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实验摘要：

- 初步熟悉 MATLAB；
- 掌握 MATLAB 基本操作；
- 熟悉各种常见信号的 MATLAB 表示方法；
- 能够使用脚本画出信号图像。

实验题目

1. 利用 MATLAB 实现下列信号，并绘出图形

(1) $f_1(t)=\varepsilon(t)$，取 $t=-1\sim10$

(2) $f_2(t)=4e^{-0.5t}\cos(\pi t)$，取 $t=0\sim10$

(3) $f_3(t)=g_2(t)+g_4(t)$，取 $t=-10\sim10$

(4) $f_4(k)=\varepsilon(k+2)-\varepsilon(k-5)$

(5) $f_5(k)=7(0.6)^k\cos(0.9\pi k)$

(6) $f_6(t)=Sa(t)=\sin(t)/t$

2. 利用 MATLAB 实现以上信号 $f_3(t)$ 的变化：

(1) $f_3(2t)$

(2) $f_3(4-2t)$

(3) $f_3'(4-2t)$

3. 如下图所示：

9. *** Write a function called `square_wave` that computes the sum

$$\sum_{k=1}^{n}\frac{\sin((2k-1)t)}{(2k-1)}$$

for each of 1001 values of t uniformly spaced from 0 to 4π inclusive. The input argument is a positive scalar integer `n`, and the output argument is a row vector of 1001 such sums—one sum for each value of t. You can test your function by calling it with `n == 200` or greater and plotting the result, and you will see why the function is called "square_wave".

实验内容

一 实验基本原理及步骤

利用 **MATLAB** 的矩阵运算特性，用离散数据近似表示连续量，使用内置函数进行图像绘制。

各题目代码如下：

1.

```
%% Signal & System Experiment - Class 1 - Task 1
pace = 0.1;    % Determines accuracy, reduce to increase sampling
rate.
figure('name','Task 1', 'numbertitle','off');

% Figure 1.(1)
t = -1:pace:10;
f1 = stepfun(t,0);
subplot(321); plot(t,f1); title('Fig 1.(1)'); xlabel('t');
ylabel('f1');

% Figure 1.(2)
t = 0:pace:10;
f2 = 4.*exp(1).^(-0.5.*t).*cos(pi.*t);
subplot(322); plot(t,f2); title('Fig 1.(2)'); xlabel('t');
ylabel('f2');

% Figure 1.(3)
t = -10:pace:10;
f3 = rectpuls(t,2) + rectpuls(t,4);
subplot(323); plot(t,f3); title('Fig 1.(3)'); xlabel('t');
ylabel('f3');

% Figure 1.(4)
k = -10:10;
f4 = stepfun(k,-2) - stepfun(k,5);
subplot(324); stem(k,f4); title('Fig 1.(4)'); xlabel('k');
ylabel('f4');

% Figure 1.(5)
f5 = 7.*(0.6).^k.*cos(0.9.*pi.*k);
subplot(325); stem(k,f5); title('Fig 1.(5)'); xlabel('k');
ylabel('f5');

% Figure 1.(6)
t = -10:pace:10;
f6 = sinc(t./pi);
subplot(326); plot(t,f6); title('Fig 1.(6)'); xlabel('t');
ylabel('f6');
```

2.

```
%% Signal & System Experiment - Class 1 - Task 2
pace = 0.1;    % Determines accuracy, reduce to increase sampling
rate.
figure('name','Task 2', 'numbertitle','off');
f3 = @(t) rectpuls(t,2) + rectpuls(t,4);
t0 = -10:pace:10;

% Figure 2.(1)
t = 2.*t0;
f31 = f3(t);
subplot(311); plot(t0,f31); title('Fig 2.(1)'); xlabel('t');
ylabel('f3(2t)');

% Figure 2.(2)
t = 4-2.*t0;
f32 = f3(t);
subplot(312); plot(t0,f32); title('Fig 2.(2)'); xlabel('t');
ylabel('f3(4-2t)');

% Figure 2.(3)
t = t0;
f33 = diff(f3(t));
subplot(313); plot(t0(1:end-1),f33); title('Fig 2.(3)'); xlabel('t');
ylabel("f3'(2t)");
```

3.

```
%% Signal & System Experiment - Class 1 - Task 3
% Requires square_wave.m to function.
n = 200;    % Increase to gain accuracy.

t = linspace(0,4*pi,1001);
y = square_wave(n);
figure('name','Task 3', 'numbertitle','off');
plot(t,y); xlabel('t'); ylabel('y');
```

square_wave.m

```
function Sum = square_wave(n)
    t = linspace(0,4*pi,1001);
    Sum = zeros(1,1001);
    for k = 1:n
        temp = sin((2.*k - 1).*t)./(2.*k - 1);
        Sum = Sum + temp;
    end
end
```

二 实验结果

1.

