

Multi-dimensional Signal Processing

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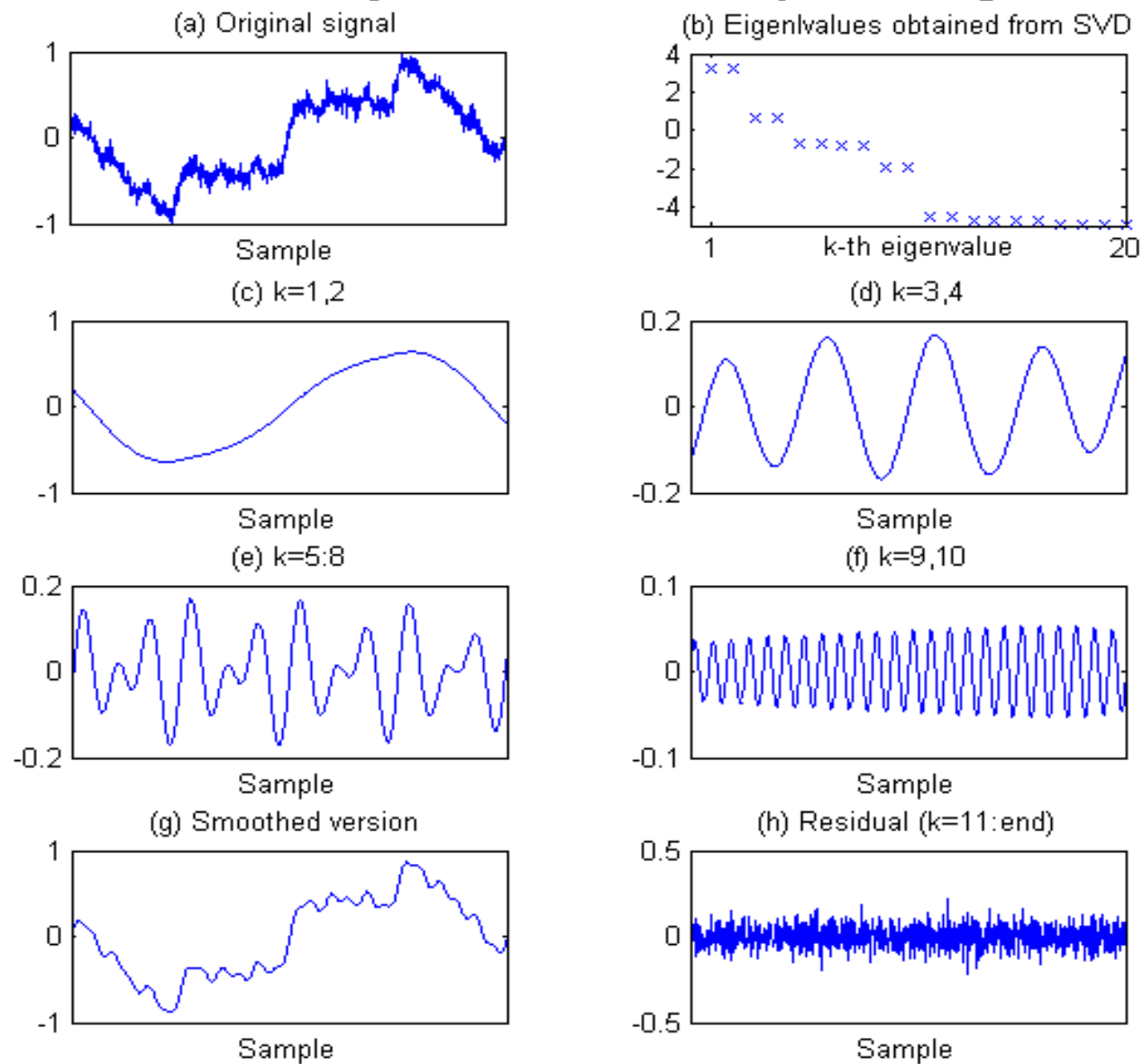
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Research area

- Singular spectrum analysis (SSA)
 - Bio-signal processing, image processing, earth science, economics and finance.
- SSA stages:
 - Decomposition
 - Reconstruction

SSA decomposition for a basic synthetic signal



Complex-valued analysis

- Need for complex-valued algorithms
- Second-order augmented statistics
 - Considering correlation between real and imaginary part to cater both circular and non-circular data.

