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Parameters setting for fixed-step closed loop power control algorithm in compressed mode

Abstract

This article deals with an improved uplink (resp. downlink) closed loop power control algorithm in downlink (resp. uplink) compressed mode proposed by Alcatel. This algorithm consists basically in increasing power control step during a certain amount of time (*recovery period*, see [1]) after transmission restarts, in order to recover faster a SIR close to target SIR (SIR_{target}). It has been shown in [1] that this improved algorithm leads to significant improvements compared to the standard one. The aim of this article is to show the influence of parameters such as power control step size applied during *recovery periods* or *transmission gaps*.

1. Introduction

All that follows in this article is valid for both uplink and downlink compressed modes, but in order to simplify the description, only the downlink compressed mode will be considered in the following.

One of the drawbacks of the downlink compressed mode is that during the *transmission gap* (number of slots noted *transmission gap length* or TGP), uplink closed loop power control (CLPC) is not active. Indeed, the user equipment (UE) does not receive any TPC command in this time period. Therefore, the signal to interference ratio (SIR) of the uplink signal at the Node B can deviate far from SIR_{target}, degrading performances of the uplink transmission. When transmission restarts, some time is required for the SIR to converge to SIR_{target}, and obviously, the shorter this time the better the performances.

The proposed algorithm, described below, gives important improvements (up to 0.8 dB) compared to the standard algorithm. The mean used to reduce this convergence period is to apply a larger power control step during a given *recovery period*:

Every time slot (TS),

1) if we are in the transmission gap, do not perform any power control action
2) if we are in the recovery period, perform CLPC algorithm with step $\Delta' > \Delta$
3) if we are not in one of those 2 cases, perform CLPC algorithm with step Δ

In previous performance results we presented (see [1]), we have considered $\Delta' = 2\Delta$ and a *transmission gap length* of 8 slots in all the cases. In this article, we demonstrate the interest and the relevance of those particular values.

2. Parameters choice

The assumptions we made, the working model, and the performance estimators we used are described in details in [1]. Please refer to this document for any precision. In all that follows:

- TGP is the period (in number of slots) of the transmission gaps.
- TGL is the transmission gap length.
- RL is the recovery length (in number of slots) that is the length of the recovery period.
- TEP is the average error probability on TPC commands.

The SIR variance is only evaluated during the recovery periods.

2.1 Recovery step D'

We test our algorithm with two other values for Δ': Δ' = 3/2.Δ and Δ' = 3Δ. Δ is set to 1dB. The different set of values are summarized in the following table. Results are shown in Figure 1.

Δ (dB)	1	1	1
Δ' (dB)	2	1.5	3

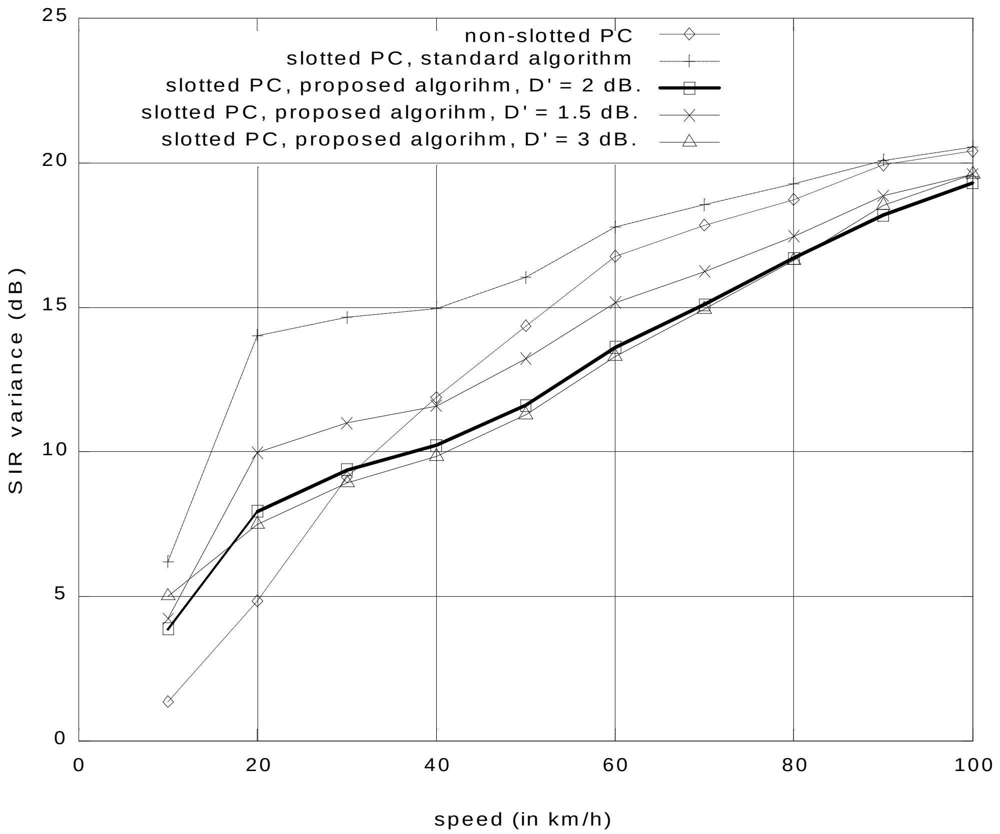

Figure 1. SIR variance as a function of speed. Comparison of different steps for proposed algorithm. Pedestrian A. TGP = 160. TGL = RL = 8. TEP = 4%.

