In the name of God

Department of Physics
Shahid Beheshti University

COMPUTATIONAL PHYSICS

Exercise Set 3

(Date Due: 1394/08/30)

1. Compute the PDF of Random generator of computer.

2. Generate 1000 particles in a box containing the velocity corresponds to Maxwell-Boltzmann PDF.

3. Using simple method for generating random number with Gaussian pdf, make such data.

4. Using data "*marks.txt*" and compute the PDF of these data sets. Then use a gaussian Kernel to smooth it. Use various values of σ for your kernel.

5. High-pass and low-pass filters:
   A: Using random generator of computer, make a time series and then superimpose it with typical periodic function such as $\sum_{i=1}^{10} A_i \sin(2\pi/T_i t)$, where A's and T's are the amplitude and period time scale, respectively. Plot this data.
   B: Using Fourier transform, compute power spectrum.
   C: In Fourier space, by setting some higher value of Fourier coefficients to zero, make a low-pass filter and then do inverse Fourier transform and compare it with original data.
   D: In Fourier space, by setting some lower value of Fourier coefficients to zero, make a high-pass filter and then do inverse Fourier transform and compare it with original data.

6. Alias effect:
   A: Make a sinusoidal series according to:

$$x(t) = \sum_{i=1}^{10} A_i \sin(t/i)$$

Compute power spectrum of this data.
   B: Now suppose that the sampling frequency for recoding data is: $f_s = 10$Hz, provide a new set of data by mentioned data sampling frequency and determine the power spectrum. Explain your result.
   C: Suppose that the sampling frequency for recoding data is: $f_s = 15$Hz, provide a new set of data by mentioned data sampling frequency and determine the power spectrum. Explain your result.

Good luck, Movahed