Space-Time Characterisation and Adaptive Processing of Ionospherically-Propagated HF Signals

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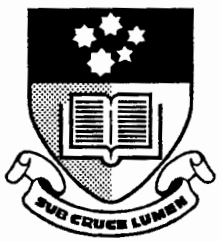
Doctor of Philosophy



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Contents

Abstract

This thesis is concerned with the mathematical characterisation and adaptive processing of narrowband high frequency signals received by a very wide aperture antenna array after reflection from the ionosphere. A major component of this research focuses on the experimental validation of space-time signal processing models for the complex (amplitude and phase) data received when a far-field source is propagated by a single-hop mid-latitude ionospheric path. Deterministic and statistical signal models are described and validated in terms of the accuracy with which they can represent the characteristics of complex-valued wavefields received by a 2.8 km long uniform linear array over time intervals in the order of a few seconds and a few minutes respectively.

The second major component of this research quantifies the effect of ionospheric propagation on the interference cancellation performance of various adaptive beamforming schemes. The improvements in output signal-to-noise ratio gained by adaptive beamforming relative to conventional beamforming are statistically quantified and compared with predictions made by a multi-sensor HF channel model. Degradations in performance caused by instrumental uncertainties are also considered and signal processing techniques which compensate for the relevant hardware imperfections are proposed and experimentally tested.