

**SEA LEVEL FORECASTING
BY KALMAN FILTER**

by

Choi Iat Chu

Master of Science in Civil Engineering

2002



Faculty of Science and Technology

University of Macau

TABLE OF CONTENTS

List of Figures	iii
List of Tables	iv
Chapter 1: Introduction	1
Chapter 2: Tides	5
2.1 Equilibrium Theory of Tide	5
2.2 Other Astronomical Factors on Equilibrium Theory	8
2.3 Dynamic Theory of Tide	11
2.4 Meteorological effects	14
Chapter 3: Harmonic Sea-Level Model	16
3.1 Modeling Equations	16
3.2 Tidal Constituents	19
Chapter 4: Kalman Filter	23
4.1 Introduction to Kalman Filter	23
4.2 State-Space Form	25
4.3 General Form of Kalman Filter	27
4.4 Derivation of Kalman Filter	29
4.4.1 Linear Optimal Estimator	30
4.4.2 Proof of Prediction Equations	31
4.4.3 Proof of Updating Equations	38
Chapter 5: Solving Harmonic Sea-Level Model by Kalman Filter	46
5.1 State Space Form of Harmonic Sea-Level Model	46
5.2 Solving Procedures by Adopting Kalman Filter	48
Chapter 6: Results of the Macau Case Study	51
6.1 Macau Case Study	51
6.2 Results of the Case Study	55
Chapter 7: Summary and Conclusions	66
References	68
APPENDIX A: Notation	70

APPENDIX B: Tide Data.....72
APPENDIX C: Computer Procedure for Calculation.....75