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Source: **Motorola**
Title: **Observations on Interfering Signal Simplification for ARP Testing**
Document for: **Discussion**

1. Introduction

As discussed in Section 9 of the SAIC Feasibility Study Technical Report (TR, [1]), there are a number of potential approaches to test apparatus design for ARP assessment. Figures 9-9 and 9-10 of the TR show two examples – one based on the 'conventional' approach of combining multiple discrete signal generators and fading channel emulators at radio frequency, and a second method based on synthesising the entire interfering waveform at baseband prior to up-conversion to RF.[1]

As the number of discrete faded interferers and residual interferers increases, the signal processing complexity of the baseband approach rises, and this can be problematic if the component hardware (DSP's etc.) is under-specified. The complexity (and therefore cost) of the conventional approach can, however, be more significantly impacted by the number of interfering source signals given the need for multiple discrete fading channel emulator units, frequency conversion apparatus, combiners, noise-generators etc.

Accordingly, as part of an overall simplification effort, it may be beneficial to consider how the number of signal sources in the TR interferer models can be reduced. Nevertheless, as directed by Section 9.1 of the TR, it is also important to minimise any deviation from the original models. This contribution provides an example of one approach to the problem of source reduction which may stimulate further discussion of the topic before and during GERAN#19.

2. Reduced Complexity Model and Simulation Results

Taking the System Configuration 2 model (40% load) as an example, the standard interferer model is defined in Table 5-1 of the TR. One potential approach to simplification would be to consider the alternative model defined in Table 1, comprising two discrete faded co-channel interferers and a single co-channel residual interferer.

Interferer	I_1	I_2	I_r
Relative Power (dB)[2]	0	-6.0	-5.5
Description	Single GMSK co-channel interferer with randomly selected TSC excluding TSC 0.	Single GMSK co-channel interferer with randomly selected TSC including TSC 0.	Residual interferer modelled as $c0$-filtered AWGN.

Table 1 – Example interferer model simplification – Configuration 2 (40% load).

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[1] *Other approaches, including hybrids of the two methods described in the TR, are also feasible.*

[2] *Define with respect to the dominant interferer,* I_1.

Obviously, this alternate model differs significantly from the original TR definition, since the adjacent channel interferers are eliminated, along with the third co-channel interferer. Despite this, it is interesting to compare the resulting C/I and DIR distributions from the original TR model and this example simplified model. Simulated results appear in Figures 1-3 of Annex A (corresponding to verification step 7 of the alignment process).

Figure 1 shows the cumulative density function (CDF) of the simulated carrier to interferer ratio (C/I) for a mean C/I ratio of 0dB for both the standard Configuration 2 TR model ('TR') and the alternate model ('Alt.') of Table 1.[3] It can be observed that the two distributions are closely aligned. Similarly, Figure 2 shows that the DIR distributions for both the TR and alternate models are also aligned. In fact, as shown in Figure 3, in addition to the alignment of the marginal distributions, the joint distributions of (C/I,DIR) observed from the TR and alternate models are also quite similar.

3. Discussion

It can be seen from Annex A that the alternate reduced complexity model defined in Table 1 appears capable of accurately replicating the joint (C/I,DIR) distribution of the full TR model. If one accepts that the pair (C/I,DIR) is sufficient to abstract the relationship between the observed desired and interfering signal states and the receiver raw bit error performance (and ultimately frame erasure performance) this suggests that a model such as that of Table 1 might be a sufficiently accurate method of emulating the full TR model.

Nevertheless, the alternate model contains no adjacent channel interferer components, and this has been identified by some companies as an important component of any practical test configuration.[4] Further, even though the joint (C/I,DIR) distribution is properly modelled, other statistics (such as DIR_2) may not be fully captured (although this may present a challenge for any reduced-complexity approach). Most significantly, there is no guarantee that when offered to a *practical* advanced receiver, the reduced complexity model will not lead to significantly different performance compared to the full TR model (which would deviate from the directions provided by the TR). These issues require further discussion.

4. Conclusions

A example of a reduced complexity interference model for Configuration 2 is described which has similar C/I and DIR statistics to the original TR model. This contribution is not intended, however, to propose a particular reduced-complexity model for use in practical ARP performance assessment, but rather to stimulate further discussion of how such a simplified model might be achieved, and what observable statistics would be important in defining its suitability as a replacement for the interferer models used in the original SAIC Technical Report. The comments of other interested companies are welcome.

5. References

[1] GP-032675, Rapporteur, "DRAFT Feasibility Study on Single Antenna Interference Cancellation (SAIC) for GSM Networks"

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[3] *For the purpose of model comparison, and in keeping with the original TR assumption, an adjacent channel rejection value of 18dB is assumed for the TR model when computing C/I and DIR.*

[4] *In fact, simulations indicated the probability that the discrete adjacent channel interferer was dominant to be less than 1%.*

