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ARIMA-GARCH, A Statistical Modeling for Epileptic Seizure Prediction

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Abstract : In this paper, we provide a procedure to analyze and model EEG (electroencephalogram) signal as a time series using ARIMA-GARCH to predict an epileptic attack. The heteroskedasticity of EEG signal is examined through the ARCH or GARCH, (Autore- gressive conditional heteroskedasticity, Generalized autoregressive conditional heteroskedasticity) test. The best ARIMA-GARCH model in AIC sense is utilized to measure the volatility of the EEG from epileptic canine subjects, to forecast the future values of EEG. ARIMA-only model can perform prediction, but the ARCH or GARCH model acting on the residuals of ARIMA attains a con- siderable improved forecast horizon. First, we estimate the best ARIMA model, then different orders of ARCH and GARCH modelings are surveyed to determine the best heteroskedastic model of the residuals of the mentioned ARIMA. Using the simulated conditional variance of selected ARCH or GARCH model, we suggest the procedure to predict the oncoming seizures. The results indicate that GARCH modeling determines the dynamic changes of variance well before the onset of seizure. It can be inferred that the prediction capability comes from the ability of the combined ARIMA-GARCH modeling to cover the heteroskedastic nature of EEG signal changes.

Keywords : epileptic seizure prediction , ARIMA, ARCH and GARCH modeling, heteroskedasticity, EEG
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