MATLAB Marina: Numerical Integration Examples

Numerical Integration of Exponential Function

The MATLAB program of Figure 1a computes the cumulative integral (approximate anti-derivative) of the exponential function $h(t) = 5.0e^{-25t}, t \geq 0s$. Figure 1b shows the function and its cumulative integral.

```
% function h(t) = 5e^(-25t), t > 0
t = 0 : 0.01 : 0.25;
h = 5*exp(-25*t);
% approximate anti-derivative of h(t)
cuminth = cumtrapz(t,h);

figure(1)
plot(t,h,'b-',t,cuminth,'g-')
xlabel('t')
legend('h(t)','approximate anti-derivative of h(t)')
```

Figure 1a. MATLAB Program Performing Numerical Integration of Exponential Function

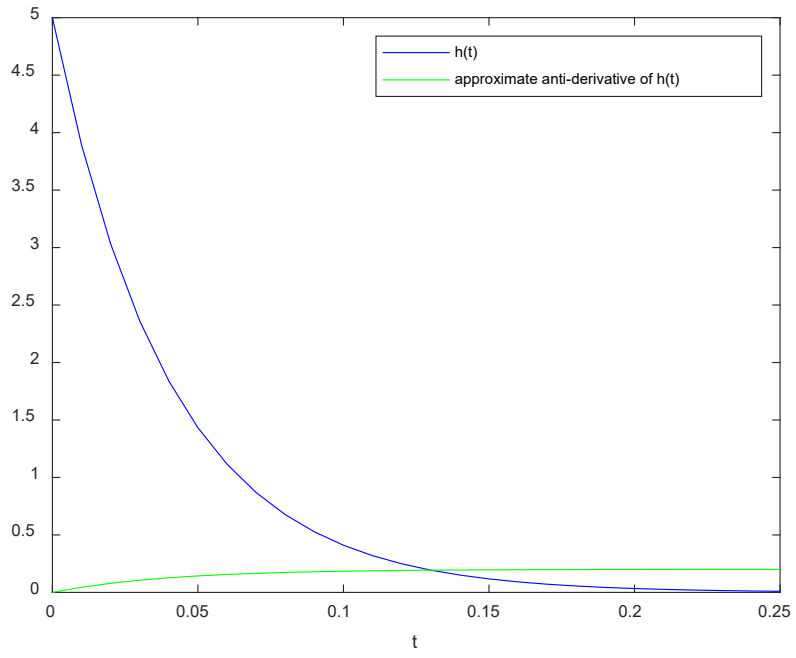

Figure 1b. Approximate Anti-derivative of Exponential Function

The analytical integral of h(t) is $\int_0^t 5.0e^{-25\tau}d\tau = \frac{5.0}{-25}e^{-25\tau}\Big|_0^t = -\frac{1}{5}e^{-25t} + \frac{1}{5}$ which corresponds to the plot of the cumulative integral.

Numerical Integration of Sinusoidal Function

The MATLAB program of Figure 2a computes the cumulative integral of $x(t) = 7.5\cos(10\pi t)$. Figure 2b shows the function and its cumulative integral.

```
% function x(t) = 7.5*cos(10*pi*t)
f = 5;
t = 0 : 1/(20*f) : 2/f;
x = 7.5*cos(10*pi*t);
% approximate anti-derivative of h(t)
cumintx = cumtrapz(t,x);

figure(1)
plot(t,x,'b-',t,cumintx,'g-')
xlabel('t'
legend('x(t)','approximate anti-derivative of x(t)')
```

Figure 2a. MATLAB Program Performing Numerical Integration of Sinusoidal Function

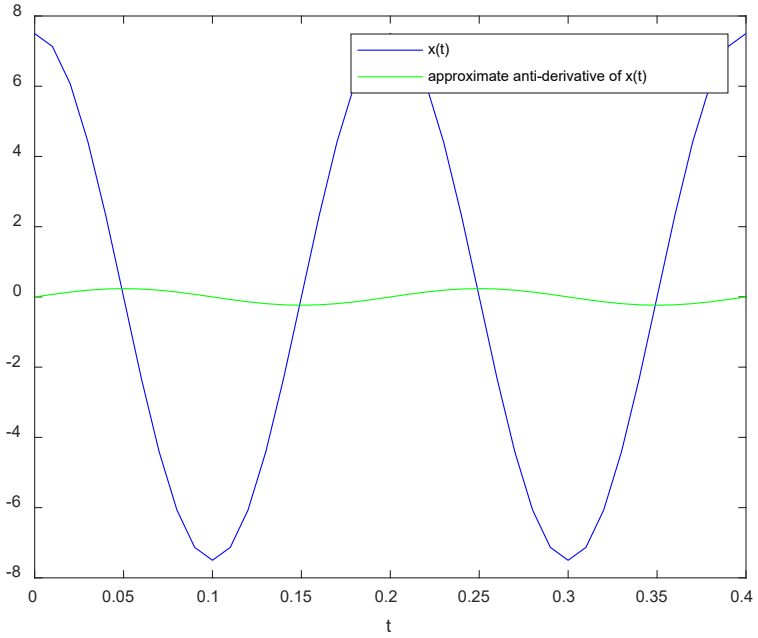

Figure 2b. Approximate Anti-derivative of Sinusoidal Function

The analytical integral of x(t) is $\int_0^t 7.5\cos(10\pi\tau)\,d\tau = \frac{7.5}{10\pi}\sin(10\pi\tau)\Big|_0^t = \frac{7.5}{10\pi}\sin(10\pi t)$ which corresponds to the plot of the cumulative integral.

Last modified October 21, 2020

MATLAB Marina is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.