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THE IMPLEMENTATION OF SINGULAR SPECTRAL ANALYSIS IN DIGITAL SIGNAL PROCESSING (DSP)

SERGEJS HILKEVICS, GALINA HILKEVICA

Ventspils University College

Inzenieru iela 101, LV-3601, Ventspils, Latvija

E-mail: hil@venta.lv, galina.hilkevica@venta.lv

The whole set of digital signal processing procedures can be used in a very different and looking not related with each other practical applications - exact measurements, technical systems control, image processing, medical diagnostics, financial mathematics, economical forecasting [1]. One of such procedures is signal extraction from the mixture "signal plus noise".

There are many methods for signal extraction form mixture with noise and the common property of them is that the better we know structure of signal, the better we can separate it from the noise. For signals with unknown structure under conditions of unknown statistical properties of noise the task of signal extraction from mixture is very complicated.

Singular spectral analysis (SSA) is one of the best methods, which allows to separate signal from noise [2] under very poor knowledge about noise statistical properties. The base scheme of SSA consists of four steps. The first step is called the embedding step and converts one-dimensional time series into L - dimensional vectors $X_i = (f_{i-1}, \ldots, f_{i+L-2})^T$, $1 \le i \le K$. The second step is called the singular value decomposition and represents trajectory matrix as the sum or resultant matrices $\mathbf{X} = \mathbf{X}_1 + \cdots + \mathbf{X}_d$. The third step is called the grouping and distributes the eigenvalues $\lambda_1, \ldots, \lambda_L$ into m subsets $I_1, \ldots, I_m$. The fourth step is called as diagonal averaging and calculates new averaged values of resultant matrices for each $I_1, \ldots, I_m$, representing initial time series as sum of m series. Our results are illustrated by the set of MATLAB programmes for SSA implementation for different practical tasks, including industrial mathematics, space technologies and financial mathematics.

REFERENCES

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