DCCDL LAB4

matlab

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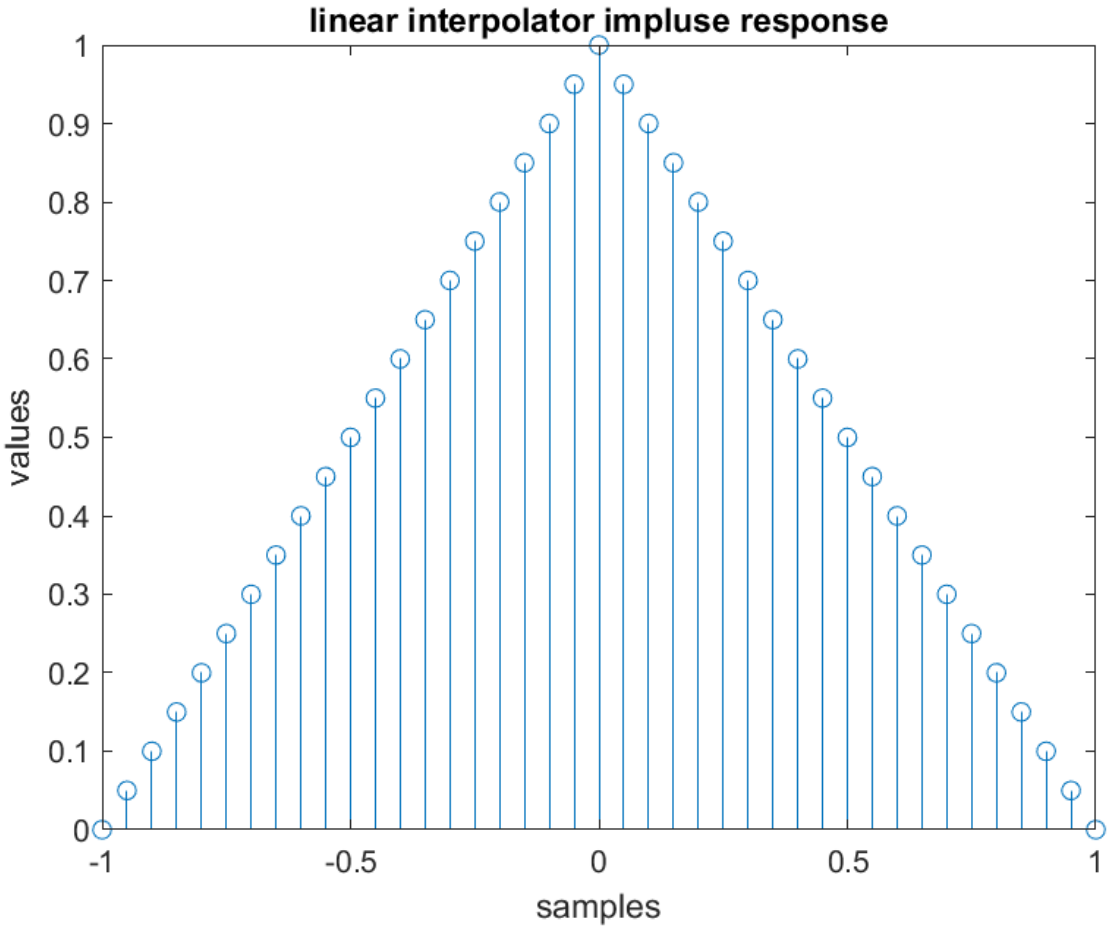
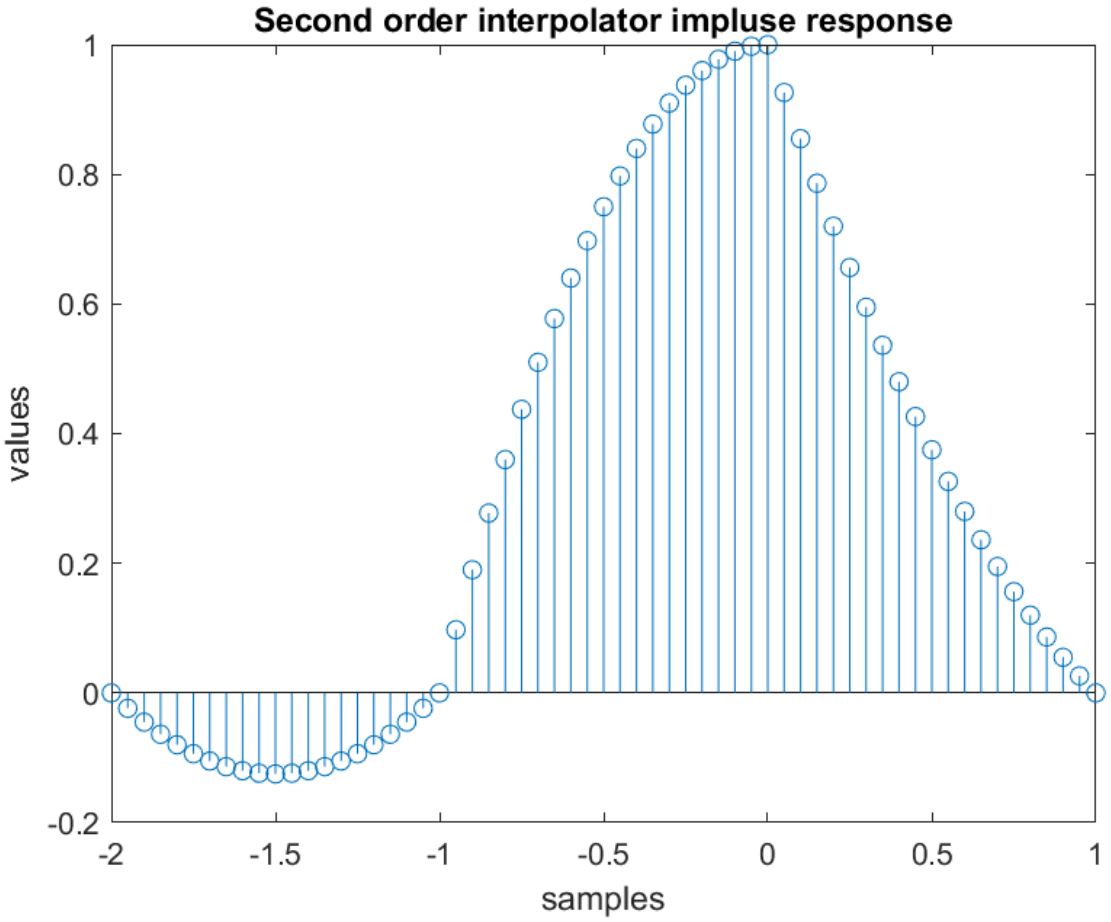
1. Please draw the time-domain impulse response of the linear interpolator, second-order polynomial interpolator, and piecewise parabolic interpolator. Show the correct labels of x axis and y axis. (20%)