First, we can notice the significant improvement from standard to proposed algorithm, with all three values of Δ'. We also notice a good improvement from Δ' = 1.5 dB to Δ' = 2 dB.

The other aspect we observe is that for Δ’ = 3 dB, the performances are similar to the ones with Δ’ = 2 dB, except at low speeds where a 3dB recovery step degrades performances.
Therefore, a 2 dB recovery step seems to be a good compromise between the performances at low and high speeds.

For medium and large speeds, proposed algorithm in compressed mode is even better than in non-compressed mode, since a power control step larger than 1 dB is better for these speeds (in non-compressed mode, the SIR variance at 50 km/h is 14 dB with a 1 dB step, 11 dB with a 1.5 dB step, 9 dB with a 2 dB step, and 8 dB for a 3 dB step).

2.2 Transmission gap length

Performances of the algorithm with other possible values of TGL are shown on Figure 2.

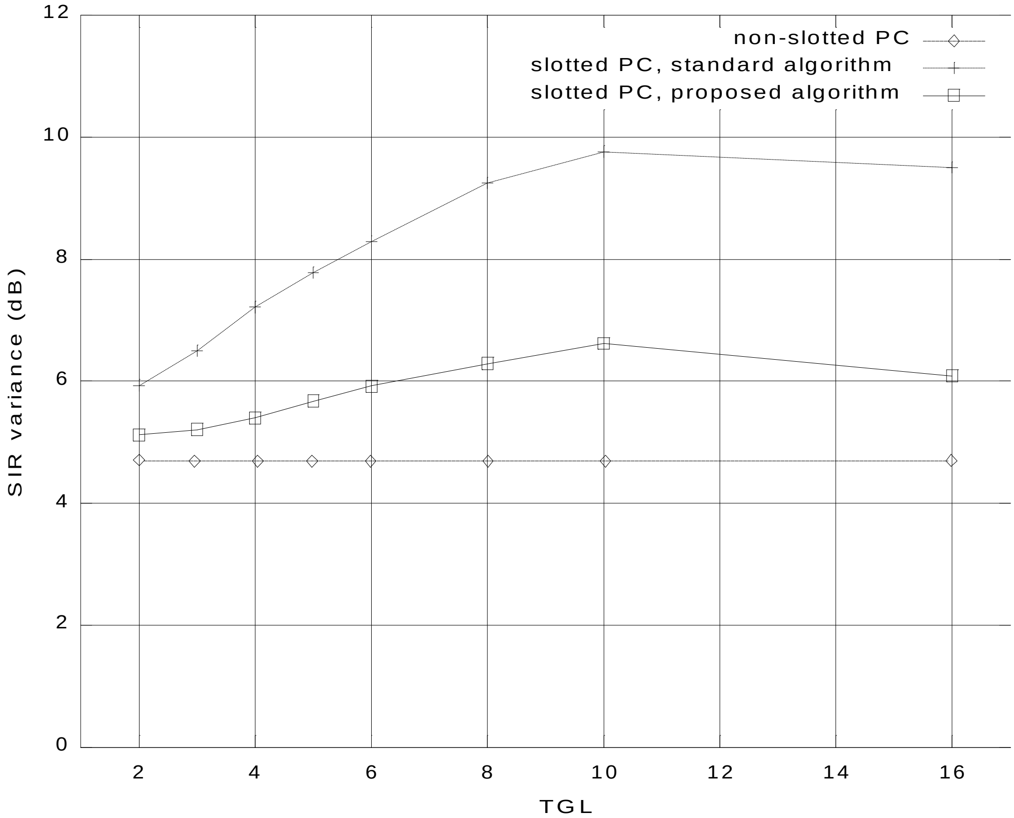

Figure 2. SIR variance as a function of TGL. Pedestrian A.

RL = TGL. UE speed = 20 km/h. TEP = 4%.

First, we can notice that the proposed algorithm leads to better performances than the standard algorithm for all values of TGL. For TGL smaller than 10 slots, performances in compressed mode decreases while TGL increases. For TGL greater than 10 slots, performances remain more or less constant. Indeed, if the transmission gap is large, it lasts longer than the channel fast fading typical variation time at 20 km/h, and therefore, the degradations due to compressed mode remain of the same order.

Numerous other simulation results are available in [2].

3. Conclusion

Numerous other simulations not presented in this paper have been run. Especially, different values of RL have been tested. We consider that the best parameters choice for the proposed algorithm is a recovery step Δ' twice as large as the normal power control step Δ (**Δ'=2Δ**), for a recovery period as long as transmission gap (**RL=TGL**). For this set of values, the proposed algorithm for uplink (resp. downlink) closed loop power control in downlink (resp. uplink) compressed mode is very efficient and useful.

References

[1] TSGR1 4 (99)342. Improved closed loop power control in compressed mode. Alcatel. (04/1999).

[2] TSGR1 5 (99)542. Additional results for fixed-step closed loop power control algorithm in slotted mode. Alcatel. (05/1999).