UNIVERSITI TEKNOLOGI MARA

PERFORMANCE AND ROBUSTNESS ANALYSIS OF ITERATIVE TURBO DECODING STOPPING CRITERIA FOR HIGH DATA RATE TRANSMISSION

MOHAMAD YUSUF BIN MAT NASIR

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Electrical Engineering)

College of Engineering

December 2022

ABSTRACT

In the early termination of turbo-decoding iterations, stopping criteria are used to minimise the decoding delay without sacrificing performance. However, most stopping criteria have been integrated with low-modulation techniques. To adapt the stopping criteria to high-speed networks, they need to be integrated into high-modulation techniques. Hence, to address this requirement, this research aimed to analyse the performance and robustness of stopping criteria with high-modulation techniques for high data rate transmission contexts. Several stopping criteria, including cross-entropy (CE), the sign-change-ratio (SCR), the hard-decision-aided (HDA) approach and improved minimum descriptive length (IMDL), were integrated and tested using quadrature amplitude modulation (QAM). The research also developed a predefined threshold computation technique using MATLAB as the simulation tool to determine suitable thresholds for iterative turbo-decoding stopping criteria. From the performance analysis, it was found that most performances of the CE, HDA and SCR stopping criteria with QAM were close to the fixed stopping criterion. However, IMDL performances tended to suffer from bit error rate (BER) performance degradation. The study also determined suitable thresholds for CE, SCR and IMDL of 0.01, 0.03 and 0.00001, respectively. The robustness results illustrate that the CE threshold of 0.01 is the most robust stopping criterion, and it is capable of coping with signal-to-noise ratio mismatch. In contrast, the IMDL threshold of 0.00001 is less robust. Choosing suitable stopping criteria can minimise the iteration number and provide good BER performance. The findings from the analysis provided will help future researchers choose the most suitable stopping criteria from the existing options.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for allowing me to embark on my Master's study and complete this long and challenging journey. My gratitude and thanks go to my supervisor Dr. Roslina Mohamad, both my co-supervisor, Dr. Murizah Kassim and Prof Dr. Noritawati Md Tahir

My appreciation goes to the School of Electrical Engineering, College of Engineering, who provided the facilities during the simulation. Special thanks to my colleagues and friends for helping me with this project.

Finally, this thesis is dedicated to my father and mother for their vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulillah.

TABLE OF CONTENTS