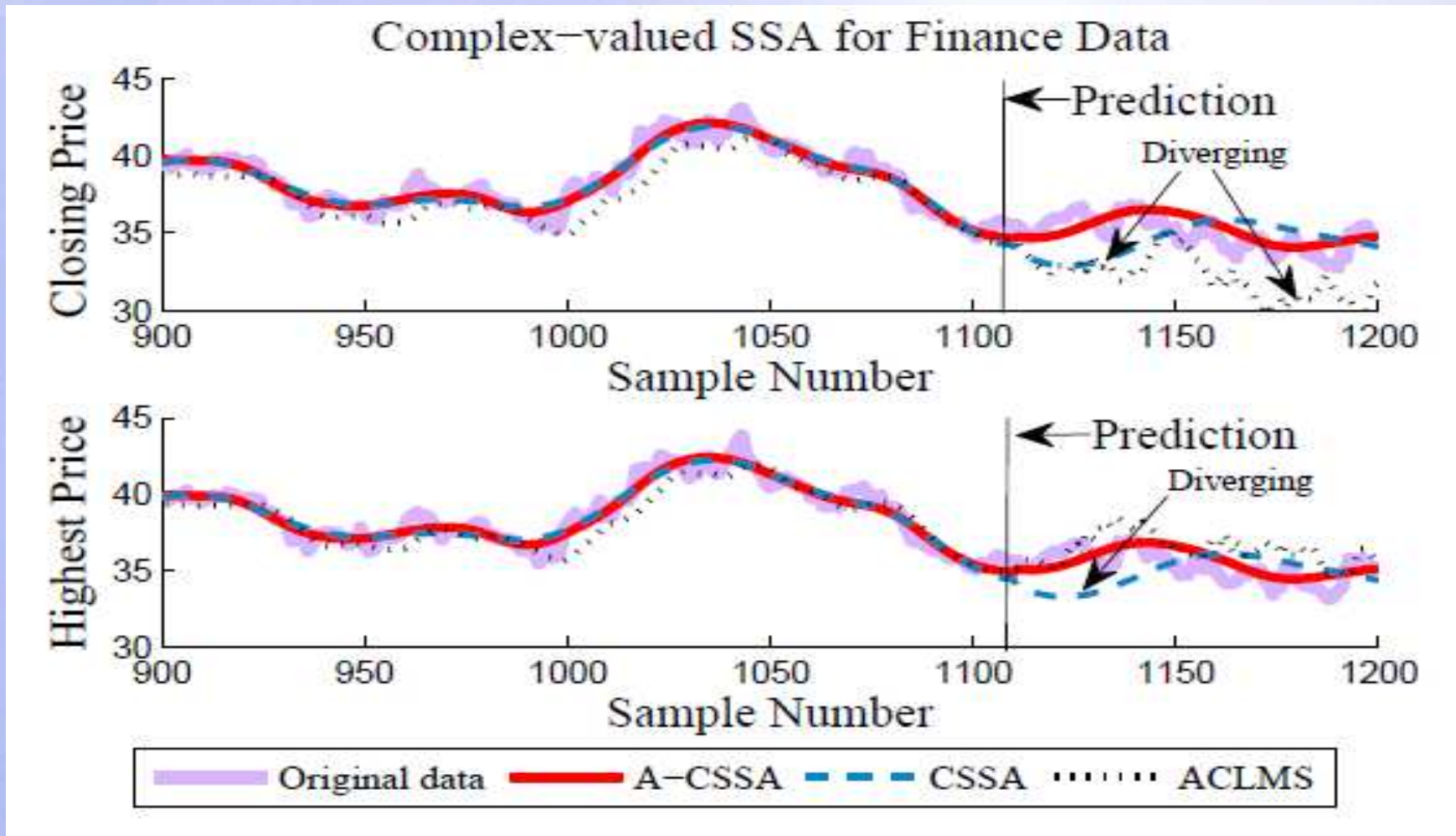
$$\mathbf{v} = [x, y]^T \subset \mathcal{C} \rightarrow \mathfrak{R} = E[\mathbf{v}\mathbf{v}^T] = E \begin{bmatrix} x^2 & xy \\ yx & y^2 \end{bmatrix}$$

$$\mathbf{v} = x + jy \subset \mathcal{C} \rightarrow \begin{cases} C = E[\mathbf{v}\mathbf{v}^H] = E[x^2 + y^2] \\ Pc = E[\mathbf{v}\mathbf{v}^T] = E[x^2 + y^2 + j2xy] \end{cases}$$

