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Power offset estimation performance in ASPC method

Introduction

This paper shows the unrobustness of a power ratio based power control algorithm utilized during recovery period in DL. The method is defined in [1].

Study 1 / valid for medium to high speeds: >= 20 km/h

In the first study the power of the tpc and power of the pilot were both estimated without any filtering of previous slots. The pure AWGN channel was used, and Eb/N0 level was the one which gave BER=0.1 %. The distribution of different RA values is shown below. Eg. if RA=3 was sent, the probability of detecting RA=3 was 60.3 %, the probability of detecting RA=2 was 20.3 % and so on.

Detected	0	1	2	3	TPC error %
RA = 3	2.9 %	16,6 %	20,3 %	60,3 %	6,9 %
RA = 2	9.6 %	25,3 %	20.4 %	44,7 %	7,0 %
RA = 1	21,6 %	30,9 %	17,0 %	30,6 %	7,9 %
RA = 0	42,9 %	32,5 %	11,3 %	13,2 %	

Study 2 / valid for low speeds: 3 km/h

This study gives more ideal results. Here it was assumed that the vehicular speed is so slow that optimum filtering for the pilot part could be performed. Thus it was assumed that the amplitude and the phase of the pilot signal (or any signal into which the power of the TPC symbol is compared to) were known, so that the problem of measuring the power ratio is effectively only measuring the power level of TPC symbol. These assumptions constitute a task of simple coherent demodulation of PAM, i.e. comparing the amplitude of the received TPC symbol to a certain fixed levels. As known, PAM is quite sensitive to noise, so it certainly is not the best possible way to transmit information in a radio channel.

The study was carried out measuring the distributions and error ratios of detected power levels as a function of Es/N0 in an AWGN channel. Two different schemes were studied for curiosity's sake:

- The sign of the TPC symbol was known beforehand (case 1)
- The sign of the TPC symbol was not known beforehand (case 2)

Figure 1 and Figure 2 present the error rates of the TPC power level detection for unknown and known TPC symbol sign respectively. Figure 3, Figure 4, Figure 5 and Figure 6 present the distributions of detected power levels in case 2 for RA's 0, 1, 2 and 3 respectively.
Some simulations indicate that in a typical speech case in 3GPP an Es/N0 of 3 dB would correspond to a BER of 0.1 %. The Es/N0's in the abovementioned figures are the reference Es/N0's in which the power level of the TPC symbol is compared to. This means that when the RA has been 3, the Es/N0 of the TPC symbol has been 'Es/N0+10log(3)'.
When we observe the more realistic case (which is still very idealised) with unknown tpc symbol sign at Es/N0 point 3 dB, we see that the error rates vary from 25 % to 65 %. This is clearly not a very admirable error rate. Furthermore, looking at the distribution in Figure 5, we see that in the 3 dB Es/N0 point, the correct detection of the RA value is not the most probable one but an RA of 3 is detected more often. Any other figure show quite poor performance as well.

Conclusion

This paper shows that the power ratio measurement method proposed to the recovery mode power control can be idealised to a PAM system. The simulations prove that even in this very idealised scheme this method gives very high error rates. This means that the ASPC simulations must be conducted with realistic error rates for the power offset estimation, in order to get fair comparison with other power control methods proposed for compressed mode. The error rates from study 1 should be used with medium to high vehicular speeds, and the error rates from study 2 should be used with low vehicular speeds.

