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14. Abstract/Notes

This review is a compilation of Brazilian contributions to the area of URSI's Commission C (Signals and Systems), published in English or French in the period from October 1983 to September 1986. It is focussed on academic contributions in the field of telecommunications.

15. Remarks

RESUMO

Este relatório é uma compilação de contribuições brasileiras na área da Comissão C da URSI (Sinais e Sistemas), publicadas em Inglês ou Francês no período de outubro de 1983 a setembro de 1986. Salienta as contribuições acadêmicas na área de telecomunicações.

SUMMARY

URSI – COMMISSION C – SIGNALS AND SYSTEMS

REPORT ON CONTRIBUTIONS IN BRAZIL (1984–1986)

by Max H.M. Costa

INTRODUCTION:

This review summarizes results obtained in Brazil within the
area of Commission C and published in English or French in the period from
Oct. 1983 to Sept. 1986. It has been edited from material sent to the reviewer
by researchers active in the field. It is in no way an exhaustive list and
valuable contributions have certainly been omitted for lack of reports. Also,
it does not reference a large number of results which were published in
Portuguese[†]. The report is focussed on academic contributions in the field
of telecommunications.

1. DIGITAL SIGNAL PROCESSING:

A modification of instantaneously companded delta coders, which
causes the effect of bit errors to diminish with time, was investigated by
Alcaim (Sept. 1984). In noisy channels, the performance of the modified coder
is superior to that of continuously variable slope delta modulation (CVSD)
and its dynamic range much wider.

The average power density spectrum of the readback voltage from
particulate media was investigated by Anzaloni, A. and Barbosa, L. (Sept.
1984). A new formulation was proposed that tied variations in gain and noise
to the frequency of the written signal.

[†] The main forum for discussion and publication of results in Signals and
Systems in Brazil is the Brazilian Symposium on Telecommunications, held
every year during the first week of September. The full papers presented
are published in proceedings, which can be ordered from Sociedade Brasi-
leira de Telecomunicações, Caixa Postal 38076, Rio de Janeiro, RJ 22452
Brasil.

The benefits independently due to the quantizer and to the predictor in the CCITT 32 kbps ADPCM codec were investigated (Araujo et al., Feb. 1986). It was shown that most of the performance gain over simple ADPCM is due to the adaptive predictor.

2. CIRCUITS AND SYSTEMS:

A Kalman-filter-based adaptive echo cancellation structure was proposed for data transmission, using the so-called fast Kalman filtering algorithms (Coelho and Andrade, Dec. 1985). Computer simulations were used to evaluate its performance. They show that the fast Kalman structure performs better than gradient algorithms and is less sensitive to double talking.

The increasing use of voice communication networks for data transmission has motivated simulation studies of the performance of delta coders fed with data signals (Nunes, Dec. 1985). Four delta coders working at various data rates were investigated.

3. INFORMATION THEORY:

The similarity between Shannon's entropy power inequality and geometry's Brünn-Minkowski inequality was pointed out (Costa and Cover, Nov. 1984). This similarity relates results in information theory to others in geometry. An example was given that relates the isoperimetric inequality with an inequality involving the trace of the Fisher information matrix.

From the fact that finding good linear unit-memory codes is equivalent to solving a knapsack problem, a cryptosystem using these codes was proposed (Palazzo Jr., Apr. 1985).

Several cryptographic schemes using trellis codes were proposed and analyzed (Palazzo Jr., Sept. 1985).

Still in the cryptography area, a distributed file system was proposed (Fraga and Powell, Dec. 1985) that tolerates a certain number of intrusions without violating data security.

A new entropy power inequality for the case where one of the random variables involved is Gaussian was found (Costa, Nov. 1985). This new inequality has applications in multiple user information theory. In one application, new extreme points of the capacity region of the Gaussian interference channel were established (Costa, Sept. 1985).

Using the concept of generalized entropies, Taneja (Dec. 1985) has obtained upper and lower bounds on the generalized average lengths of best 1:1 codes, introduced by Leung-Yan-Cheong and Cover in 1978.

4. CODING AND MODULATION:

A class of t error-correcting pseudocyclic multilevel codes was introduced (da Rocha Jr., May 1984). These are maximum-distance separable random-error-correcting codes with q^m symbols, where q is prime.

An efficient algorithm for finding good convolutional codes with any rate and short constraint lengths was presented (Palazzo Jr., Sept. 1984).

By properly combining the rates of distinct sources, an efficient use of a communication channel was proposed, with only a slight degradation on BER when compared to conventional digital modulation under the same bandwidth constraint (Palazzo Jr., Oct. 1984).

Finite field transforms and symmetry groups were investigated by Campello de Souza (Oct. 1985).

It was shown that finding good linear unit-memory codes is a knapsack problem (Palazzo Jr., Apr. 1985A).

A detailed mathematical characterization set on firm grounds the equivalence between short constraint length convolutional codes and the information flow in data networks (Palazzo Jr., June 1985). A relationship between the minimum distance of the codes and the maximum flow in networks was established (Palazzo Jr., Sept. 1986).