- Augmented statistics by considering the conjugate

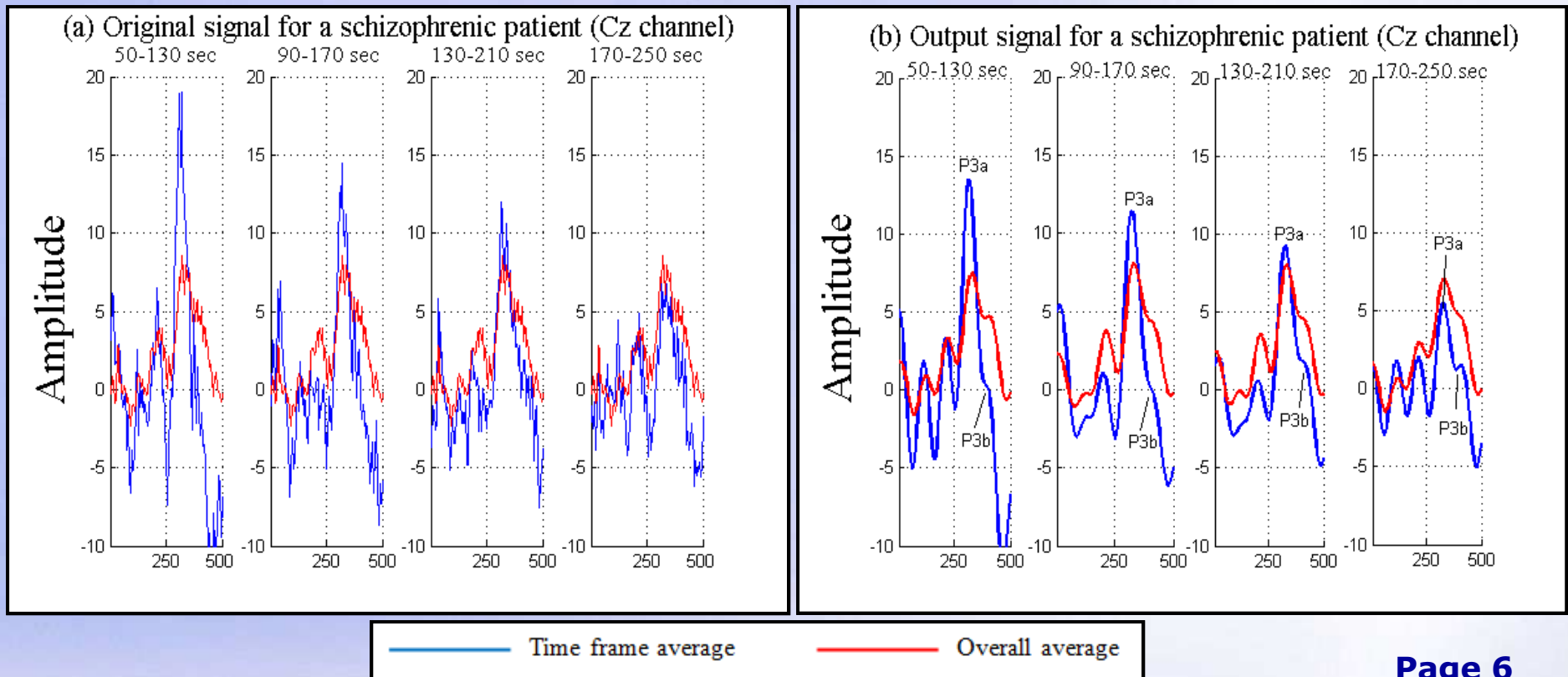
$$\mathbf{v}_a = [\mathbf{v}, \mathbf{v}^*]^T \rightarrow C_a = E[(\mathbf{v}_a \mathbf{v}_a)^H] = E \begin{bmatrix} C & Pc \\ Pc^* & C^* \end{bmatrix}$$

Finance Forecasting



EEG Signal Processing

- AC-SSA for detection and tracking of P300 wave subcomponents in EEG signals



Future work

- Improve prediction accuracy
 - Break down the prediction based on daily, monthly and annual periodicities
- Develop quaternion-valued (four-dimensional) SSA
- Multi-dimensional motion analysis

