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Title of the talk: Iterative Techniques for Cooperative Communications Allowing Intra-Link Errors

Abstract: This talk is started by reviewing our previous work for MIMO turbo equalization for broadband single carrier signaling. Then, a simple structure that combines turbo equalization and decoding of correlated sources in multipath-rich multiuser Rayleigh fading multiple access channels (MAC), where the correlation between the sources is exploited by vertical iterations (VI) between the decoders. The bit-flipping model with a flipping probability p is used to express the correlation. The proposed simple structure, spatial concatenated codes for correlated sources, can achieve turbo-like performance over MAC channels suffering from severe inter-symbol interference (ISI) even with short memory convolutional codes. First of all, to achieve turbo-like performance we introduce VIs to exploit the knowledge about the source correlation by exchanging extrinsic log-likelihood ratio (LLR) between the decoders. We then add a rate-1 doped accumulator (D-ACC) to flexibly adapt the variation of correlations between the sources. We found that D-ACC makes it possible to achieve better matching between turbo equalizer and decoder's extrinsic information transfer (EXIT) curves, and further helps the equalizer's EXIT curve reach a point very close to the (1.0,1.0) mutual information (MI) point. A comprehensive EXIT chart analysis is presented to evaluate the convergence behavior of the proposed structure. The results of computer simulations confirm that in multipath-rich environments the proposed structure can achieve excellent performances, 1.02–1.28 dB away from the Slepian-Wolf-Shannon limit, at 1% outage probability with $0 \leq p <$ 0:5.

After a short break, this talk focuses on a very coding technique for relay systems without equalization. In relay systems, the probability of error occurring in the source-relay link can be viewed as representing correlation between the source and the relay. This talk proposes a simple iterative decoding technique, accumulator-assisted distributed turbo coding (ACC-DTC) using 2-state (memory-1) convolutional codes, where the correlation knowledge between the source and the relay is estimated, and exploited in the destination. The relay only extracts the un-coded source bits, interleaves, re-encodes, and forward it to the destination. To adapt the correlation variation due to the link quality between the source and the relay, we add a D-ACC to assist the decoder's extrinsic information transfer (EXIT) curve to reach

a point very close to (1,1) mutual information (MI) and avoid error floor. The results obtained via a series of computer simulations conducted to evaluate convergence property and bit-error-rate (BER) performance show that the proposed ACC-DTC provides much better BER performances compared to the conventional distributed turbo code (DTC) and its advanced version, super turbo codes (SuTC).

Some theoretical basics supporting the techniques presented in this lecture, such as EXIT chart analysis, EXIT-based code design, and convergence property and mutual information will be provided prior to the key part of the lecture, but the timing of this very basic part depends on the reaction of the audience to the instructor's presentations. Also, some key questions will be spread in this lecture to verify the proper understanding of the participants.

Short Bio

Tad MATSUMOTO received his B.S., M.S., and Ph.D. degrees from Keio University, Yokohama, Japan, in 1978, 1980, and 1991, respectively, all in electrical engineering. He joined Nippon Telegraph and Telephone Corporation (NTT) in April 1980. Since he engaged in NTT, he was involved in a lot of research and development projects, all for mobile wireless communications systems. In July 1992, he transferred to NTT DoCoMo, where he researched Code-Division Multiple-Access techniques for Mobile Communication Systems. In April 1994, he transferred to NTT America, where he served as a Senior Technical Advisor of a joint project between NTT and NEXTEL Communications. In March 1996, he returned to NTT DoCoMo, where he served as a Head of the Radio Signal Processing Laboratory until August of 2001; He worked on adaptive signal processing, multiple-input multiple-output turbo signal detection, interference cancellation, and space-time coding techniques for broadband mobile communications. In March 2002, he moved to University of Oulu, Finland, where he served as a Professor at Centre for Wireless Communications. In 2006, he served as a Visiting Professor at Ilmenau University of Technology, Ilmenau, Germany, funded by the German MERCATOR Visiting Professorship Program. Since April 2007, he has been serving as a Professor at Japan Advanced Institute of Science and Technology (JAIST), Japan, while also keeping the position at University of Oulu.
Prof. Matsumoto has been appointed as a Finland Distinguished Professor for a period from January 2008 to December 2012, funded by the Finnish National Technology Agency (Tekes) and Finnish Academy, under which he preserves the rights to participate in and apply to European and Finnish national projects. Prof. Matsumoto is a recipient of IEEE VTS Outstanding Service Award (2001), Nokia Foundation Visiting Fellow Scholarship Award (2002), IEEE Japan Council Award for Distinguished Service to the Society (2006), IEEE Vehicular Technology Society James R. Evans Avant Garde Award (2006), and Thuringen State Research Award for Advanced Applied Science (2006), 2007 Best Paper Award of Institute of Electrical, Communication, and Information Engineers of Japan (2008), Telecom System Technology Award by the Telecommunications Advancement Foundation (2009), and IEEE Communication Letters Exemplifying Reviewer Award (2011). He is a Fellow of IEEE and a Member of IEICE. He has been appointed as an IEEE Distinguished Lecturer during the period 2011-2013.