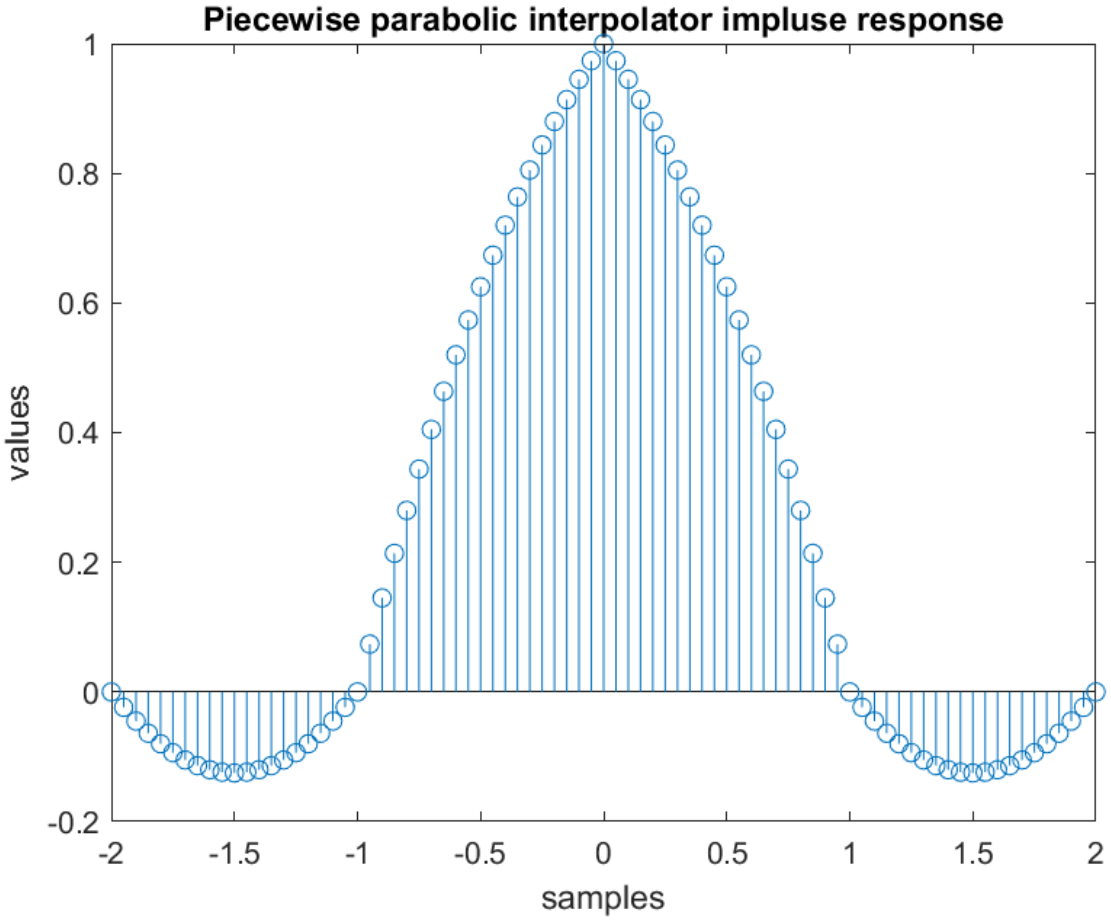
   (1) Time-domain impulse response of the linear interpolator:



(2) Time-domain impulse response of the second order interpolator:

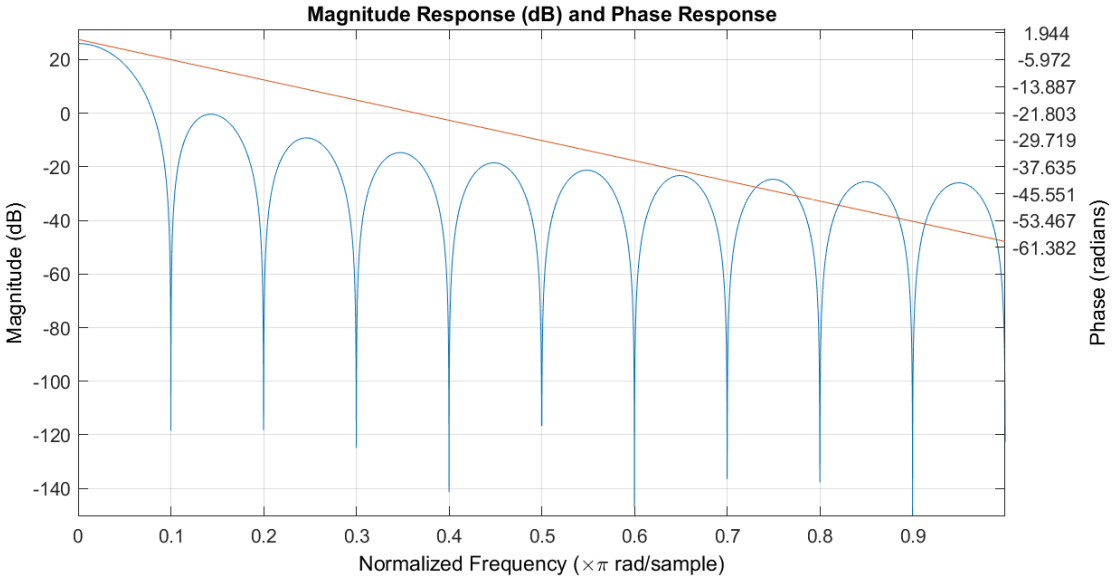


(3) Time-domain impulse response of the piecewise parabolic interpolator:

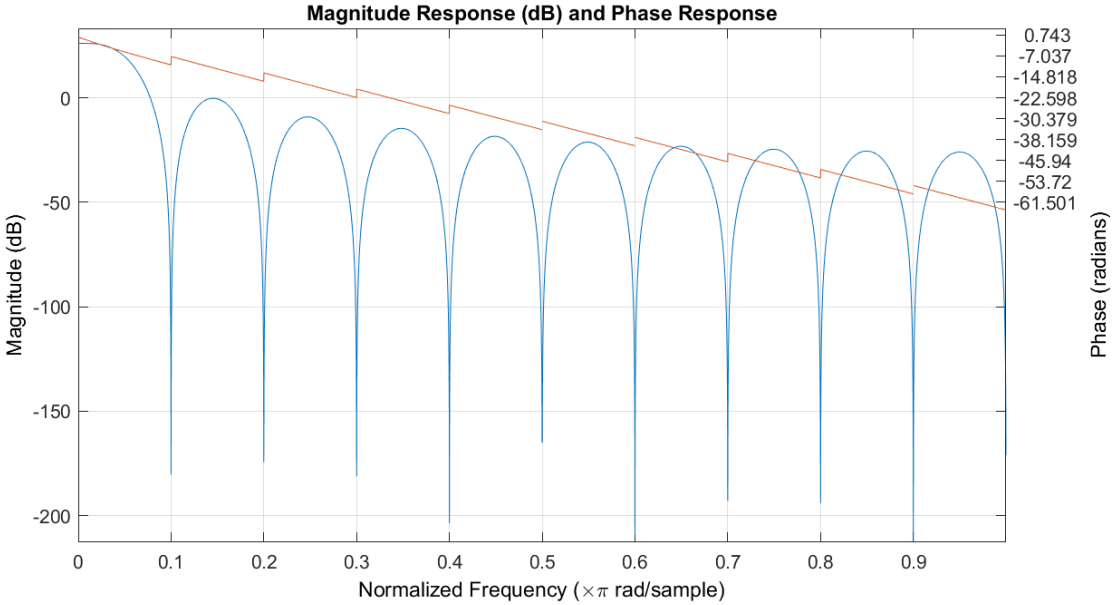


2. Please draw the frequency response, including magnitude and phase, of the linear interpolator, second-order polynomial interpolator, and piecewise parabolic interpolator. Observe their properties in the frequency domain. Note that proper resolution may be required for the observation. Show the correct labels of x axis and y axis. The magnitude is expressed by dB with a 60-dB range of Y axis from the maximum.(20%)

