

Tune-Up Tuesday #8 Continuous-Time Convolution

Homework problem 7.4(a)iv. Convolve $x(t)$ and $h(t)$ where

- $x(t)$ is a rectangular pulse that lasts from 0 seconds to 9 seconds
- $h(t)$ is a rectangular pulse that lasts from 0 seconds to 4 seconds

Perform the convolution in continuous time using `cconvdemo` from *Signal Processing First*.

Install the code from <https://dspfirst.gatech.edu/matlab/ZipFiles/cconvdemo-v218.zip>. Please copy and paste the link into your browser, and unzip the contents in your local Matlab directory. Change directories to `cconvdemo` and run the command `cconvdemo`.

Describe the output $y(t)$.

Answer: Trapezoid of duration $T_y = 4 + 9 = 13$ seconds. Let $T_{min} = \min(4,9) = 4$ seconds and $T_{max} = \max(4,9) = 9$ seconds. As we flip and slide one rectangular pulse against the other, partial overlap occurs from 0 to T_{min} seconds, complete overlap from T_{min} to T_{max} seconds, and partial overlap from T_{max} to T_y seconds.

$$y(t) = \begin{cases} 0 & \text{for } t < 0 \\ t & \text{for } 0 \leq t < 4 \\ 4 & \text{for } 4 \leq t < 9 \\ 13 - t & \text{for } 9 \leq t < 13 \\ 0 & \text{for } t > 13 \end{cases}$$

We can check the points at the boundaries between intervals for a sanity check. For example, when $t = 4$, partial overlap gives an amplitude of 4 and so does complete overlap.

