

Frequency Domain Turbo Equalization for Single Carrier Signaling, and its Information Theoretic Considerations

Professor Tad Matsumoto, Center for Wireless Communications, University of Oulu and Japan Advanced Institute of Science and Technology (JAIST)

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ABSTRACT: The goal of this talk is to provide participants with understanding of "turbo equalization", from its fundamentals to information theoretic issues and applications. Technological fundamentals of turbo equalization for broadband single carrier signaling, exemplifying the turbo principle, are provided in this talk with an intensified focus on the technique, frequency domain soft cancellation and minimum mean squared error filtering (FD SC-MMSE) equalization, as a practical and flexible platform. FD SC-MMSE can reduce the computational complexity to the same level as that required by OFDM signaling. FD SC-MMSE is then applied to the multi-user multiple input multiple output (MU-MIMO) cases as a reasonable extension of the technique.

The talk will then change the focus to more information theoretic issues, covering convergence property analysis of turbo equalization using the extrinsic information transfer (EXIT) chart as a tool for evaluating the efficiency of mutual information exchange. Asymptotic and convergence properties of the FD SC-MMSE turbo equalization are analyzed. Adaptive coded transmission concept based on EXIT analysis is also provided, of which aim is to achieve the best matching between code and equalizer. Finally, the latest results of our research work, (1) repetition coded Bit Interleaved Coded Modulation with Iterative Detection (BICM-ID) with extended mapping and irregular degree allocations, and (2) Probabilistic Data Association based convergence analysis of equalization systems having internal and global turbo loops are briefly introduced.

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 Finnish 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), and 2007 Best Paper Award of Institute of Electrical, Communication, and Information Engineers of Japan.