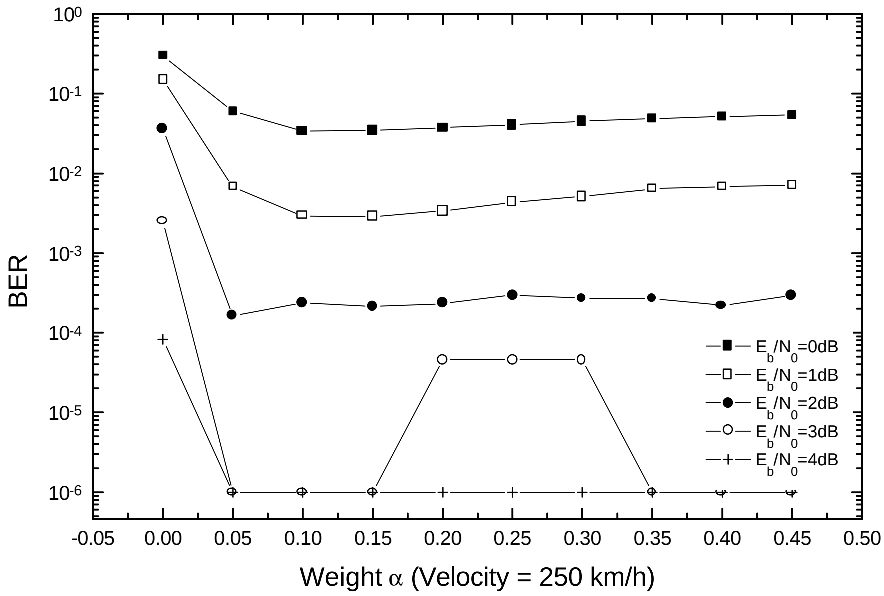

Fig.4 Receiver Performance at Velocity of 250 km/h

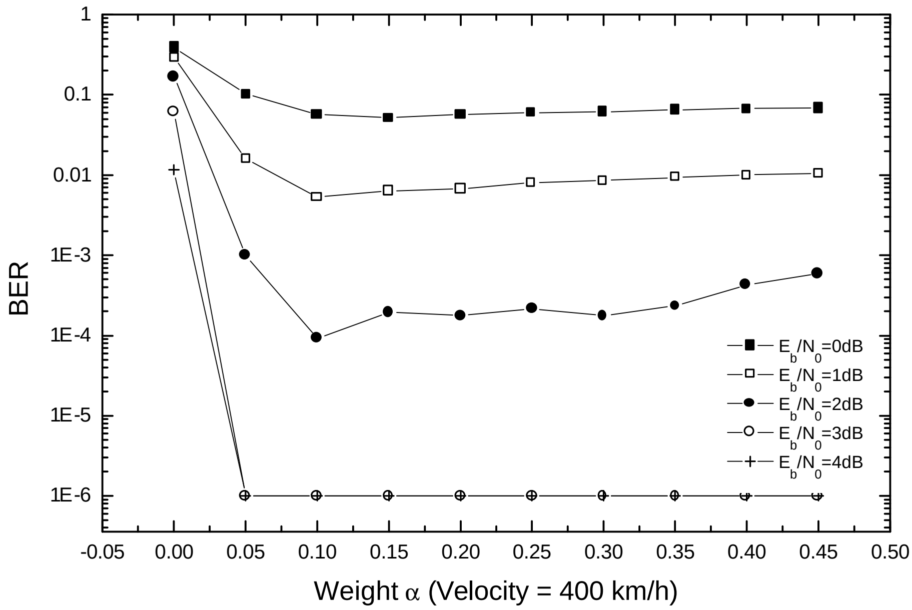

Fig 5. Receiver Performance at Velocity of 400 km/h

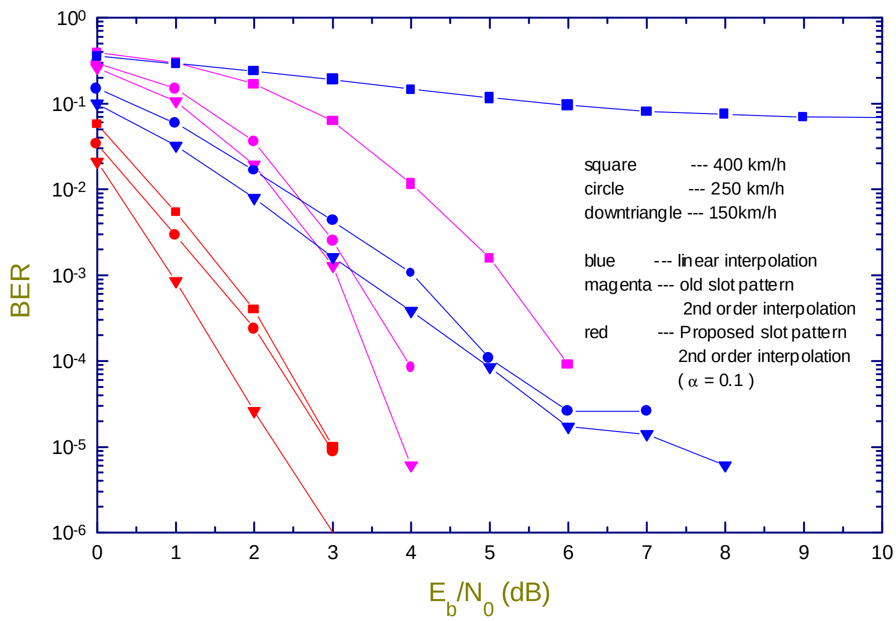

Fig 6. Receiver Performance of Different Velocity

Obviously, the performance is greatly improved under our proposed slot pattern with the help of our channel estimation method, and there exists an optimal value of weighting factor α between 0.05--0.1 minimizing the BER.

Conclusion

From the above results, we can see that the performance of the receiver using our proposed slot pattern and channel estimation method is much better than that using old ones, no matter the velocity or the SNR. We recommend that slot patterns be changed as we proposed.

Reference

[1] S. Sampei, and T. Sunaga, “Rayleigh fading compensation for AQM in land mobile radio communications”, IEEE Trans. Vehic. Tech. Vol. VT-42, No.2, pp.137-147, May 1993,