6. Annex A

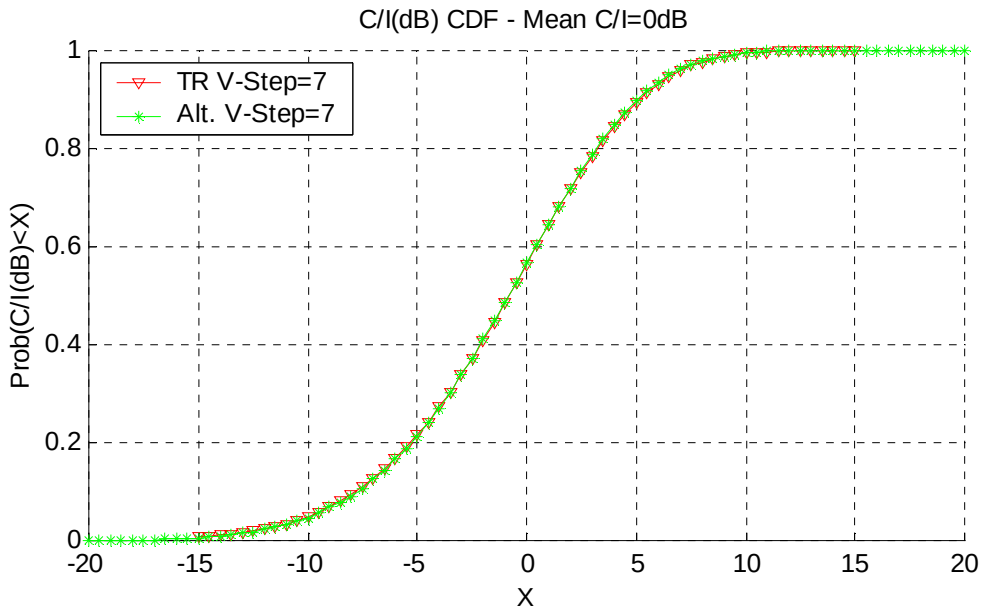

Figure 1 – Comparison of C/I distribution of TR and alternate (Table 1) model.

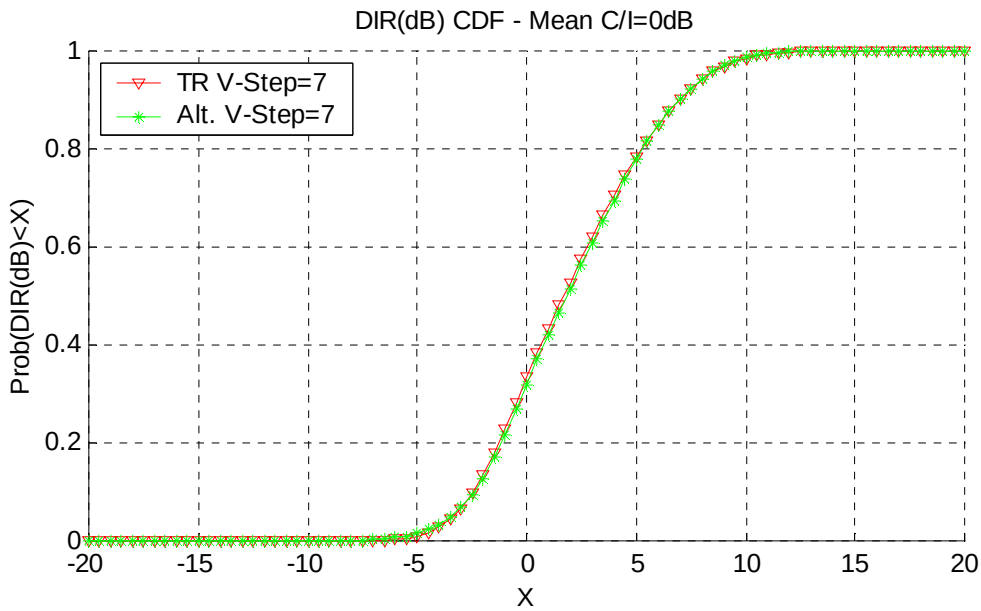

Figure 2 – Comparison of DIR distribution of TR and alternate (Table 1) model.

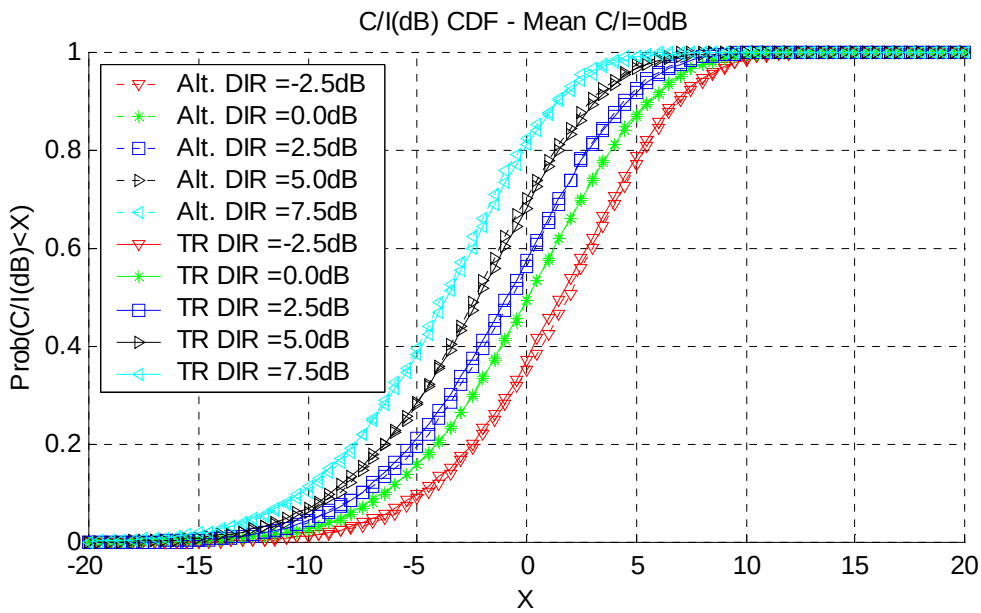

Figure 3 – Comparison of joint (C/I,DIR) distribution of TR and alternate (Table 1) model.