TESTING DIGITAL RECEIVER PERFORMANCE THROUGH AN HF ENVIRONMENT SIMULATOR

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CONTENTS

ABSTRACT

The work described in this thesis mainly consists of the development of a method for realistically simulating the HF environment and the testing of a particular digital receiver in this simulated environment. In particular, the HF environment was evaluated as to its effectiveness as a dither signal. The simulated environment was created from the limited sampling of a real HF spectrum database (the samples can be regarded as a distribution of carriers to which representative modulation needs to be added). This database was collected from an OTHR frequency management system and contains hourly samples of spectral data. The digital receiver was tested with two input signals added to representative simulated HF environments. The tests measured the IMD products and harmonics that were generated by the two input signals, with and without the HF environment present. These tests allowed the evaluation of the effect of HF environments upon digital receiver performance.

The existence of an HF environment simulator has allowed the development of a completely automatic testing system. It can perform two-tone testing in a recreated HF environment and achieves this using data from sparse samples derived from a suitable broadband spectrum monitor. The database used in the current work was derived from the Jindalee over the horizon radar frequency management system and was a good source of HF environmental data since it contains information covering several full sunspot cycles. As a result, a good set of tests can be performed using this database. If real testing in an HF environment were done it would take years to be completed since it would need to include a variety of times of day, times of the year, and different stages of the sunspot cycle. Spectrums were chosen from the database to be representative of the full range of ionospheric conditions of importance and two tone frequencies were chosen to be representative of the whole HF band of interest.

In the current research, only one digital receiver was tested in the HF environment simulator, this being the Echotek ECDR-GC214-PIC/TS. Tests were carried out to determine how the Echotek receiver operated in a variety of HF environments and to help determine strategies to operate the digital receiver in the HF environment. The environmental generator is a fairly general tool and can be used to test any sort of HF receiver. As a consequence, it could prove an important addition to the available testing facilities for HF communication and radar equipment.

STATEMENT OF ORIGINALITY

This thesis does not contain any material which has been accepted for the award of any degree or diploma in this university or other tertiary institution. Unless where stated or referenced, this work contains no material which has been previously published or written by other researchers.

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LIST OF FIGURES

NOTE: Numbers in square brackets [] refer to the source reference.

LIST OF TABLES

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LIST OF ABBREVIATIONS

ADC	Analogue to digital converter
AM	Amplitude modulation
BW	Bandwidth
CFIR	Compensating finite impulse response
CIC	Cascade integrate comb
CW	Continuous Wave
DAC	Digital to analogue converter
DAB	Digital Audio Broadcasting
DC	Direct current
DDC	Digital down converter
DSBLC	Double sideband large carrier
DSBSC	Double sideband suppressed carrier
DSP	Digital signal processing
DSTO	Defence Science and Technology Organisation
FFT	Fast Fourier transform
FIFO	First in first out
FIR	Finite impulse response
FMS	Frequency management system
GPIB	General purpose interface bus
HF	High frequency
IF	Intermediate frequency
IIR	Infinite impulse response
IMD	Intermodulation distortion products
LSB	Lowest significant bit
LUT	Look up table
MSPS	Mega samples per second
NCO	Numerically controlled oscillator
OTHR	Over the horizon radar
PAD	Attenuator
PCI	Peripheral component interconnect
PFIR	Programmable finite impulse response
PLD	Programmable logic device
RTTY	Radio Teletypewriter
SFDR	Spurious free dynamic range
SINAD	Signal + noise + distortion to noise + distortion ratio
SNR	Signal to noise ratio
SSBC	Single sideband suppressed carrier
S/H	Sample and hold
VCO	Voltage controlled oscillator