Elizabeth A. Essex, *An Investigation of Ionospheric Irregularities*, PhD Thesis, University of New England, Armidale, NSW, Australia, Submitted March 1966

SUMMARY

Existing theoretical approaches to the problem of spatial and frequency correlation of the amplitude of radio waves reflected vertically from an irregular ionosphere are examined in detail. Because of the complexity of the ionospheric processes, simple surface models have to be applied. More exact volume type models are found to be difficult to apply because of the prohibitive nature of the mathematics and the limited knowledge of the reflection mechanisms and parameters involved.

Simultaneous observations of spatial and frequency correlation of amplitude are described and are interpreted in terms of simple surface models. Estimates of angular spread are made from the spatial correlation measurements. These values of angular spread are used in conjunction with the simultaneous observations of frequency correlation to deduce the true height of the irregularities. These values for the true height of the irregularities are often found to be different from the group height of the reflecting surface measured from the delay of the echo. These differences may arise either from irregularities below the reflection level or from scattering in depth at the reflection level. In either case the application of the simple surface model situated at the reflecting level may lead to errors.

The horizontal dimensions of the irregularities are estimated from

spatial correlation measurements on the assumption that the irregularities are situated at the reflection level. Similar estimates of the vertical dimensions of irregularities from frequency correlation measurements are found to be difficult. The separation of the contributions to the loss of frequency correlation from angular spread and from vertical effects, depends on a knowledge of the true height of the diffraction screen containing irregularities, on the quality of the data and on a suitable model which considers the effect of variation in height of reflection with frequency.

Observations of amplitude variations on closely spaced frequencies often show a time displacement between the maxima on the separate frequencies. Suggestions are made of possible causes of these time displacements.

Several miscellaneous experiments are also described. These include observations of ordinary and extraordinary components of sporadic E, fading on multiple echoes, observations of the ordinary and extraordinary components of the F echo on closely spaced frequencies and the determination of collision frequencies in the E region.