Window Function Transform and Visualization

Project Description:

I proposed a tool for transforming functions into window functions, which are zero-valued except a specific interval, and visualizing the resulting window functions. When the interval is around zero, resulting functions will become low-pass filters, which play an important role and are widely used in signal processing.

Method:

If statements in List Comprehension were utilized to define a specific non-zero interval for the window functions, and the initial values in the non-zero interval were set to be one. These window functions were then multiplied with functions that required to be transformed. Next, the transformed functions were plotted with a given range of t-axis, which was built as an array in advance. The sample number for plotting was tuned as 2000.

Demo:

To demonstrate the function of this tool, following six functions w_1~w_6 were transformed into window functions and then visualized. Non-zero intervals were set as $-0.5 < t < 0.5$, and the range for t-axis is assumed ±2.

(a) $w_1(t) = 1$

(b) $w_2(t) = 1 - 2\,|t|$

(c) $w_3(t) = 0.5 + 0.5\cos(2\pi t)$

(d) $w_4(t) = t + 0.5$

(e) $w_5(t) = \cos(\pi t/2)$

(f) $w_6(t) = e^{-0.5(t + 1/2)}$

Result: