ESTIMATION OF THE ARRIVAL TIMES OF SEISMIC WAVES BY MULTIVARIATE TIME SERIES MODEL

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Abstract. A computationally efficient procedure was developed for the fitting of many multivariate locally stationary autoregressive models. The details of the Householder method for fitting multivariate autoregressive model and multivariate locally stationary autoregressive model (MLSAR model) are shown. The proposed procedure is quite efficient in both accuracy and computation. The amount of computation is bounded by a multiple of Nm^2 with N being the data length and m the highest model order, and does not depend on the number of models checked. This facilitates the precise estimation of the change point of the AR model. Based on the AICs' of the fitted MLSAR models and Akaike's definition of the likelihood of the models, a method of evaluating the posterior distribution of the change point of the AR model is also presented. The proposed procedure is, in particular, useful for the estimation of the arrival time of the S wave of a microearthquake. To illustrate the usefulness of the proposed procedure, the seismograms of the foreshocks of the 1982 Urakawa-Oki Earthquake were analyzed. These data sets have been registered to AISM Data Library and the readers of this Journal can access to them by the method described in this issue.

Key words and phrases: Locally stationary AR model, AIC, Householder transformation, P wave, S wave, arrival time, seismology.