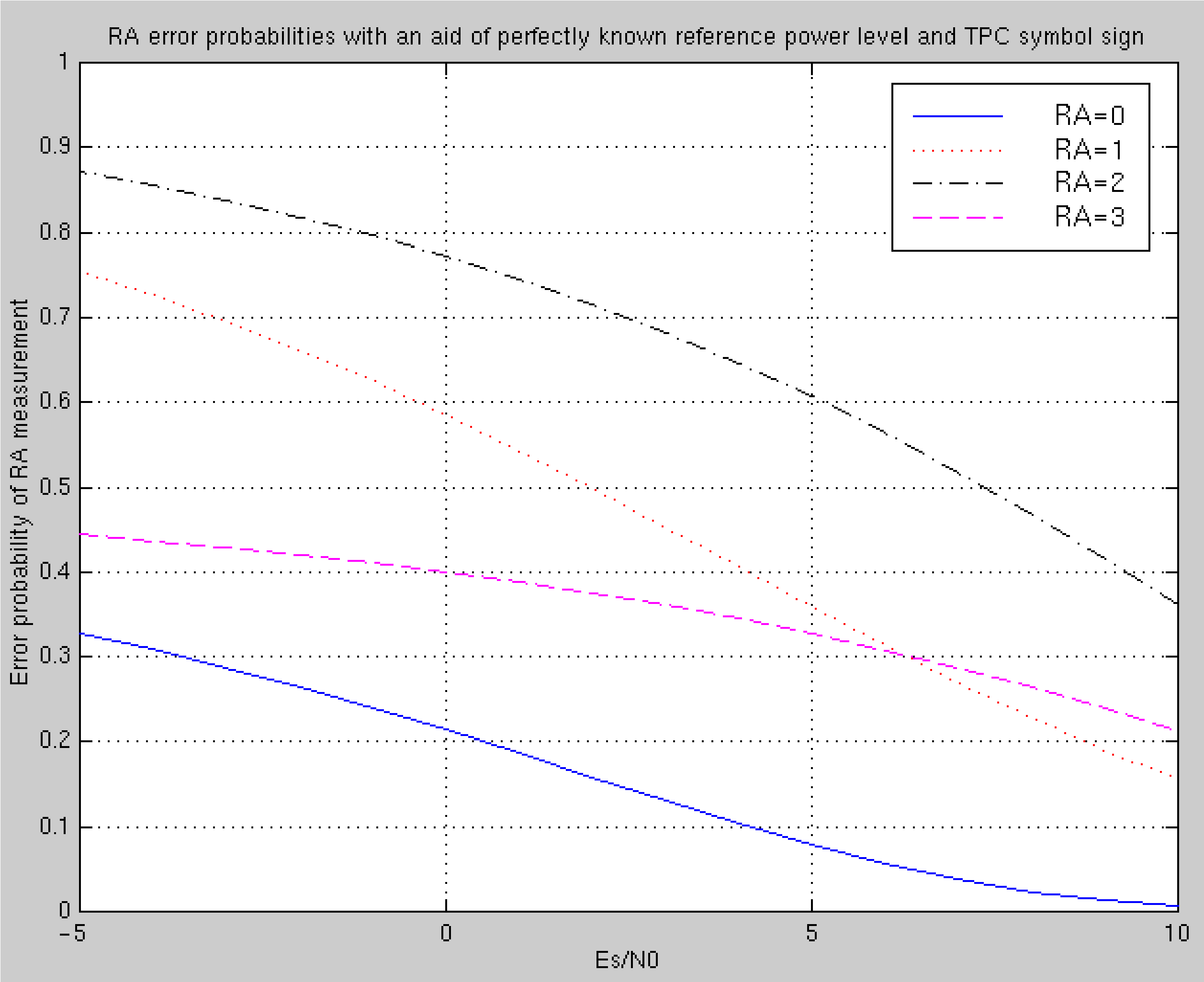

Figure 1 Error probability of detected TPC level, TPC symbol sign known

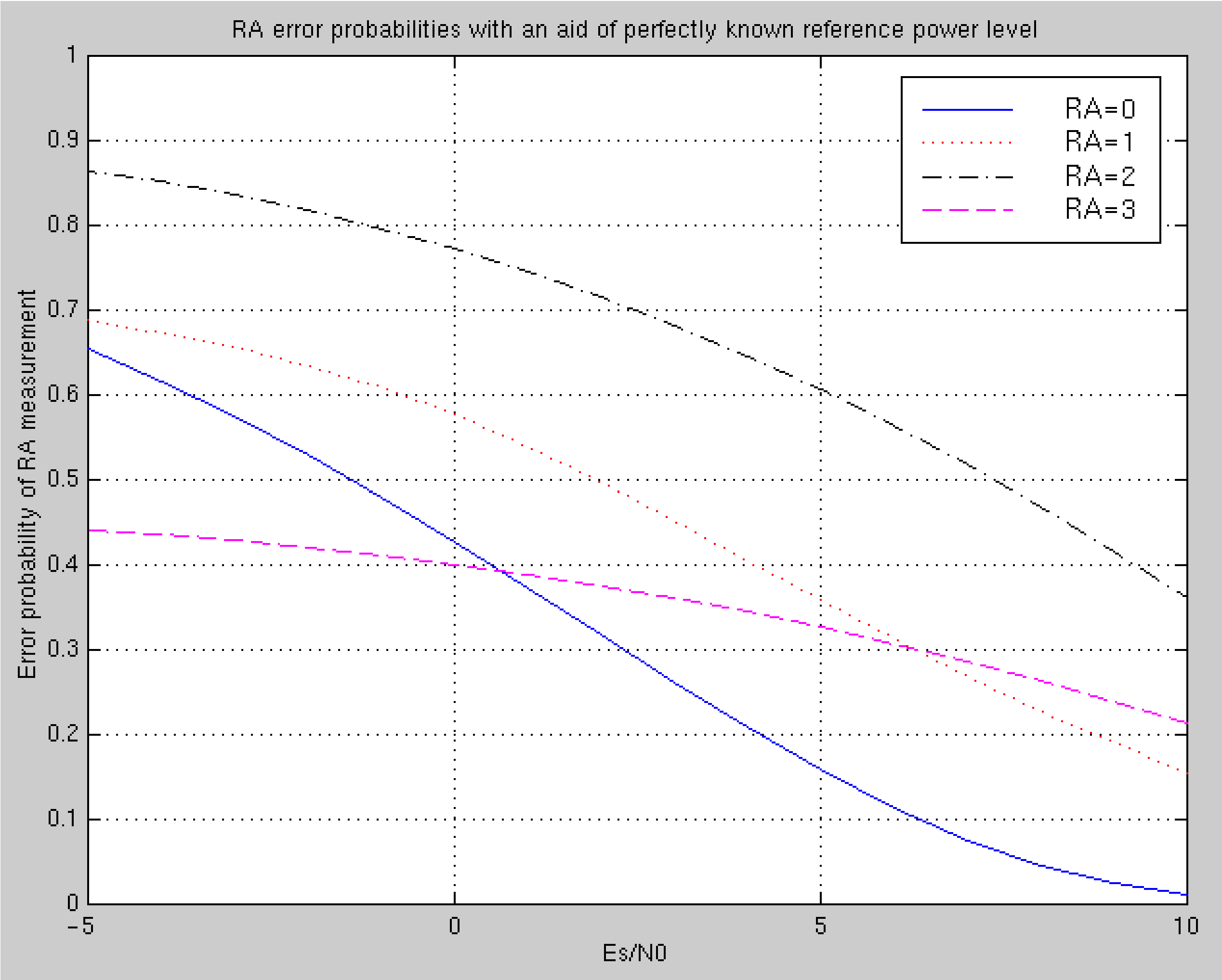

