

Indian Institute of Science
E9–252: Mathematical Methods and Techniques in Signal Processing
Instructor: Shayan G. Srinivasa
Homework #7, Fall 2017

Late submission policy: Points scored = Correct points scored $\times e^{-d}$, $d = \#$ days late
Assigned date: Oct. 16th 2017 **Due date:** Oct. 23rd 2017 by end of the day

PROBLEM 1:

Derive wavelet decomposition of a signal using m-adic Haar wavelets.

PROBLEM 2:

Let W_j be the space of all functions with basis $\psi(2^j t - k)$ where $k \in \mathbb{Z}$. Prove $V_{j+1} = V_j \oplus W_j$.

PROBLEM 3:

Obtain the Haar wavelet decomposition for the signal $f(t)$ using the Haar basis. Indicate the signal dimension at each subspace. Sketch the waveforms explicitly at each subspace. Obtain the reconstructed signal in functional form after nulling out any spike of $(1/8)^{\text{th}}$ unit of time. Analyze using Fourier Transform. How much of energy is lost in the recovered signal?

$$f(t) = \begin{cases} 3 & 0 \leq t < \frac{1}{4} \\ -1 & \frac{1}{4} \leq t < \frac{3}{8} \\ 2 & \frac{3}{8} \leq t < \frac{5}{8} \\ 0 & \frac{5}{8} \leq t < 1 \end{cases}$$