Numerical Methods

**Assignment 9**

**1 st order ODE-IVP**

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**Problem**

Solve for the response of an RC circuit with a sinusoidal input

텍스트, 시계, 손목시계이(가) 표시된 사진

자동 생성된 설명

tau=1; T=1/tau; f=10; Vm=1; w=2\*pi\*f; a=0; b=0.1; h=0.001;

**Procedure**

* **Write down a pseudocode for the function of (1) Euler and (2) Euler's modified method**

**Euler**

**// Variable Initializing +) Myfunc pseudocode**

**// Euler Method**

**Euler Modified**

**// Variable Initializing**

**// Euler Modified Method**

* **Use MATLAB’s function command “ ode45()” to solve for the answer and plot the result.**

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| Figure 1.1 MATLAB Simulation(1) | Figure 1.2 MATLAB Simulation(2) |

MATLAB Simulation결과 ‘ode45()’함수를 이용하여 얻은 값과 Euler Modified Method를 통해서 얻은 값이 오차 없이 거의 일치함을 확인할 수 있었다.

반면에 Euler Method를 통해서 얻은 값은 값이 Euler Modified Method와 비교하여 오차가 비교적 큼을 직관적으로 확인해볼 수 있었다.

**MATLAB code**

clear all ; close all; clc;

% Given Properties

a = 0; b = 0.1;

h = 0.001; yINI = 0;

t = a:h:b; y(1) = yINI;

N = (b-a)/h;

tau = 0.01; T = 1/tau;

f = 100; Vm = 1;

w = 2\*pi\*f;

% Solving Equation Using Ode 45

[tmat,ymat] = ode45(@myRC, [a b], yINI); % Fourth/Fifth RK

figure();

plot(tmat,ymat,'\*k');

hold on;

% Euler Explicit Method

yE(1) = yINI;

for i = 1:N

t(i+1) = t(i) + h;

yE(i+1) = yE(i) + myRC(t(i),yE(i))\*h;

end

plot(t,yE,'-b');

hold on;

% Euler Modified Method

yEu = 0;

Slope2 = 0;

yEM(1) = yINI;

for i = 1:N

t(i+1) = t(i) + h;

Slope1 = myRC(t(i),yEM(i));

yEu = yEM(i)+Slope1\*h;

Slope2 = myRC(t(i+1), yEu);

yEM(i+1) = yEM(i) + (Slope1+Slope2)\*h/2;

end

plot(t,yEM,'-r')

hold off

% Plot Propertiews

title("NM\_ODE\_Euler");

grid on;

xlabel('x'); ylabel('y');

xlim([0 0.1])

ylim([-0.02, 0.02])

legend('ODE45' , 'EU' , 'EM');

% Given Problem

function dvdx = myRC(t,v)

tau = 1;

T = 1/tau;

f = 10;

Vm = 1;

dvdx = -T\*v + 1\*T\*Vm\*cos(2\*pi\*f\*t);

end

* **Create your own C/C++ function.**

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| Figure 2.1 Defining Functions |
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| Figure 2.2 C Code of Euler Method |
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| Figure 2.3 C Code of Euler Modified Method |

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| Figure 2.5 Main Code |
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| Figure 2.6 Given Equation |

* **Obtain the result. You can plot the results in MATLAB**

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| Figure 3.1 Euler Method Result from MATLAB | | |
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| Figure 3.2 Euler Method Result from C | | |
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| Figure 3.3 Euler Modified Method Result from MATLAB | | |

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| Figure 3.4 Euler Modified Method Result from C | | |

MATLAB을 통해서 얻은 결과값과 C를 통해서 구현한 결과값이 일치함을 확인함으로써 Visual Studio를 통해 Euler Method와 Euler Modified Method를 성공적으로 구현하였음을 확인하였다.

* **You can also create a function that calls different ODE method**

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| **텍스트이(가) 표시된 사진  자동 생성된 설명** |
| Figure 4.1 C Code of ODE Method |