Figure 2 Error probability of detected TPC level, TPC symbol sign not known

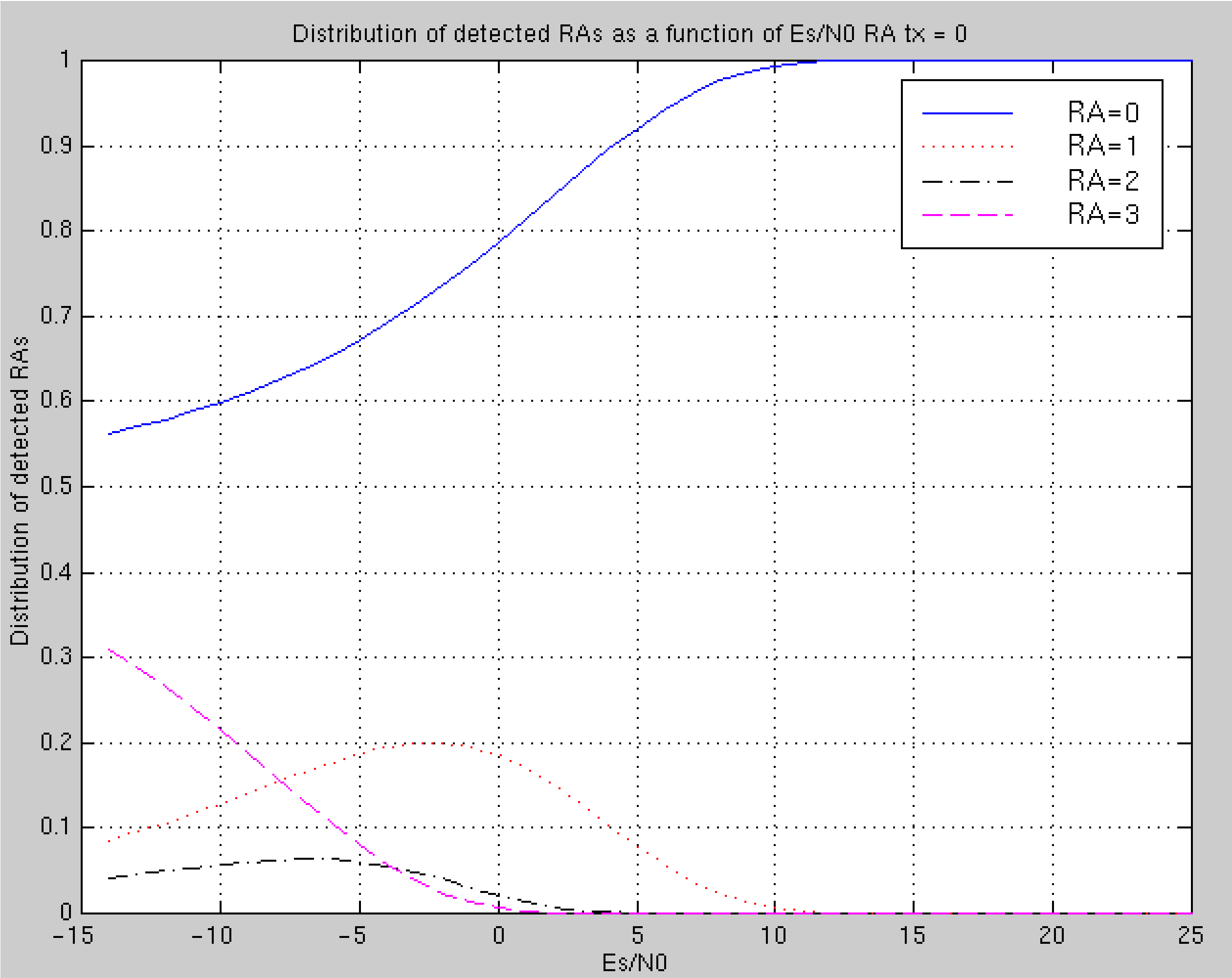

