

In the name of God

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NUMERICAL ANALYSIS COURSE

Exercise Set 13: PCA, SVD, EMD

(Due Date: 1403/10/30)

- Using the data sets (0.2.txt, 0.5.txt and 0.8.txt), do following tasks:
  - Compute the Auto-Correlation function of mentioned data and by using the direct definition of discrete Fourier transformation, compute the power spectrum of each sets.
  - For each data sets, construct the  $x(t) \rightarrow x'(t) = x(i) + 2 \sin(3t) + 2 \sin(50t)$  and then compute the power spectrum.
  - Use the random generator of computer (constant PDF) and generate 10000 data. Now according to the phase-randomized method, construct the surrogate data. Check the PDF your new data set.
- SVD: Using the sunspot.txt data and according the SVD algorithm, construct the trend and Noise parts. To this end consider  $\tau = 2$  and  $d = N/2$ , where  $N$  is the size of data. You can also changed each of mentioned parameters to let's see what happens.
- EMD: Using the sunspot.txt data and according to the EMD algorithm, and up to 10th IMF decomposition, construct the 10 components for trends and plot them.
- PCA: Using the sunspot.txt data, construct the covariance matrix with size  $100 \times 100$  such that each element is computed as  $C(\tau = |t_i, t_j|) = \frac{1}{N-|t_i-t_j|} \sum_{t_i, t_j} x(t_i)x(t_j)$ , and  $\tau = 0, 1, 2, \dots, 99$ . Now according to the PCA, construct the eigenvalues and eigenvectors. Make a High-pass filtered data and Low-pass filtered data.

Good luck, Movahed

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