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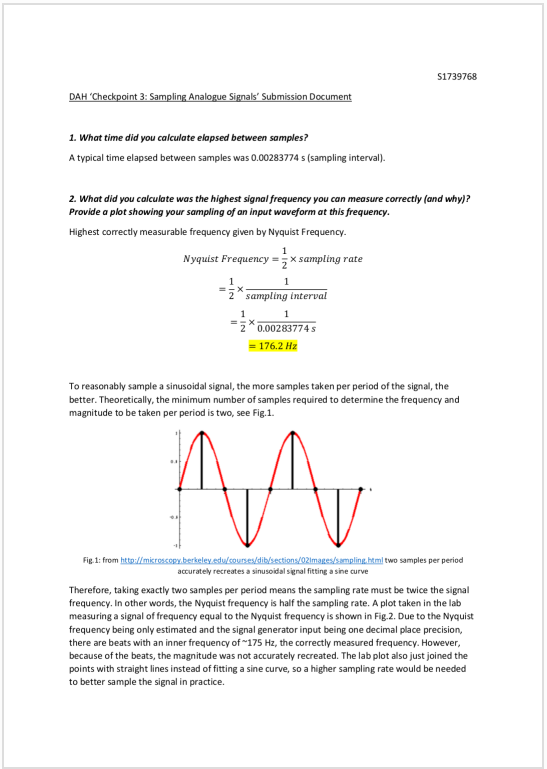
Assignment title:	DAH Checkpoint 3
Submission title:	Checkpoint 3 Submission
File name:	CP3_Submission_1.pdf
File size:	396.59K
Page count:	3
Word count:	459
Character count:	2,292
Submission date:	23-Oct-2020 12:46AM (UTC+0100)
Submission ID:	134595080



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DAH 'Checkpoint 3: Sampling Analogue Signals' Submission Document

1. What time did you calculate elapsed between samples?

A typical time elapsed between samples was 0.00283774 s (sampling interval).

2. What did you calculate was the highest signal frequency you can measure correctly (and why)? Provide a plot showing your sampling of an input waveform at this frequency.

Highest correctly measurable frequency given by Nyquist Frequency.

$$Nyquist\ Frequency = \frac{1}{2} \times sampling\ rate$$
$$= \frac{1}{2} \times \frac{1}{sampling\ interval}$$
$$= \frac{1}{2} \times \frac{1}{0.00283774\ s}$$
$$= 176.2\ Hz$$

To reasonably sample a sinusoidal signal, the more samples taken per period of the signal, the better. Theoretically, the minimum number of samples required to determine the frequency and magnitude to be taken per period is two, see Fig.1.

Fig.1: from http://microscopy.berkeley.edu/courses/dib/sections/02Images/sampling.html two samples per period accurately recreates a sinusoidal signal fitting a sine curve

Therefore, taking exactly two samples per period means the sampling rate must be twice the signal frequency. In other words, the Nyquist frequency is half the sampling rate. A plot taken in the lab measuring a signal of frequency equal to the Nyquist frequency is shown in Fig.2. Due to the Nyquist frequency being only estimated and the signal generator input being one decimal place precision, there are beats with an inner frequency of ~175 Hz, the correctly measured frequency. However, because of the beats, the magnitude was not accurately recreated. The lab plot also just joined the points with straight lines instead of fitting a sine curve, so a higher sampling rate would be needed to better sample the signal in practice.