Figure 3 Distribution of deteced RA values, RA tx = 0

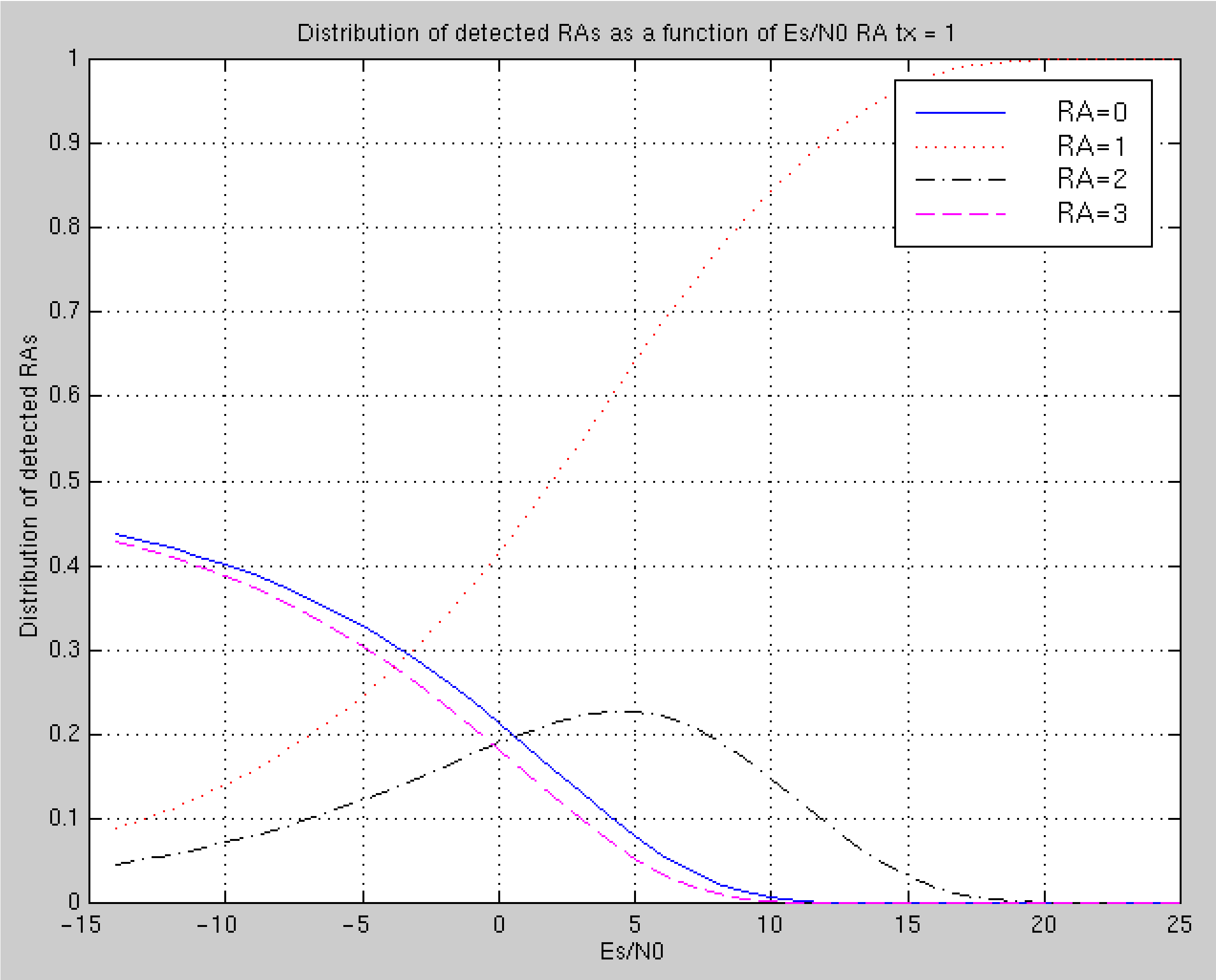

Figure 4 Distribution of deteced RA values, RA tx = 1

