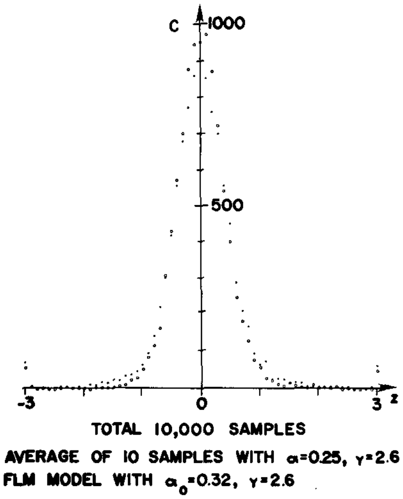

Fig. 3. Histogram for moderate-level noise.

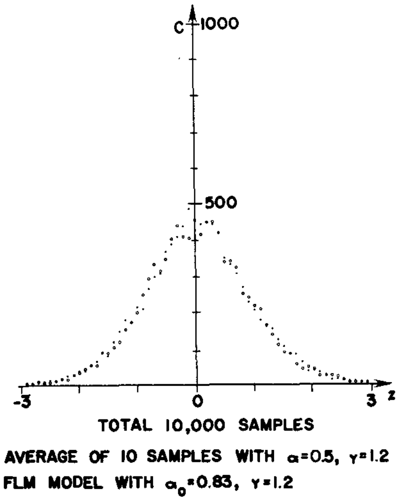

Fig. 4. Histogram for low-level noise.

and FLM noise with α_o and R_o determined by this method. In these figures, z represents the value of the random variable and C represents the count for each interval of width 0.1. For $N = 10$, it is apparent that the agreement is excellent.

These relationships are expected to be valid for values of $\alpha_o \leqslant 1$. As $\alpha_o \rightarrow 2$, the power-Rayleigh pdf tends toward the nonimpulsive Rayleigh pdf of the envelope of narrow-band Gaussian noise.

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Revisions to "Theory of Spread-Spectrum Communications—A Tutorial"

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We would like to provide come clarifications and a list of errata for the paper.[1] In the derivation of (11) for the SNR it is assumed that the set of coefficients S_{ik} are independent, identically distributed, random variables assuming the values of $\pm s$, each with a probability of one half. Furthermore, it is assumed that for every information symbol (transmitted each T seconds), a statistically independent set $\{S_{ik}\}$ is chosen. The meaning of $E(U_i|S_i)$ in (7) is then to be interpreted in the following manner. Given that the information dictates the transmission of say, symbol $S_i(t)$, $0 \leqslant t \leqslant T$, then n coefficients S_{ik}, $i \leqslant k \leqslant n$ are chosen randomly as above. (Naturally, the receiver is assumed to have access to each particular set of random sequences for correlation despreading.) Hence, in computing $E(U_i|S_i)$, even though the ith information symbol is specified at the transmitter, the pattern of coefficients used to send it is random for each transmission. For example, even if we send the *same* ith information symbol repeatedly, the pattern S_{ik} used to transmit it is randomly chosen from symbol to symbol. The randomness is necessary to "hide" the information. (In practice, of course, the need to have available a replica of all of the random sequences requires that we use "pseudorandom" sequences which have properties discussed in the paper.) Using the above interpretation, (7)–(9) follow readily by averaging over the ensembles as defined. It also follows that

$$E(U_i \,|\, S_j) = 0, \qquad j \neq i.$$

Finally, (10) should read

$$\operatorname{var}(U_i \,|\, S_m) = \frac{E_s}{n} E_j + \frac{{E_s}^2}{n}, \qquad m \neq i \tag{10}$$

and (11) is then

$$\text{SNR} \triangleq \sum_{m=1}^{D} \frac{E^2(U_i \,|\, S_m)}{\operatorname{var}(U_i \,|\, S_m)} P(S_m) = \frac{E_s}{E_J} \frac{n}{D}. \tag{11}$$

The following is a list of typographical errata:

1) On p. 857, $\sqrt{E_b}/T$ and $\sqrt{E_J}/T$ should be $\sqrt{E_b/T}$ and $\sqrt{E_J/T}$, respectively.

2) On p. 862, in the third and fourth sentences, $2r - 2$, $r - 2$, and 198 should be $2r - 1$, $r - 1$, and 199, respectively.

3) Fig. 12 was computed for $N = 1000$.

4) In Fig. 15(a), $p(t - jT_c)$ and $p(t - (2N_c - 1)T_c)$ should

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[1] R. L. Pickholtz, D. L. Schilling, and L. B. Milstein, *IEEE Trans. Commun.*, vol. COM-30, pp. 855–884, May 1982.

have T_c replaced with $T_c/2$. The same change should be made to $p(t - kT_c)$ in Fig. 17.

