

# UEP TURBO CODES

Hang Nguyen

## I. SUMMARY

One particular aspect in optimizing system performance is considering the multi-layer analysis. Low rate voice and video applications have specific unequal error protection properties that exploited at the physical layer, would certainly enhance the system efficiency. Thus, the design of an unequal error protection (UEP) turbo code has been proposed.

Associating unequal error protection properties with highly efficient turbo codes can prove very performing. Turbo codes have been widely discussed in scientific literature and adopted in many mobile standards. We propose their evolution through the embedding of UEP concepts into their parallel and serial structures, with the parallel progressive hierarchical turbo codes (PPHTC) and the serial progressive hierarchical turbo codes (SPHTC). The ideas behind the parallel and serial turbo structures have been patented. We describe in detail their architectures for the particular case of two dimensions encoding/decoding, as well as for their generalized n-dimensions encoding/decoding. We also highlight a particular property in the iterative turbo decoding through mathematical development. The codes iterative behaviors and properties are analyzed theoretically, as well as through computer simulations. Their performances are evaluated on two different platforms, based on random and LTE elements. Also, the results are given for static and dynamic environments.

Their UEP behavior is particularly interesting compared with benchmark turbo and convolutional codes. The parallel code's behavior in certain use cases specific to PMR (Private Mobile Radio) voice transmission has been analyzed. The idea presented in this research work has been also patented. Thus, the PPHTC is inserted in the LTE (Long Term Evolution standard) architecture, through the proposal of a new perspective modulation and coding scheme (MCS). This new approach proposes the use of an embedded UEP MCS that would correlate PPHTC and modulation performances to the end-user perceived voice quality. The voice transmission UEP MCS's performances are compared with two LTE benchmarks. Results are presented in terms of physical layer error rates, as well as corresponding measured voice quality. The code utility and advantages are highlighted and provide interesting development perspectives.