Signal Analysis
Lab 8: Sampling Theorem and Filtering in the Frequency Domain

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Due: Dec 4, Group A - 10:00am, Group B - 2.00pm

1) Consider the analog signal $x(t) = 2\cos(10\pi t + \pi/6) + \cos(20\pi t + \pi/3)$. Discretize it using $f_s = 25$ Hz to obtain $x[n]$. Plot it for $0\,\mathrm{s} \leq \mathrm{t} \leq 0.5\,\mathrm{s}$. Write a code to reconstruct $x(t)$ from $x[n]$. Plot the reconstructed $x(t)$ by superimposing it on $x[n]$ and the original $x(t)$. Is $x(t)$ fully recovered from $x[n]$?
2) Once again, discretize the original $x(t)$ using $f_s = 15$ Hz to obtain a new $x[n]$. Plot it for $0\,\mathrm{s} \leq \mathrm{t} \leq 0.5\,\mathrm{s}$. Write a code to reconstruct $x(t)$ from $x[n]$. Plot the reconstructed $x(t)$ by superimposing it on $x[n]$ and the original $x(t)$. Is $x(t)$ fully recovered from $x[n]$?
3) Use the data in file $Lab6\_t\_T.csv$ that contains the temperature of Waterville, WA, USA recorded over several years. The 1st column is date in YYYYMMDD format, the 2nd column is the maximum temperature, and the 3rd column is the minimum temperature. Non-existent values are represented by -9999 and all values are given in tenths of °C. Use your code from above to interpolate for non-existent and missing data. Plot your results. Do you think this interpolation is accurate?
4) Using the above interpolated data, design a filter in the frequency domain to suppress seasonal variations in temperature. Plot the filter in time and frequency domains. Plot the data before and after filtering both in frequency and time domains.