ANTIPODAL HF RADIO PROPAGATION.

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in
Radio Science.

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PREFACE.

In the 1950's and early 1960's a considerable amount of effort was devoted by Dr. H.A. Whale and others at the Seagrove Radio Research Station (now the Radio Research Centre, University of Auckland), to the examination of some of the problems involved in HF radio propagation. Among these were the evaluation of the effects of large-scale ionospheric tilts, the scattering which occurs at the earth and ionosphere, and the measurement and prediction of incoming bearing and elevation angles of signals from distant stations. In the latter stages of this work it became obvious that little was known about effects occurring at antipodal distances, so attempts were made to examine these and to postulate a propagation model consistent with the effects observed.

The results presented in this thesis are a logical extension of this early work, and comprise investigations in three main areas:

(1) The shape and size of the antipodal focussing area,
(2) The development of a more general and less idealised propagation model,
(3) The shape of the incoming angular power spectrum at antipodal distances.

A summary of the theory and experimental results contained in chapters 4, 5, 6 and 7 has been published (Bold, 1969), and that contained in chapters 8 and 9 will be submitted for publication shortly.

LIST OF ABBREVIATIONS AND SYMBOLS.

A	Ionospheric or terrestrial scattering parameter.
a.c.f.	Auto-correlation function.
ESSA/ITS	Environmental Science Services Administration, Institute for Telecommunication Sciences (U.S. Department of Commerce).
dB.	Decibels.
F_L	Gyromagnetic frequency in the ionosphere.
F_oE	Critical frequency of the E layer.
F_oE_s	Critical frequency of the sporadic E layer.
F_oF_2	Critical frequency of the F_2 layer.
HF	High frequency
LUF	Lowest usable frequency.
M(4000) factor	The ratio $\frac{MUF(4000)F_2}{MUF(ZERO)F_2}$
MUF	Maximum usable frequency for a specified propagation path.
$MUF(ZERO)F_2$	Predicted median maximum usable frequency of the F_2 layer for zero range. $MUF(ZERO)F_2 = F_oF_2 + F_L/2$.
$MUF(4000)F_2$	Predicted median maximum usable frequency of the F_2 layer for propagation over a 4000 km path.
PCA	Polar cap absorption.

R	Zurich sunspot number, or the real part of the generalised auto-correlation function between two antennas.
RTW	Round-the-world.
Subsolar point	That point on the earth's surface for which the sun is at the zenith.
UT	Universal time (Greenwich mean time).
VLF	Very low frequency.
X	The imaginary part of the generalised auto-correlation function between two antennas.
y_m	Semi-thickness of a parabolic ionospheric layer.
z	Value of the generalised auto-correlation function (a complex quantity in the general case).
Z	Modulus of z
α, ξ	Azimuthal angles of a ray measured from some reference direction.
δ	Incoming elevation angle of a ray.
λ, Λ	Free-space wavelength, or angular distance along a great circle on the earth's surface.
χ	Zenith angle of sun, or phase-difference measured between two antennas.