Fast Implementations of the Kalman Bucy Filter
for Satellite Data Assimilation*

Amir Asif
Computer Science, York University
North York, ON, Canada M3J 1P3
Tel. No. (416) 736-2100, Fax No. (416) 736-5872
Email: asif@cs.yorku.ca

Abstract

We present practical methods based on the Kalman Bucy filter (KBf) for combining satellite altimetry data with the nonlinear ocean circulation models. In physical oceanography, such signal processing techniques are referred to as data assimilation. Data assimilation is computationally challenging because of the large dimensions of the state fields. Compared with the direct implementation, our KBf implementations provide computational savings of two orders of the magnitude of the linear dimension of the state field. We run twin experiments by interfacing our data assimilation algorithms with the NLOM, a nonlinear ocean circulation model developed at the Naval Research Laboratory (NRL).


1 Introduction

Estimating the state of the ocean is a key issue in physical oceanography. We are motivated by the reconstruction of image fields like sea surface height or ocean velocity, and develop computationally efficient Kalman Bucy filter (KBf) based data assimilation algorithms, [1, 2, 3], to assimilate satellite data into the numerical ocean circulation models based on the primitive Navier Stokes partial differential equations (pde). Direct implementation of the KBf in such applications is difficult for two reasons. First, the state equations are nonlinear and the resulting KBf is nonrigorous. Second, the KBf involves formidable computational requirements, particularly in updating the error covariance matrix. The KBf requires inversion and storage of the covariance matrix, which is computationally

*Supported by the Natural Science and Engineering Research Council (NSERC) Canada under Grant # 229862-01.