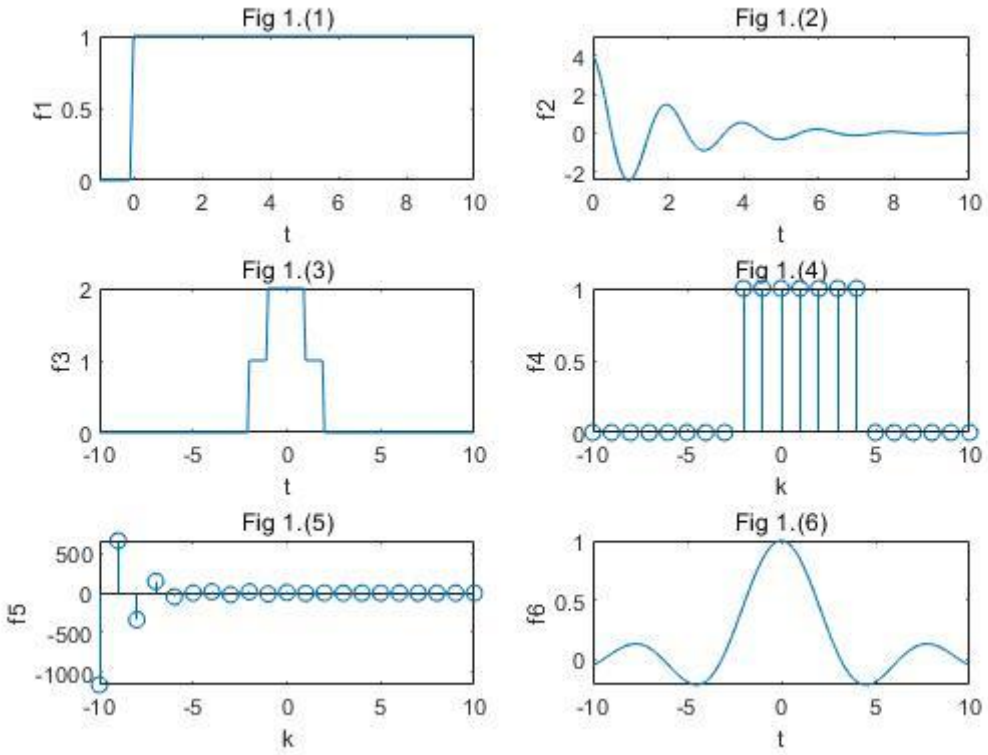


Fig 1.(1)
f1
t
Fig 1.(2)
f2
t
Fig 1.(3)
f3
t
Fig 1.(4)
f4
k
Fig 1.(5)
f5
k
Fig 1.(6)
f6
t

2.