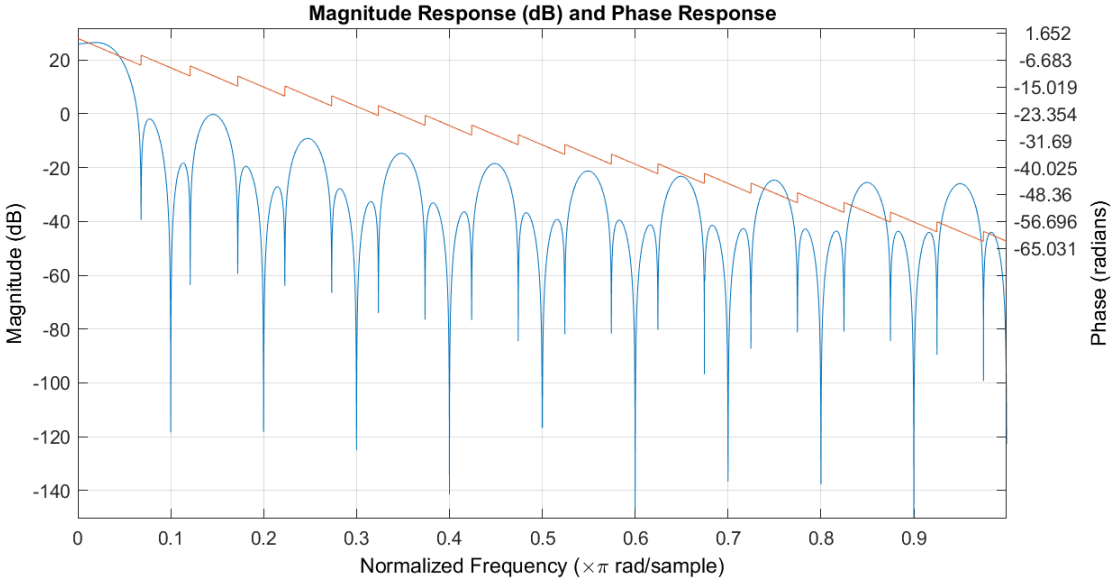
(1) frequency response of the linear interpolator:



(2) frequency response of the Second order polynomial interpolator:

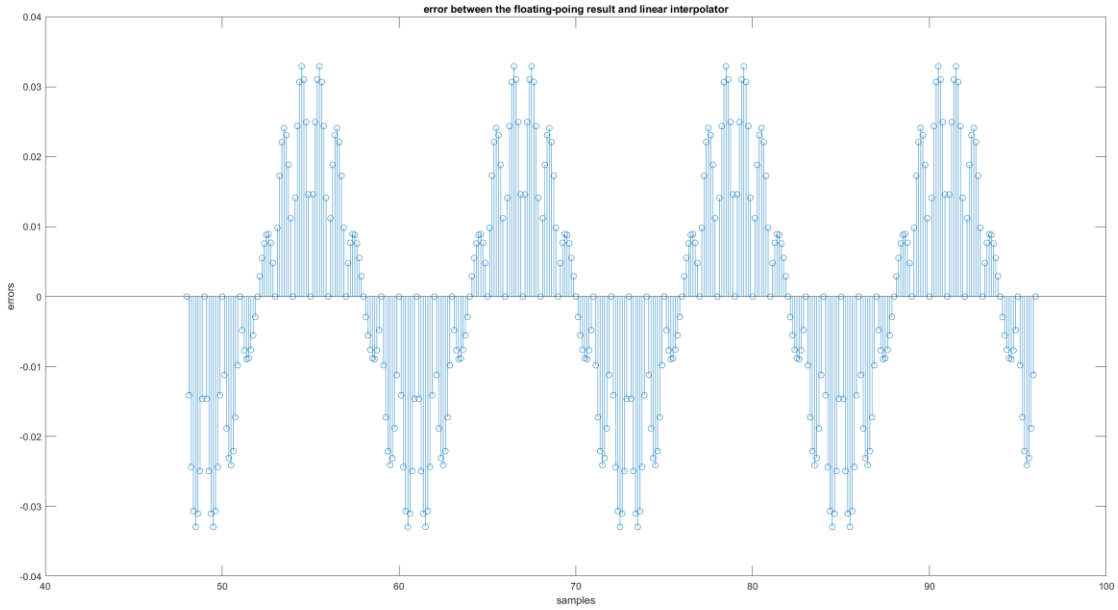


(3) frequency response of the piecewise parabolic interpolator:

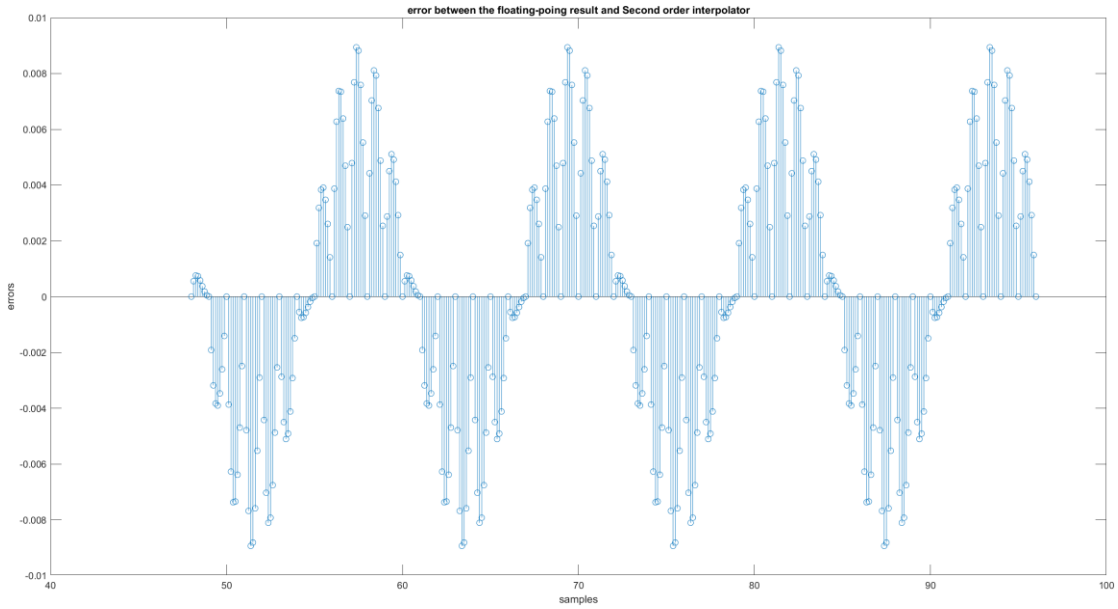


3. Show the error between the floating-point results and the interpolated outputs by linear interpolator, second-order polynomial interpolator, and piecewise parabolic interpolator in the region of $48 \leq m \leq 96$ with $\mu == 0, 1/8, 2/8, \ldots 7/8$. (15%)

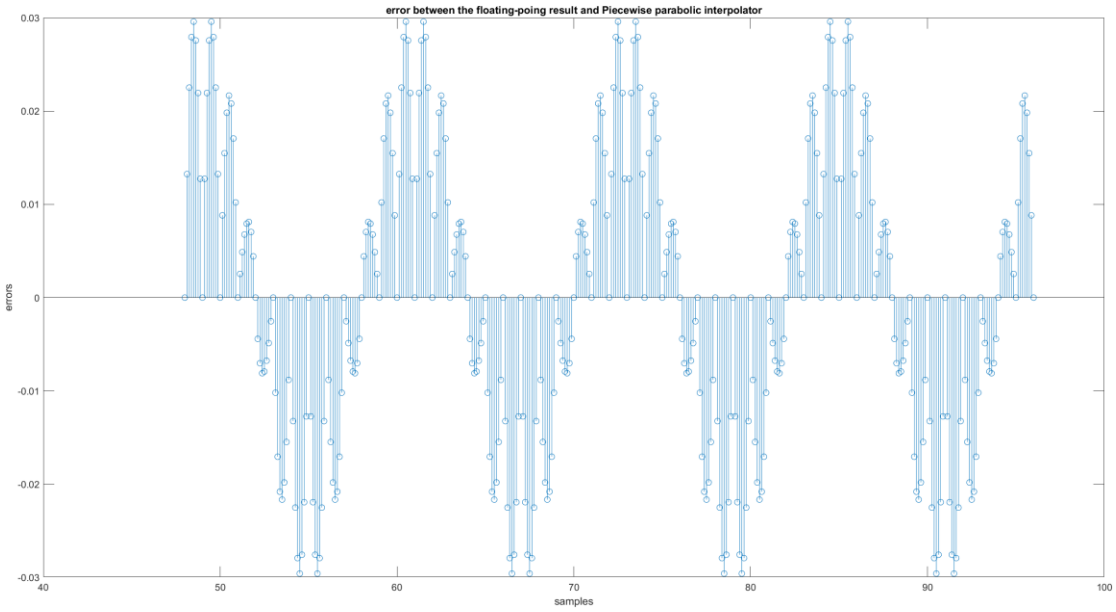
(1) The error between the floating-point results and the interpolated outputs by linear interpolator:



(2) The error between the floating-point results and the interpolated outputs by Second order polynomial interpolator:



(3) The error between the floating-point results and the interpolated outputs by piecewise parabolic interpolator:



Write your comments about comparison of interpolators. (5%)

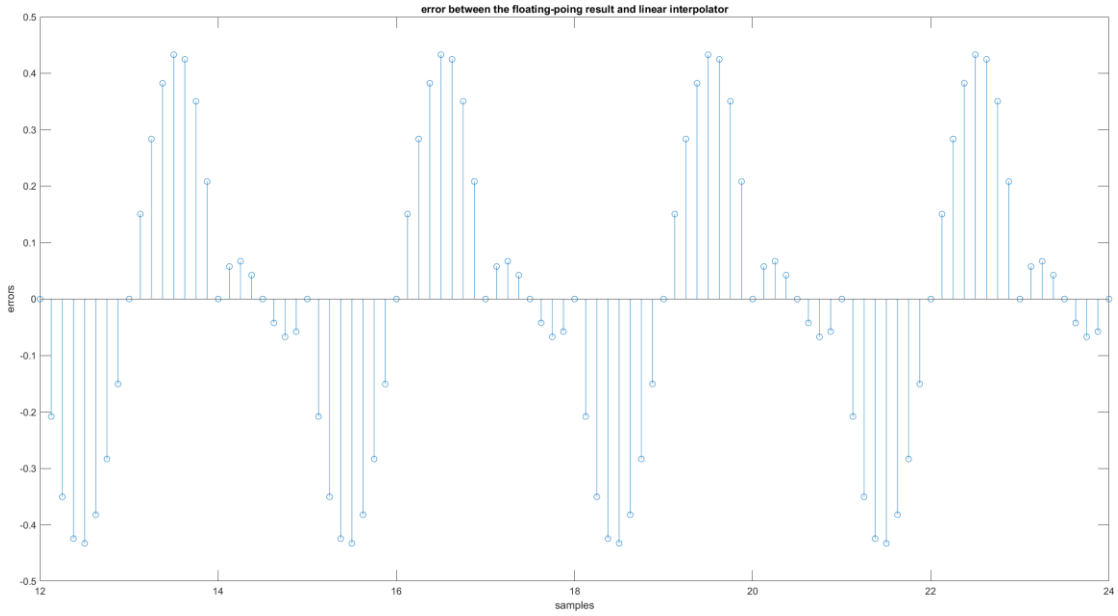
Linear interpolator 是上述 interpolators 最簡單的一個，依據前後的 x(m)與 x(m+1)決定插值的值，此作法容易根據 sample rate 的不同而有很大的誤差範圍。在此例中 Linear interpolator 則是三種 interpolators 中平均誤差最大的。

Second order polynomial interpolator 相對於 linear interpolator 則是多考慮一個 sample 的點，大幅增加了插值後的精度。在此例中 second order polynomial interpolator 是所有插值器中平均誤差最小的。

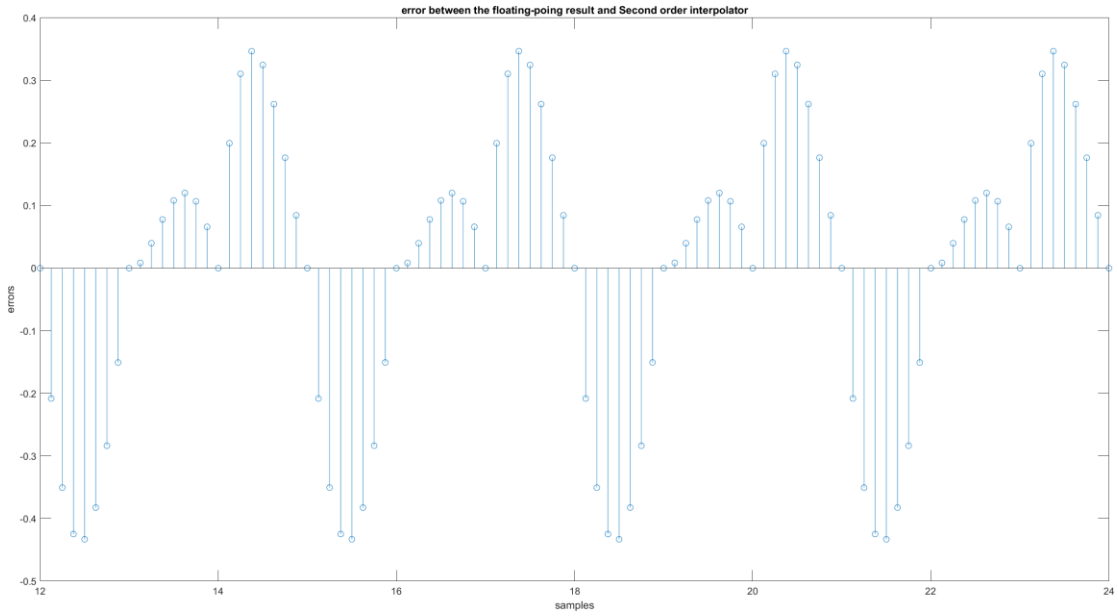
Piecewise parabolic interpolator 是三種差值器考慮的 samples 最多的差值器，理論上來說會是三者中誤差最小的差值器，不料此差值器在此例中平均誤差竟與 Linear interpolator 不相上下。此結果是由於 α 設在 0.5 所導致，學生分別使用 0.25、0.5 與 0.75 做了比較發現，α 越小 piecewise parabolic interpolator 的誤差會越小。

