

List of Figures

Figure 2.1: Adaptive Filter Model for Blind Equalization.	5
Figure 2.2: Baseband Model for a Communication System with FSE.....	7
Figure 2.3: Multi-Channel Model of the Fractionally Spaced Equalizer.	11
Figure 2.4: A Simple Communication System with Adaptive Equalizer.....	19
Figure 2.5: Effect of Initialization on LMS Algorithm.....	20
Figure 2.6: Effect of Initialization on CMA Algorithm.....	20
Figure 3.1: Adaptive Filter Model for Blind Equalization.	25
Figure 3.2: Different Types of Error Functions.	27
Figure 3.3: Block Diagram of Simulated System Used for Analysis of Different Error Signals.....	34
Figure 3.4: Impulse Response of the Minimum Phase Channel with Two Impulses.....	36
Figure 3.5: MSE Curves for Different Error Equations for the Channel Shown in Figure 3.4.	36
Figure 3.6: Zoomed Version of Figure 3.5.	37
Figure 3.7: Impulse Response of the Exponentially Decaying Channel.	38
Figure 3.8: MSE Curves of the Equalizer with Different Error Equations for the Exponentially Decaying Channel.	38
Figure 3.9: Impulse Response of the Symmetric Channel.....	39
Figure 3.10: MSE Curves of the Equalizer with Different Error Equations for the Symmetric Channel.	40
Figure 3.11: MSE Curve for Type1 and Type2 Error with Same Convergence Rate.....	41
Figure 3.12: MSE Curve with Type2 Error for Different Step Size.....	42
Figure 3.13: MSE Curves for Different Error with Same Slope at Zero Error ($\mu = 0.1$).	43

Figure 3.14: MSE Curves for Different Error with Same Slope at Zero Error ($\mu = 0.2$).	44
Figure 3.15: Effect of Initialization on Blind Equalization with Type1 Error.	45
Figure 3.16: Effect of Initialization on Blind Equalization with Type2 Error.	45
Figure 3.17: Effect of Initialization on Blind Equalization with Type3 Error.	46
Figure 3.18: Effect of Initialization on Blind Equalization with Type4 Error.	46
Figure 3.19: Modified Type 3 Error Function.	48
Figure 3.20: Effect of Initialization on Blind Equalization with Modified Type 3 Error.	48
Figure 3.21: Cost Surface of CMA with Modified Type3 Error.	49
Figure 3.22: Contour Plot of the Cost Surface of Figure 3.21.	49
Figure 3.23: MSE Curves of the FSE with Type 3 Error and Modified Type3 Error for the Minimum Phase Channel (Figure 3.4); $\mu=0.1$	50
Figure 4.1: Block Diagram of a One Step Ahead Predictor.	52
Figure 4.2: RLS Window Function.	54
Figure 4.3: WRLS Window Function.	55
Figure 4.4: Base-Band Power Spectrum of the Fading Envelope with Doppler Spread of 100 Hz.	58
Figure 4.5: General Block Diagram of Rayleigh Fading Envelope Generator.	59
Figure 4.6: Magnitude Response of the Idealized and Simulated Doppler Filter.	63
Figure 4.7: Actual and Predicted Fading Envelope (RLS Type Window Used to Update the Correlation Sequence).	64
Figure 4.8: Actual and Predicted Fading Envelope (WRLS Type Window Used to Update the Correlation Sequence).....	65
Figure 4.9: Mean Squared Prediction Error with RLS and WRLS Windows for Different Realizations.....	66
Figure 4.10: Overall Mean Squared Prediction Error for Different f_m	66

Figure 4.11: Velocity Profile of the Fading Envelope for Different Accelerations.	67
Figure 4.12: Rayleigh Fading Envelope for Constant Acceleration of 10 miles/sec ² and the Predicted Envelope. WRLS Type Window Used in the Predictor. Sampling Frequency, $f_s = 2000$ Hz.	68
Figure 4.13: Mean Squared Prediction Error for Different Accelerations.	68
Figure 5.1: Proposed FSBEEP System Model.....	70
Figure 5.2: Impulse Response of the Simulated Channel (in fractional space).....	76
Figure 5.3: Mean Squared Error Curve for the FSBEEP and Conventional Blind Equalizers.	77
Figure 5.4: Mean Squared Error Curve and Predictor Output for FSBEEP During an Ill Convergence Situation.....	78
Figure 5.5: Output of the Predictor When the System Converges to a Global Minimum (one of the realizations that produced Figure 5.3).....	79
Figure 5.6: Impulse Response of the Averaging Filter for Different Values of λ	80
Figure 5.7: Modified FSBEEP System Model.....	80
Figure 5.8: MSE Curves for the Original and Modified FSBEEP System ($\mu=0.1$).	81
Figure 5.9: MSE Curve for the Conventional Blind Equalizer and FSBEEP for Signal to Noise Ratio of 40 dB ($\mu=0.1$).	82
Figure 5.10: Impulse Response of the Maximum Phase Channel (in Fractional Space).	83
Figure 5.11: MSE Curve for the Conventional Blind Equalizer and FSBEEP While Equalizing a Maximum Phase Channel.....	83
Figure 5.12: MSE of FSBEEP for Two Different Trials (with same statistics) when Equalizing the Maximum Phase Channel.	84
Figure 5.13: MSE Curve of the Conventional Blind Equalizer and FSBEEP for the Minimum Phase Channel with $\mu = 0.01$	85
Figure 5.14: Channel Profile with Changes from Minimum Phase to Maximum Phase.	86

Figure 5.15: Tracking Property of the Conventional Equalizer and FSBEEP for the Channel Shown in Figure 5.14.....	87
Figure 5.16: Tracking Property of the Conventional Equalizer and FSBEEP when the Channel Changes from Maximum to Minimum Phase.....	88
Figure A 1: Block Diagram of the General Prediction Filter.....	91
Figure B.1: Variance of U as a Function of A and the Variance of X	97