**深 圳 大 学 实 验 报 告**

**课程名称：­ Signals and Systems**

**实验项目名称： Experiments on convolution of signals**

**学院： 电子与信息工程学院**

**专业： 电子信息与工程**

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**实验时间： 2024.4.18**

**实验报告提交时间： 2024.4.18**

**教务处制**

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| Aim of Experiment:  The aim of this experiment is to simulate the convolution of a periodic square wave signal, x(t), with an impulse response , using software. The results will be compared with those obtained from a hardware-based experiment to validate the effectiveness and accuracy of theoretical signal processing techniques when applied in practical, real-world systems. The parameters for *x*(*t*) and *h*(*t*) will be the same as those used in the hardware experiment to ensure a direct comparison. |
| Experiment Content:  Matlab simulation |
| Data Logging and Processing:    Fig 1 Relevant data    Fig 2 Function construction and convolution    Fig 3 Output result  Analysis of the experimental process:  In the experiment, I think the best challenge is how to output a better image. I use two methods to make my image more clearly.   * Normalization the convolution     After the normalization, the original figure and convolution can be shown clearly on the same picture.   * Dynamic coordinate range adjustment     After the adjustment, the original figure and convolution can be shown clearly on the same picture. |
| Experimental Results and Analysis:  Results:    Fig 4 The software experiment    Fig 5 The hardware experiment  Analysis   1. Design ideas:   Get the hardware experiment’ parameters and use the conv function. Then, use the matlab Picture Gallery to output the image.   1. Analyses and summaries of the experiments   Form the results we can easily see that the figure’s amplitude and the position of the image is different. The hardware’s image is all above the zero line. But the matlab simulation image has image below the zero line. The hardware’s voltage is limited from 0 to 5 v. Overall the real signal and simulated signal fairly similar.  Code:  % Initialisation  clc;  close all;  % Relevant parameters  frequency = 1e+4;  amplitude = 5;  offset = 1;  C = 1e-8;  R = 2.2e3;  % Time vector from -250 us to 250 us  t = linspace(-250e-6, 250e-6, 1000); % Increased number of points for better resolution  x = amplitude \* square(2 \* pi \* frequency \* t, 50) + offset; % Use 2\*pi\*f for the period  % Define the impulse response of an RC circuit  h = 1 / (R \* C) \* exp(-t / (R \* C));  % Convolution of the input signal with the impulse response  y = conv(h, x, "same");  % Normalize the convolution result  y = y / max(abs(y));  % Create a figure  figure;  % Plotting the impulse response h on the first subplot  subplot(2,1,1);  plot(t, h);  title('Impulse Response h(t)');  xlabel('Time (s)');  ylabel('Amplitude');  axis tight; % Tighten the axis around the plotted data  % Plotting the original square signal x and the convolved signal y result on the second subplot  subplot(2,1,2); % Selects the second subplot  plot(t, x, 'b', t, y, 'r--'); % 'b' for blue solid line, 'r--' for red dashed line  legend('Original Square Wave Signal y(t)', 'Convolved Signal Result(t)');  title('Original Square Wave Signal and Convolved Signal');  xlabel('Time (s)');  ylabel('Amplitude');  axis tight; % Tighten the axis around the plotted data  % Dynamically adjust the y-axis limits based on both y and x  combined\_min = min(min(x), min(y)); % Find the minimum value of both signals  combined\_max = max(max(x), max(y)); % Find the maximum value of both signals  % Set y-axis limits with some padding for better visibility  padding = 0.1 \* (combined\_max - combined\_min); % 10% padding  ylim([combined\_min - padding, combined\_max + padding]); |
| 指导教师批阅意见：  成绩评定：  指导教师签字：  年 月 日 |
| 备注： |

注：1、报告内的项目或内容设置，可根据实际情况加以调整和补充。

2、教师批改学生实验报告时间应在学生提交实验报告时间后10日内。