Fourier Analysis

Example

Using Fourier series expansion, a square wave with a period of 2 ms, peak-to-peak value of 2 volts and average value of zero volts can be expressed as

$$g(t) = \frac{4}{\pi} \sum_{n=1}^{\infty} \frac{1}{(2n-1)} \sin\left[(2n-1)\, 2\pi\, f_0\, t\right]$$

where f_0 = 500 Hz

if $a(t)$ is given as

$$a(t) = \frac{4}{\pi} \sum_{n=1}^{m} \frac{1}{(2n-1)} \sin\left[(2n-1)\, 2\pi\, f_0\, t\right]$$

Write a MATLAB program to plot $a(t)$ from 0 to 4 ms at intervals of 0,05 ms and to show approximation of $g(t)$ for m = 2 to 40.

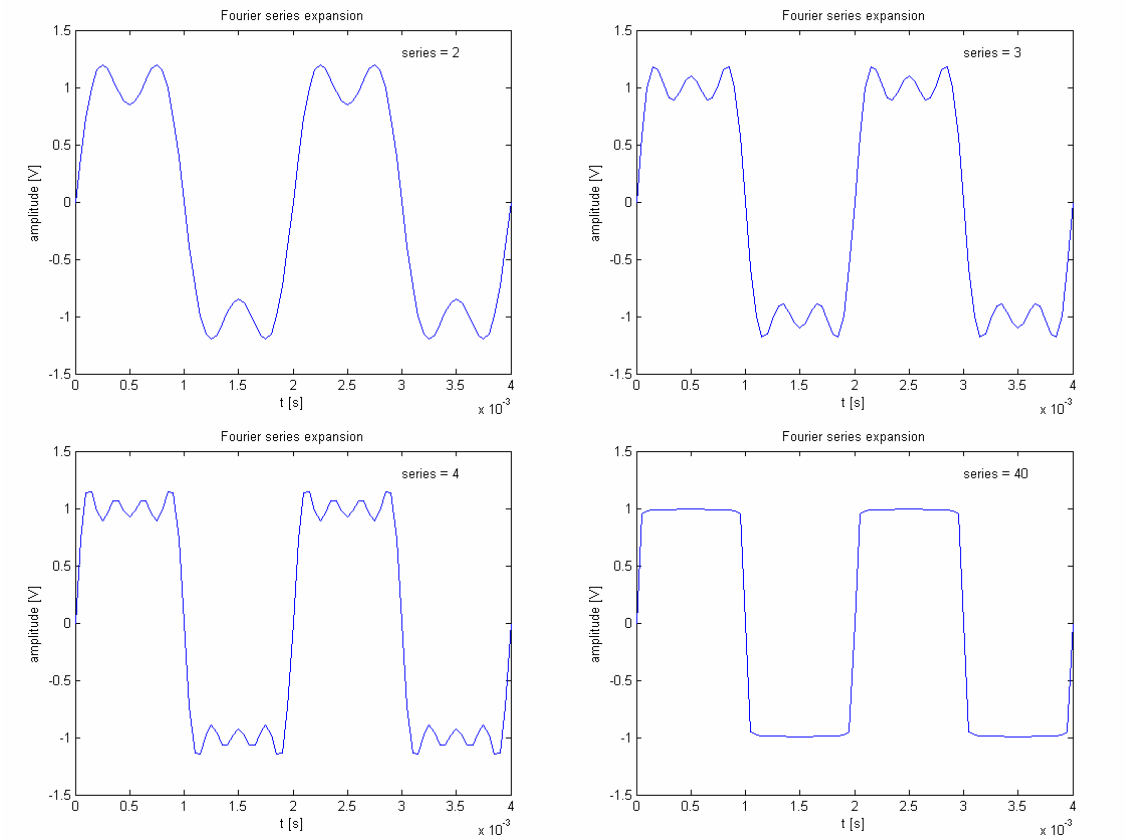
Solution

The MATLAB program for solving this task is

MATLAB Script

```
% Fourier Series Expansion
clear; clc;
f0=500; t=0:5e-5:4e-3; max_m=40;
for n=1:max_m
  s(n,:)=4/pi*sin((2*n-1)*2*pi*f0*t)/(2*n-1);
end
for m=2:max_m
 ex=sum(s(1:m,:));
 clf; % clear current figure
 plot(t,ex);
 xlabel('t [s]');
 ylabel('amplitude [V]');
 title('Fourier series expansion');
 axis([0 4e-3 -1.5 1.5]); % control axis scaling
 % It adds the text to location on the current axes.
 text(3e-3,1.3,['series = ',num2str(m)]);
 pause(0.2); % It pauses for 0.2 seconds before continuing.
end
```

Some plots obtained from MATLAB are



Notice

If you want the procedure to stop and wait for you to press any key before continuing, replace the command *pause* (*0.2*) by the command *pause*.