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Time series forecasting in multimodal interface device controlling

In the course of working out of the applied software for mobile devices the model of short-term forecasting (ARIMA) has been considered [1].

The basic application finds ARIMA model in the statistician, at the analysis and forecasting of non-stationary processes.

Interest for research was represented by applied use of the given statistical model in mobile devices for forecasting of the time series registered by hardware sensors.

A mobile phone accelerometer has been chosen by source of the data.

A circular moving of the hand with a mobile phone became the process, which was under investigation.

During the experiment, when the hand was describing a circle, the accelerometer detected a clear change in the harmonic projection of the apparent acceleration on the axes X and Y.

The values of the accelerometer varied from -4 to $+6$ values on the axis X, and on the axis Y – from $+4$ to $+14$ values, respectively.

The retrieved data were smoothed out and, as a result, formed a time series with character similar to a sine curves.

It was found, that predictions on the axis X was giving incorrect results during forecasting a four time series for one and ten steps ahead.

The correctness was checked by comparing the values of the forecast and actual data obtained in previous times.

If the analyzed process had among possible values negative and positive numbers, then the error of the prediction was increasing for values close to zero.

$$Y_t = \varphi_0 + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \cdots + \varphi_p Y_{t-p} + e_t,$$
$$\varphi_0 = \mu(1 - \varphi_1 - \varphi_2 - \cdots - \varphi_p).$$

Each previous value of time series corresponds to its coefficient, that can be seen from the formula of autoregressive model. Thus all coefficients found earlier and multiplied by zero lose their meaning, thereby shifting the predicted value to previous.

In addition to the delay, another feature was found, that must be tackled during the process of prediction.

In the case, where the first term of the autoregressive equation is equal to zero

$$Y_t = \varphi_0 + \varphi_1 \cdot 0 + \varphi_2 \cdot (-1) + \varphi_3 \cdot (-2) + \ldots,$$

the situation appears in which the multiplication by zero yields a nonzero value.

This problem can be solved by adaptive narrowing of the sample size.

$$Y_t = \varphi_0' + \varphi_2 \cdot (-1) + \varphi_4 \cdot (-3) + \ldots,$$

References

1. John E. Hanke, Business forecasting. Seventh edition / John E. Hanke // Prentice Hall – 2003. – 453 p.