4. Show the error between the floating-point results and the interpolated outputs by linear interpolator, second-order polynomial interpolator, and piecewise parabolic interpolator in the region of $12 \leq m \leq 24$ with $\mu = 0, = 0, 1/8, 2/8, \ldots 7/8$ . . (15%)

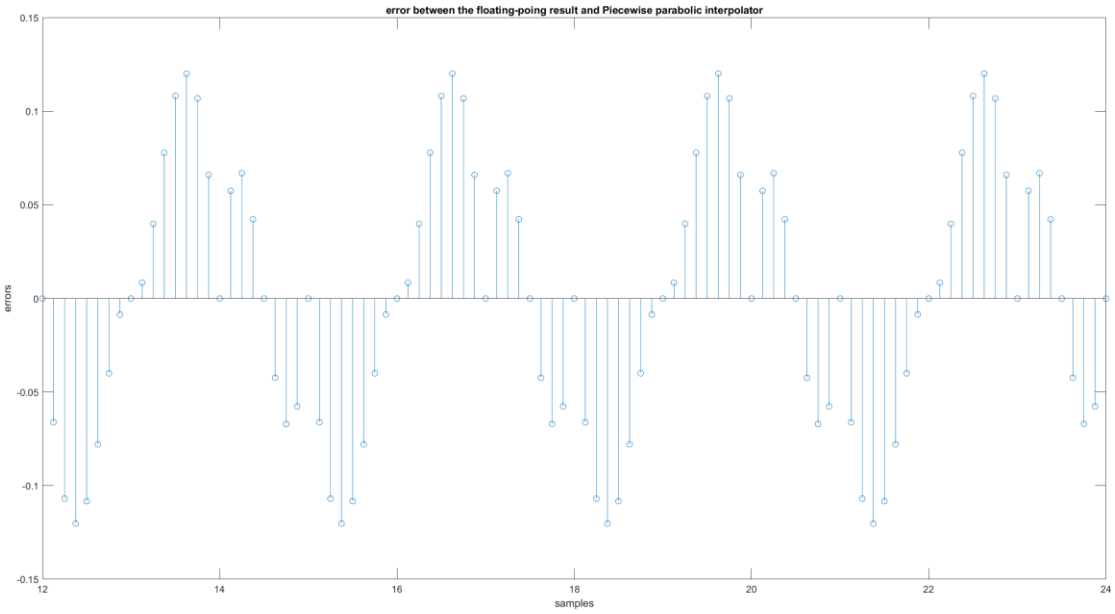
(1) The error between the floating-point results and the interpolated outputs by linear interpolator:



(2) The error between the floating-point results and the interpolated outputs by Second order polynomial interpolator:



(3) The error between the floating-point results and the interpolated outputs by piecewise parabolic interpolator:



Write your comments about comparison of interpolators (5%)

