Q4.

The Lyapunov exponent is a quantity that measure the rate of separation of very close trajectories. A positive Lyapunov exponent can indicate chaotic behaviour of a data-set. Because of the size of the data-set and the time complexity of the max\_lypov function we had to find the region of pixels in the image which co-responded specifically to the prostate region(i.e [30-80],[40 90]). As we can see from the dataset there is no indication that the region containing the prostate is behaving abnormally.

Q5. The Magnitude and frequency characteristics for the Daubechies (1,5,9) element filters are displayed below. When analyzing the phase response, we bring up a concept called group delay. Group delay is defined as the negative derivative of phase with respect to frequency. When analyzing the phase response, we can see that as we move towards higher elements (i.e 1,5,9) the group delay changes from a constant to an non-linear function. This indicates that the Daubechies (5,9) filters may produce some signal distortion because of their non-linear phase response. However the Daubechies 1 filter would produce minimal signal distortion ( within the passband) because of its linear phase response (i.e all frequencies are getting shifted by a constant amount).

Q6.

1. Fixed points are values of Pt+1 that are equal to Pt, i.e P­­­t+1 = f(Pt) = Pt. These points indicate where the function will remain fixed as the next point will be equal to the previous point via the difference equation. To determine these fixed points, we set P­­­t+1 = Pt = f(Pt­­). and solve for Pt. The point were determined to be as follows
   * 1. Pt = 0
     2. Pt = -((8\*C^2 + 9)^(1/2) - 3)/(4\*C)
     3. Pt = ((8\*C^2 + 9)^(1/2) + 3)/(4\*C)

Solutions ii and iii were disregarded because both of their solutions required negative values of C and the difference equation strictly states that C must be a positive integer.

1. To analyze the stability of the fixed points we look at the derivative of the difference equation around i.

If ||1 - 2C|| <1 then the fixed point is stable, monotonically if 0< 1-2C <1 and oscillatory if 0>1-2C > -1. Which lead to ½ > C > 0 and – ½ < C < 0 respectively.

If || 1-2C|| >1 then the fixed point is unstable. This leads to the following conditions. C > 0 and C>1.