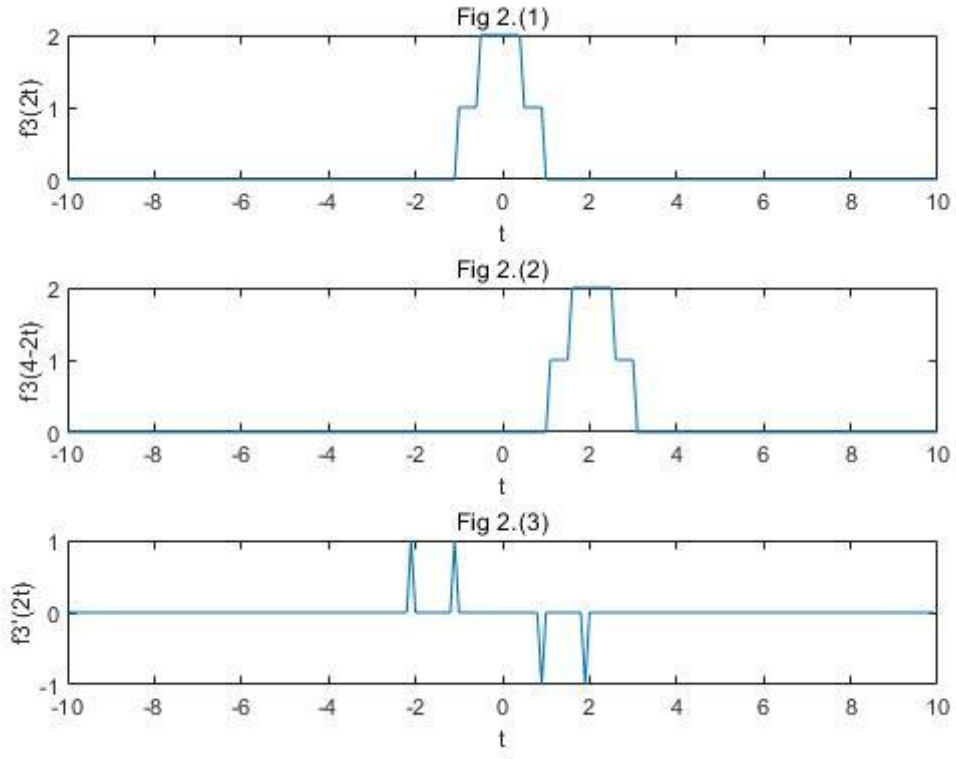
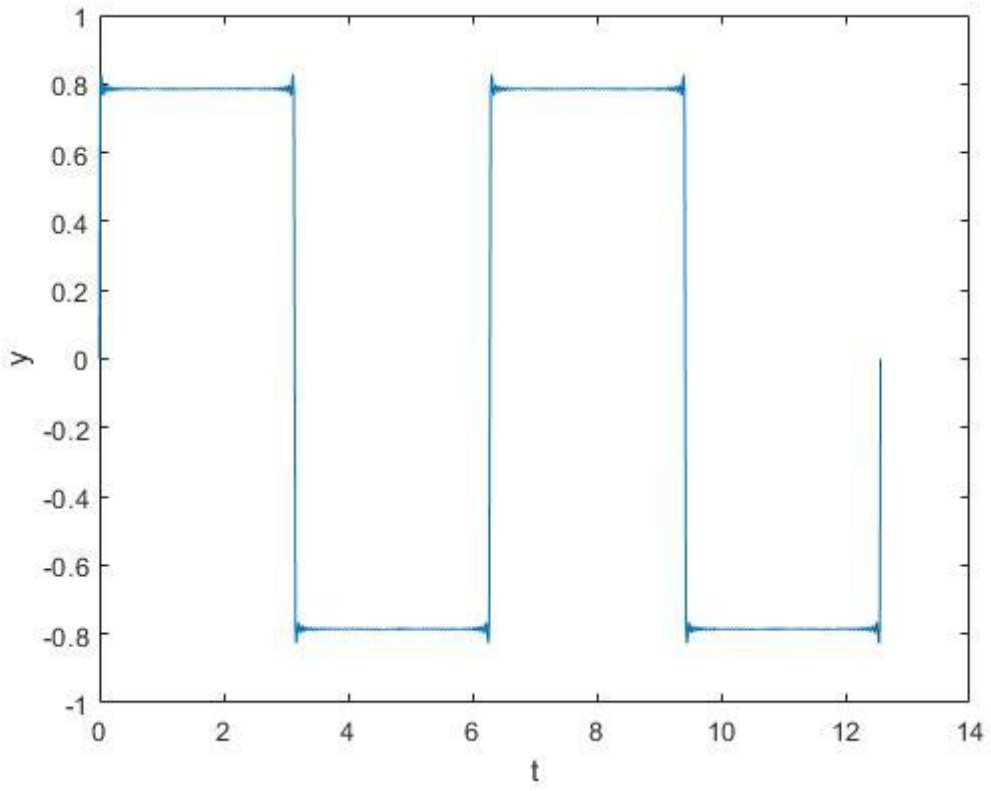


Fig 2.(1)
f3(2t)
t
Fig 2.(2)
f3(4-2t)
t
Fig 2.(3)
f3'(2t)
t

3.



三 实验结果的分析

达成实验目标，符合实验预期。

实验总结

部分绘图结果误差较大，通过适当调整 **pace** 变量增加采样率解决。

参考文献

- **MATLAB Documentation**
- **CSDN** 论坛
- 《信号与线性系统分析》 吴大正 编