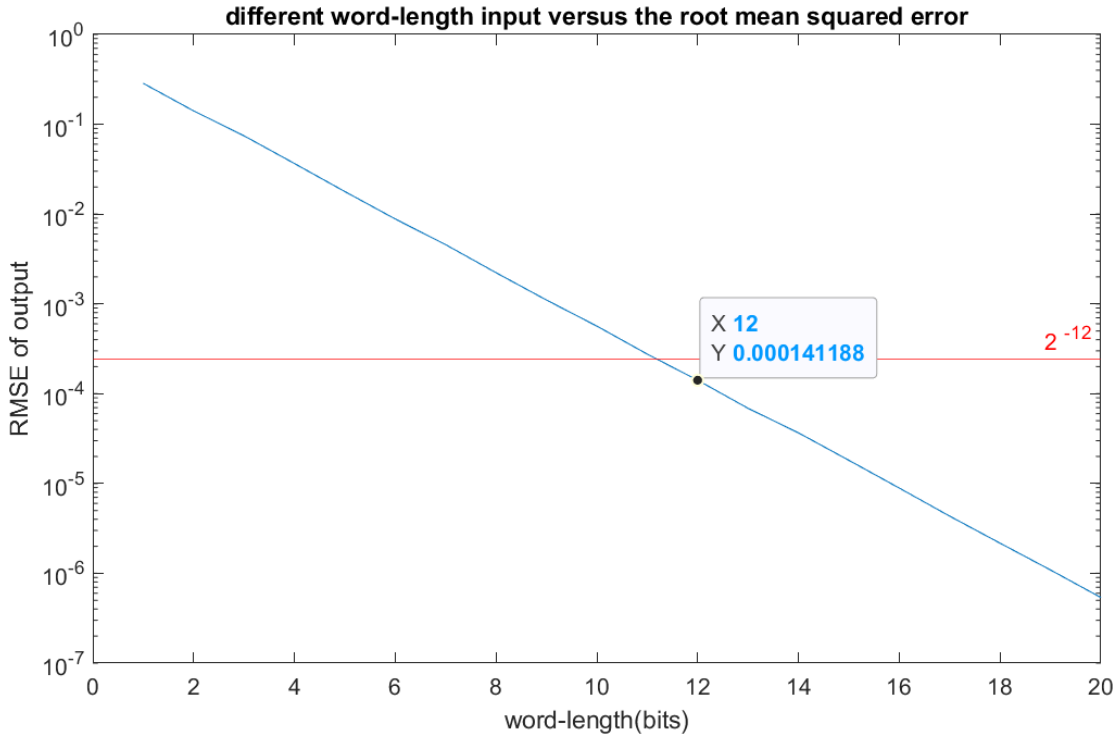
Linear interpolator 是上述 interpolators 最簡單的一個，依據前後的 x(m)與 x(m+1)決定插值的值，此作法容易根據 sample rate 的不同而有很大的誤差範圍。在此例中 Linear interpolator 則是三種 interpolators 中平均誤差最大的。

Second order polynomial interpolator 相對於 linear interpolator 則是多考慮一個 sample 的點。在此例中因取樣的頻率不同，Second order polynomial interpolator 的平均誤差與 Linear interpolator 差不多。

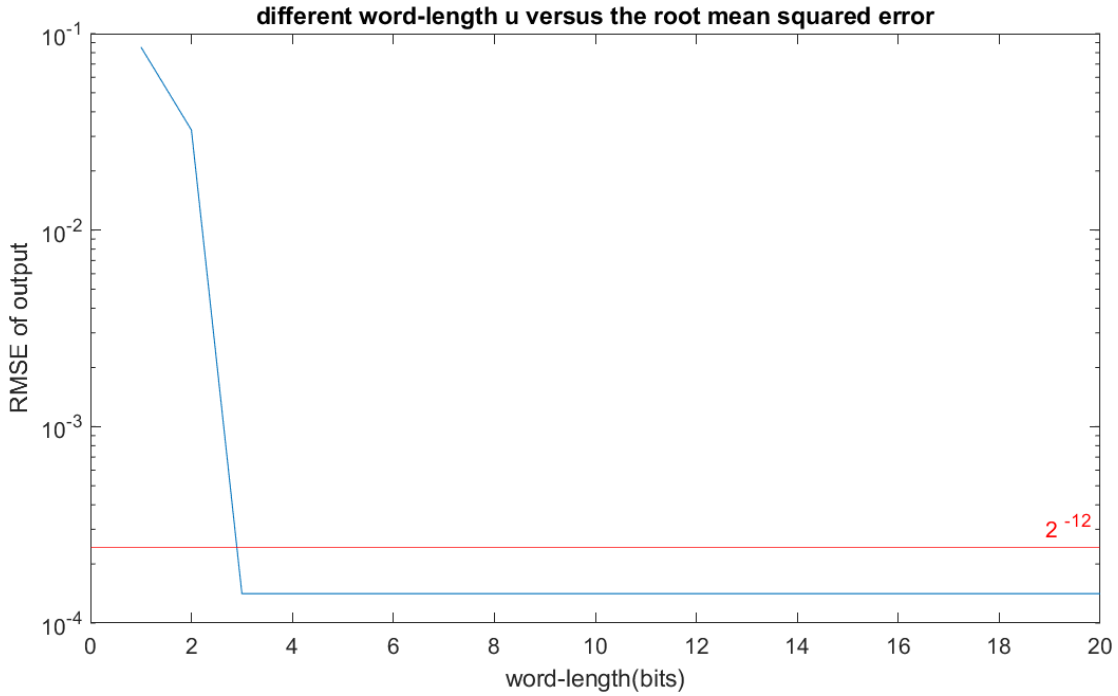
Piecewise parabolic interpolator 是三種差值器考慮的 samples 最多的差值器，在此例中 Piecewise parabolic interpolator 是所有插值器中平均誤差最小的。學生分別使用 0.25、0.5 與 0.75 做了比較發現，α 越大 piecewise parabolic interpolator 的誤差會越大。

5. Please depict the final architecture of the linear interpolator (6%) and show the results of different word-length settings versus the root mean squared error for

   a. Word-length of input. (7%)



   b. Word-length of μ. (7%)



The architecture of the linear interpolator: