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# Phase measurements and narrow spectral band inference

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This thesis examines the problem of obtaining spectral estimates in the situation where the analysis is to be confined to a narrow band of frequencies concentrated about some fixed frequency of interest. In particular, the standard estimation procedures which require the spectral density function to be smooth over this range of frequencies are extended to cover the case where substantial variation does exist across the band.

Chapter 2 develops a central limit theorem for the finite Fourier transforms based on $N$ observations from a vector stationary discrete time sequence having absolutely continuous spectral distribution function. In order to arrive at a satisfactory asymptotic theory the spectral density matrix is made to depend on $N$ in such a way that the variation modelled is reflected in the limiting distribution. This limiting distribution takes the form of a certain complex multivariate normal distribution.

Chapter 3 yields a procedure for estimating coherence in the case where the phase or cross-spectral argument is changing across the band. It is with relation to the group delay that the phase variation is modelled over the frequencies considered and this parameter is estimated together with the other spectral parameters. The approach taken is that of maximising the likelihood which is given by an appropriate form of the limiting distribution described in Chapter 2. The various statistical properties of the estimates are also established.

Chapters 4 and 5 consider the case where a signal is received together with lagged and attenuated forms of the signal. The appropriate

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likelihood given by the central limit theorem of Chapter 2 is then maximised with respect to the various parameters and statistical properties are again established for the resulting estimates. The estimation of a signal's characteristics using an array of recorders is also discussed in the light of these methods.

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