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On a non-linear prediction analysis for multi-dimensional stochastic processes with its applications to data analysis

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Abstract. Recently, Matsuura-Okabe solved the prediction problem for one-dimensional stochastic processes which had remained to be solved for forty years after Masani-Wiener's work. In this paper, we shall develop a non-linear prediction analysis for multi-dimensional local stochastic processes based upon the theory of KM_2O-Langevin equations, which gives a refinement of Okabe-Yamane's work for causal problems and Matsuura-Okabe's work for prediction problems that have been investigated for one-dimensional stochastic processes. Moreover, we apply our results to concrete time series which concern the increase problem of earth temperature.

Key words: non-linear prediction analysis, non-linear causal analysis, KM_2O-Langevin equation, fluctuation-dissipation theorem, meteorological phenomena.

1. Introduction

The non-linear prediction problem for stochastic processes has a long history. Masani-Wiener ([1]) have given a prediction formula for calculating the non-linear predictor for the one-dimensional strictly stationary process satisfying the boundedness and the non-degenerateness. As stated in [1], their formula lacks a workable and computable algorithm. It has remained to weaken these conditions and give certain workable and computable algorithms for calculating the non-linear predictor.

Under the same conditions as in [1], Okabe-Ootsuka ([7]) have given a workable and computable algorithm for calculating the non-linear predictor by using the theory of KM_2O-Langevin equations for non-degenerate flows in inner product spaces. Based upon the fluctuation-dissipation principle behind this theory, one of the authors has proposed a method for detecting non-linear information behind a given time series data by using three kinds

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