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# ON THE DESIGN OF HF RADIO MODEMS

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# ABSTRACT

The subject of this thesis is the design of HF radio modems. The investigation begins with a review of the distortion, noise and interference characteristics specific to modems designed for the HF channel. Based on the findings from this review a number of techniques have been invented which substantially improve HF modem performance.

An HF modem is confronted with distortion and additive perturbations, i.e. noise and interference. In the past statistical simulators were commonly used to guide the design of HF modems but these risked ignoring pertinent aspects of the channel. Replay simulators, constructed by the author overcame this problem. The design study began by examining a recently-developed modem thereby taking advantage of much previous research. The modem, employing a parallel-tone waveform and trellis coded modulation, was uncomplicated yet attained high performance amid HF distortion. Having identified, acquired and, where necessary, constructed all the experimental tools, the problem of combating interference was addressed. A combination of interleaving, windowing and the use of an adaptive decoding metric was found to give excellent performance in narrowband interference. Experiments using impulsive noise revealed that interleaving with an adaptive metric substantially improved performance. It was then demonstrated that a combination of these modifications could be incorporated into one modem giving outstanding performance for a wide range of expected HF channel conditions.

The approach adopted here, of giving priority to an understanding of the channel, has resulted in substantial HF modem performance improvements. These improvements would not have even been recognised if it had not been for the advanced simulation techniques developed.