

Convolution in Digital Signal Processing

Curriculum Module

Created with R2020b. Compatible with R2020b and later releases.

Description

This package contains [live scripts](#) and supporting data files centered around the fundamentals of convolution in digital signal processing. These materials are designed to be flexible and can be easily modified to accommodate a variety of teaching and learning methods. Used in a sequence, the live scripts progressively add depth to the topic. However, each script can be easily adapted for standalone use. We include a brief background, interactive illustrations, tasks, reflection questions, application examples, and guided exercises for the different concepts explored.

Suggested Prework

[MATLAB Onramp](#) – a free two-hour introductory tutorial to learn the essentials of MATLAB.

Details

`convolutionBasics.mlx`

Products: MATLAB, Signal Processing Toolbox

Learning Goals:

- Define and compute convolution of two 1-D signals
- Use FFT to compute 1-D convolution
- Define and compute circular convolution
- Achieve equivalence between circular and linear convolution

`convolutionLTI.mlx`

Products: MATLAB, Signal Processing Toolbox

Data files: *ringtone.wav*, *1st_baptist_nashville_balcony.wav*

Learning Goals:

- Identify the moving average operation as a simple LTI system
- Define an LTI system
- Compute the output of an LTI system for an arbitrary input signal given its impulse response

`convolutionFilters.mlx`

Products: MATLAB, Signal Processing Toolbox, Image Processing Toolbox (optional), Deep Learning Toolbox (optional)

Data files: *lettert.png*, *flower.jpg*

Learning Goals:

- Explain the frequency domain implications of convolving two signals in the time domain
- Apply convolution to perform low pass filtering of signals
- Define and compute convolution of two 2-D signals
- Perform spatial filtering of images to achieve effects such as blurring and embossing

`practiceExerciseSolns.mlx`

This script contains completed solutions for all the practice problems.