DSP software tech test

File *testData.txt* contain recordings from 8 antenna elements in complex IQ samples at 4000Hz.

testData.txt: Total 16 columns.

- Column 1 contains **I** part from element 1, and column 2 contains **Q** part from element 1.
- Column 3 contain **I** part of element 2, and column 4 contain **Q** part of element 2.
- Remaining columns are from elements 3 to 8, stored in same order as described above.
- Each row in the txt file is a snap shot of a time domain samples for all 8 elements.

Received signals in testData.txt is modeled as:

$$y_m(n) = e^{j\frac{2\pi f n}{f_s}} + D_m + P_m(n),$$

where $y_m(n)$ is received signal at sample index *n*, *m=1,…,8* is the element index, *f* is signal frequency in Hz, f_s is sample frequency in Hz, D_m is Direct current (DC) offset at element index *m*, $P_m(n)$ is complex white gaussian noise, *n=0,1,2,3,…,* is the sample index.

Task 1: Create a script to read in the testData.txt into your preferred language (do not use Matlab/Octave/R).

Submit your script/code.

Task 2: Estimate DC offset D_m for all elements. Consider the recorded data in the text file as input from a real-time system. Designing a buffer to emulate real-time input shall be considered.

Implement DC offset algorithm in language selected in Task 1. Utilizing toolbox and array processing is strongly recommended.

Example of a DC offset algorithm:

$$\left|\frac{1}{N}\sum_{n=0}^{N-1} y_m(n)\right| = \widehat{D}_m$$

Where $\widehat{D}_m$ is estimated DC offset.

Note that above algorithm is defined for one window, in actual implementation the window has to step forward in time.

Question 1: How does buffer size affect estimation accuracy?

Question 2: List few cons and pros behind buffer size selection?

Question 3: Is it possible to average DC estimate over antenna elements? If no why not?

Submit your script/code, answers to the questions, and note down estimated DC offset $\widehat{D}_m$(for all 8 elments).

Task 3: With a given buffer size, propose a method to improve estimation accuracy on DC offset. Implement your idea in language selected in Task 1.

Submit your script/code.

Task 4 (Optional):

- Propose a computational efficient method to estimate frequency f?
- Can you use two complex sample to estimate the frequency?
- What is the frequency on recorded signal?

Submit script/code if applicable, and your answers to the questions.