University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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MSc (Military Technical College, 2002)
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"Ternary Coding and Triangular Modulation"

Department of Electrical and Computer Engineering

Thursday, August 10, 2017
10:30 A.M.
Engineering and Computer Science Building
Room 468

Supervisory Committee:
Dr. T. Aaron Gulliver, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Xiaodai Dong, Department of Electrical and Computer Engineering, UVic (Member)
Dr. Alex Thomo, Department of Computer Science, UVic (Outside Member)

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Dr. Abu Sesay, Department of Electrical and Computer, University of Calgary

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Dr. Daniel Bub, Department of Psychology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Adaptive modulation is widely employed to improve spectral efficiency. To date, square signal constellations have been used with adaptive modulation. In this dissertation, triangular constellations are considered for this purpose. Triangle quadrature amplitude modulation (TQAM) for both power-of-two and non-power-of-two modulation orders is examined. A technique for TQAM mapping is presented which is better than existing approaches. A new type of TQAM called semi-regular TQAM (S-TQAM) is introduced. Bit error rate expressions for TQAM are derived, and the detection complexity of S-TQAM is compared with that of regular TQAM (R-TQAM) and irregular TQAM (I-TQAM). The performance of S-TQAM over additive white Gaussian noise and Rayleigh fading channels is compared with that of R-TQAM and I-TQAM.

The construction of ternary convolutional codes (TCCs) for ternary phase shift keying (TPSK) modulation is considered. Tables of non-recursive non-systematic TCCs with maximum free distance are given for rates 1=2, 1=3 and 1=4. The conversion from binary data to ternary symbols is investigated. The performance of TCCs with binary to ternary conversion using TPSK is compared with the best BCCs using binary phase shift keying (BPSK).

Ternary trellis coded modulation (TTCM) is introduced. This combines triangular signal constellations with ternary convolutional codes. The performance of TTCM is presented and compared with binary trellis coded modulation (BTCM) which employs square quadrature amplitude modulation (SQAM) and binary convolutional coding. Ternary set partitioning (TSP) for TTCM is introduced and binary to ternary conversion is introduced that is suitable for TTCM. M-ary triangular QAM (TQAM) modulations that compatible with TSP are illustrated. The performance of BTCM is compared with that of TTCM.