TSG-RAN Working Group 1 meeting #7
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Agenda Item: Ad Hoc 16 (measurement)

Source: Siemens

Title: Downlink interference measurement method using reserved code

Document for: decision

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1 Introduction

In [1] the proponents introduce a measurement technique for downlink interference and mention the importance of this measurement to SIR estimation. It is emphasised that this measurement consider intra-cell orthogonality and that it be accurate. In that Tdoc it is recommend to use a "missing code" technique to make the measurement.

Following the OHG initiative and changes to the downlink structure, accurate measurement of downlink interference and SIR is less difficult, at least on the primary scrambling code and when sharing common pilots. However there is another effect where using a "missing code" measurement system can aid downlink reception. Considering this effect adds weight to the argument for adopting a "missing code" interference estimate facility.

2 The Problem

Consider the operation of a RAKE receiver such as is commonly employed in CDMA systems. We shall begin with the basic theory for such systems.
In such a receiver each finger typically has a timing tracker function to set the sampling instant based on received values. In the case of a single code system the power of the de-spread signal is highest at the ideal sample point. This is approximated when the wanted signal is relatively powerful or when power on other codes is well suppressed.

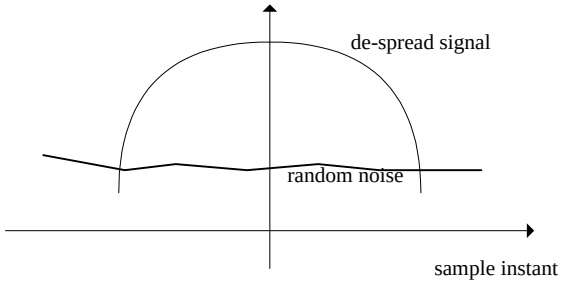

Figure 1 -simple power curve due to incorrect sampling instant

A time tracking loop may be made by taking the difference in power between early and late de-spreaders spaced about the prompt sampling instant. The estimates of de-spread power drop with time difference from the ideal sampling instant. A decision variable showing the classical S-curve can drive a feedback loop.

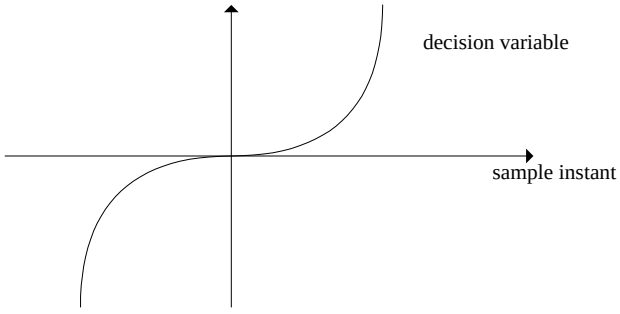

Figure 2 -S-curve from early-late time tracking loop

However in the case with a heavily loaded downlink, especially where some codes are at much higher power than the wanted code, the effect of sampling at a non-ideal instant for each finger is different. At times which are not ideal cross-talk occurs between codes, this leads to increased de-spread power estimates. This is due to loss of orthogonality.

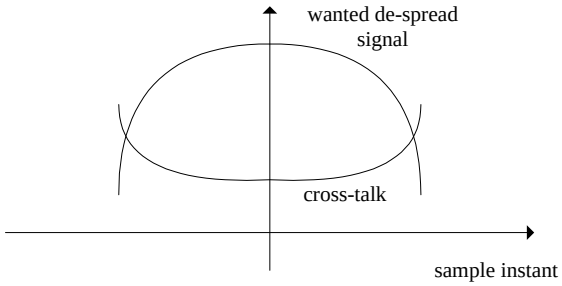

Figure 3 - imperfect orthogonality causes cross-talk

When this occurs the shape of the control curve changes. What was an S-curve which could be treated in approximately linear fashion may change slope, flatten out or even reverse.

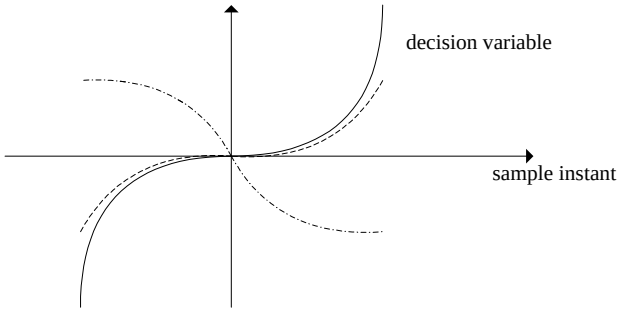

Figure 4 - changing shape of control curve

In the latter case the timing control loop would push the finger off the wanted sampling instant. When the curve is near flatness the control loop is ineffective.

3 A Solution

What is wanted is some sort of compensation for the effect of cross-talk. Suppose the cross-talk power could be estimated?

This can be done with a "missing code" scheme. A de-spreader using a code which always had no transmitted code power would estimate the value of both non-coherent and cross-talk powers. The details of such a scheme would be a matter for the implementor.

All that would need to be standardised would be a reserved code on which no power was allowed to be transmitted. A likely candidate would be the SF=256 code which is paired with the paging indicator channel (PICH).

4 Conclusion

In order to allow such methods of estimating cross-talk due to imperfect sampling times a "missing code" scheme may be used.

To enable this an unused reserved channelisation code would be needed. This could also be used for SIR estimation.

To quote from [1]:

We propose that at least the “unused reserved channelisation code” method should be possible to use, meaning that the UEs should get information that a code is unused. Similarly to the BCH, the actual channelisation code to use is hard-wired, so no signalling is needed to say what code to use for this measurement.

5 References

1 R1-99644, Proposal for downlink interference measurement method, revised, source Ericsson.