5) On p. 872 in the last two paragraphs, N should be replaced with r.

6) The approximate average synchronization times given by (47)–(50), valid for $P_F \ll 1$, all should have brackets around the expression multiplying the number of unknown cells to be searched (either 2Δ or $2L$). Also, the first terms on the RHS of (48) and (50) should have L replaced with $L - 1$.

Therefore, they should read as follows:

$$\bar{T}_{s/\Delta} = 2\Delta\left[(\lambda + \tfrac{1}{2})T_c + \frac{\lambda T_c P_F}{(1-P_F)^2}\right] \tag{47}$$

$$\bar{T}_s = (L-1)\left[(\lambda + \tfrac{1}{2})T_c + \frac{\lambda T_c P_F}{(1-P_F)^2}\right] \tag{48}$$

$$\bar{T}_{s/L} = 2L\left[(\lambda + \tfrac{1}{2})T_c + \frac{\lambda T_c P_F}{(1-P_F)^2}\right] \tag{49}$$

$$\bar{T}_{\text{acq}} = (L-1)\left[(\lambda + \tfrac{1}{2})T_c + \frac{\lambda T_c P_F}{(1-P_F)^2}\right] + \frac{1-P_D}{P_D}2L\left[(\lambda + \tfrac{1}{2})T_c + \frac{\lambda T_c P_F}{(1-P_F)^2}\right]. \tag{50}$$

7) In Fig. 21,

$$p\left(t + \frac{T_c}{2} + T\right)$$

should be

$$p\left(t + \frac{T_c}{2} + \tau\right).$$

8) In (52),

$$\left|R_p\left(\tau + \frac{T_c}{2}\right)\right|$$

should read

$$\left|R_p\left(\tau \pm \frac{T_c}{2}\right)\right|.$$

9) In Fig. 22, replace

$$R_p\left(\tau \pm \frac{T_c}{2}\right)$$

with

$$\left|R_p\left(\tau \pm \frac{T_c}{2}\right)\right|.$$

10) In (54),

$$d(t)g(t)\left|p(t)p\left(t + \tau + \frac{T_c}{2}\right)\right| + d(t)g(t)\left|p(t)p\left(t + \tau - \frac{T_c}{2}\right)\right|$$

should be

$$\left\{d(t)\bar{g}(t)p(t)p\left(t + \tau + \frac{T_c}{2}\right) + d(t)g(t) \cdot p(t)p\left(t + \tau - \frac{T_c}{2}\right)\right\} \cdot \cos(w_0 t + \theta).$$

11) The RHS of (55) should be

$$\bar{g}(t)\left|R_p\left(\tau + \frac{T_c}{2}\right)\right| + g(t)\left|R_p\left(\tau - \frac{T_c}{2}\right)\right|.$$

12) In (56),

$$g(t)\left|R_p\left(\tau - \frac{T_c}{2}\right)\right| - \bar{g}(t)\left|R_p\left(\tau - \frac{T_c}{2}\right)\right|$$

should be

$$\bar{g}(t)\left|R_p\left(\tau + \frac{T_c}{2}\right)\right| - g(t)\left|R_p\left(\tau - \frac{T_c}{2}\right)\right|.$$

13) Equation (57) should be multiplied by −1 (minus one).

14) In Fig. 23(a), the "AND" and "OR" blocks should be a multiplier and adder, respectively.

ACKNOWLEDGMENT

The authors would like to thank Prof. G. Einarsson and S. Shitz for bringing some of these points to our attention.

A New Formulation of Spectrum-Orbit Utilization Efficiency for Satellite Communications in Interference-Limited Situations

LIN-SHAN LEE

Abstract—**The spectrum-orbit utilization efficiency of satellite communications is becoming increasingly important. A first attempt is made in this paper to try to formulate the spectrum-orbit utilization efficiency in interference-limited situations by defining the self-efficiency for a single satellite, and the cross-efficiency and coordination efficiency for each pair of adjacent satellites. The various technical aspects and complicated interference considerations relevant to spectrum-orbit utilization can all be reasonably reflected by these simple efficiency parameters. They tell the behavior of each satellite by itself and with its neighbors. Such a formulation is therefore very useful for improving the spectrum-orbit utilization efficiency in future satellite communications.**

I. INTRODUCTION

The spectrum-orbit is a natural resource which should be utilized efficiently to meet the rapidly growing needs for

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