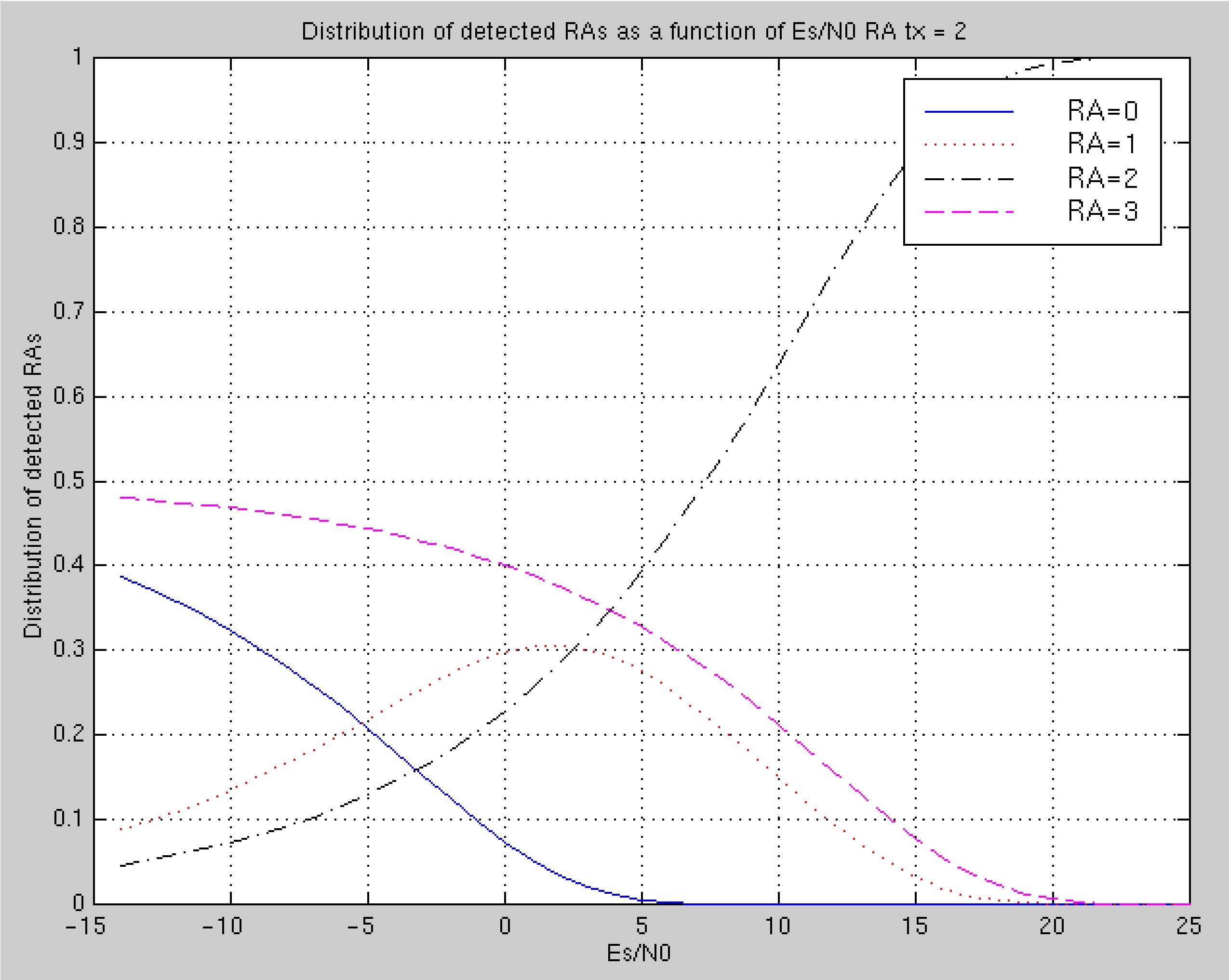

Figure 5 Distribution of deteced RA values, RA tx = 2

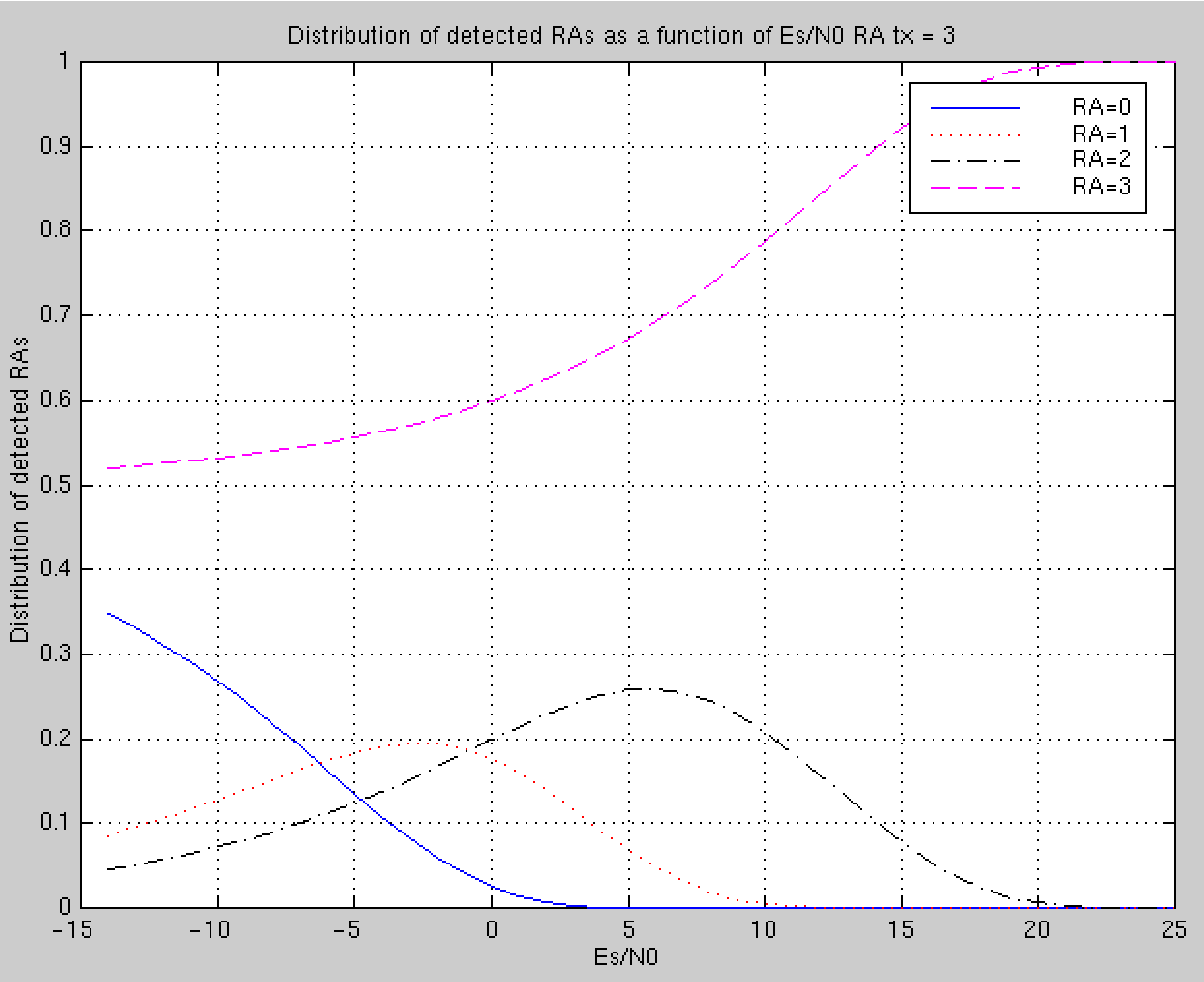

Figure 6 Distribution of deteced RA values, RA tx = 3

References

[1] TSGR1#4(99)409 Adaptive Step Power Control (ASPC) for Slotted Mode. Panasonic (Matsushita Communication Industrial Co., Ltd.)

[2] ASPC vs other comp mode PC methods with sim results.doc. Panasonic