Using the average distortion function criterion, several good linear unequal error protection convolutional codes were proposed (Palazzo Jr., R., June 1985A).

The coding properties of a binary array of numbers were investigated (da Rocha Jr., V.C., Oct. 1985). A recursive procedure for array generation was presented, as well as a conjecture on the minimum distance of the codes obtained, which turn out to be circulant and homogeneous.

The existence of periodically time varying partial response signals better than time invariant ones (under the MLSE criterion) was shown (Palazzo Jr., R., Dec. 1985).

A systematic procedure was developed for computer optimization of rate k/n convolutional codes which maximizes the free Euclidean distance between channel sequences produced by encoded modulators (Bezerra, J.B. and Arantes, D.S., Dec. 1985).

Low complexity threshold decoders were presented for block or convolutional orthogonal codes with soft decisions (Arantes, D.S. et al., Dec. 1985). The simple scheme presented can achieve coding gains of about 1.5 dB with respect to hard decision decoders, at high data rates.

A method was developed for spectral calculation of q-ary digital signals encoded by p-ary convolutional codes of any rate k/n (Bezerra, J.B. and Arantes, D.S., Mar. 1986). The encoder is modelled as a finite-state sequential machine, which results in very simple computer implementation.

An enumerator function was presented for periodically time varying nonlinear trellis codes which generalizes all previous enumerator functions for convolutional codes (Palazzo Jr., R., June 1986).

5. SATELLITE COMMUNICATION:

Extensive analysis was made of the interactions between FDM/FM carriers and digital carriers that share a memoryless nonlinear repeater in joint work of Albuquerque, Shimbo and Nguyen, while the first was at COMSAT Laboratories, on leave from Pontifícia Universidade Católica of Rio de Janeiro. Envelope fluctuations due to filtering of a digital carrier produce noise in the baseband of the FDM/FM carriers. In one contribution (Albuquerque et al., Apr. 1984), discrete and continuous power spectral densities of this noise were computed.

With several filtered digital carriers and an FM/FDM carrier sharing the repeater, the discrete component of the noise power spectrum in the FDM baseband was evaluated (Albuquerque et al., Apr. 1984A), by means of a power series expansion.

A simplified analysis and simulation results were given of the BER degradation in one digital carrier due to envelope fluctuations of other digital carriers present at the repeater (Albuquerque et al., May 1984).

When digital carriers are in burst mode, their envelope fluctuations at the repeater input are due both to filtering and to their burst nature. The discrete noise power spectral density in the baseband of an FDM/FM carrier due to envelope fluctuations in burst-mode digital carriers was computed (Albuquerque et al., Nov. 1984).

A review of these modulation transfer problems was offered by Shimbo et al. (Apr. 1986).

An analysis was made of a mixed frame-rate and line-rate TV energy dispersal waveform as a means of reducing interference effects into both narrow-band digital carriers and terrestrial FDM/FM carriers (Albuquerque et al., Sept. 1986).

An integer programming model to allocate channels and polarizations to direct broadcasting geostationary satellites was proposed by Fortes (July, 1986). A computer routine based on this model is part of the official software package of the 1983 Regional Administrative Radio Conference - RARC-BC-SAT/83.

6. SPREAD SPECTRUM TECHNOLOGIES:

Sampaio-Neto and Scholtz (Oct. 1983) have described the design of a code-tracking loop employing generalized correlators, a variation of the usual correlator circuit in which realizable filters are inserted in each input arm. Tracking performance was optimized by filter design for operation in the presence of strong colored interference of known spectral content. Performance results were contributed. In another article (Sampaio-Neto and Scholtz, Sept. 1985), these authors investigate the optimal design of a precorrelation filtering system for use in noncoherent code-tracking loops, in the presence of colored noise.

7. COMMUNICATION NETWORKS:

Two efficient polling (token) schemes, which provide multiple-access coordination for local area networks, were described, analyzed and compared (Rubin and de Moraes, Nov. 1983). Interesting results were obtained when average message waiting times were compared, in the cases of balanced and highly unbalanced network traffic.

A detailed analysis of a TDMA access-control scheme operating under a nonpreemptive message-based priority discipline was contributed (de Moraes and Rubin, May 1984).

An efficient algorithm was proposed for the optimal solution of an integrated routing and flow control problem (Gerla et al., May 1984), where direct input rate control is assumed and the objective function has an embedded fairness property.

A review of several fairness criteria proposed for wide-area packet switching computer networks was presented (Gerla et al., June 1985). A taxonomy was proposed to classify and compare the various schemes.

Application of Petri nets in the validation of communication protocols represented in CCITT's SDL language was proposed and investigated (Motoyama et al., Dec. 1985).

A combined performance analysis of joint polling/convolutional coding schemes in multiple access communication channels was given (de Moraes and Palazzo Jr., Apr. 1986). The expressions relating network throughput, code rate and BER were established.

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