%%%%% EWP spectrum analysis %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%% by shpegun60%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

clc; clear; % clear command line and workspace

syms x n;

% definition symbols

assume(n,'integer');

assumeAlso(n >= 0);

assume(x >= 0);

%define variables for deep understand

notParityConstant = 2\*(n+1); % not parity constant

mulConstant = sqrt(notParityConstant/(pi\*(n+2))); % multiplication constant for parity and non parity parameters

cosNotParityArgument = cos(x\*(2\*n + 3)); % cos with non parity argument

sinParityArgument = sin(x\*(2\*n + 2)); % sin with parity argument

sinNotParityArgument = sin(x\*(2\*n + 3)); % sin with non parity argument

cosParityArgument = cos(x\*(2\*n + 4)); % cos with parity argument

% non parity EWP parameter definition \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

U2n1 = mulConstant \* ((sinParityArgument/(notParityConstant\*sin(x))) - cosNotParityArgument);

% parity EWP parameter definition \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

U2n2 = mulConstant \* ((1/notParityConstant)\*(sinNotParityArgument/sin(x) - 1) - cosParityArgument);

%plot parameters \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

plotX = linspace(0.001, pi-0.001, 100); % space for x value

plotN = linspace(0, 3, 4); % space for n value

U2n1Plot = zeros(length(plotN),length(plotX));

U2n2Plot = zeros(length(plotN),length(plotX));

U2n1X = subs(U2n1,x,plotX);

U2n2X = subs(U2n2,x,plotX);

for i=1:length(plotN)

U2n1Plot(i,:) = subs(U2n1X,n,plotN(i));

U2n2Plot(i,:) = subs(U2n2X,n,plotN(i));

end

figure('Name','Non parity and parity EWP parameters','NumberTitle','off');

% plot non parity EWP parameter

subplot(2,1,1);

plot(plotX,U2n1Plot);

title('Non-parity parameter');

set(gca, 'XTick',0:0.2:pi);

axis([0 pi -1 1]);

grid on;

xlabel('x')

ylabel('U2n+1')

legend({'n = 0','n = 1','n = 2','n = 3'},'Location','southwest');

legend('boxoff');

% plot parity EWP parameter

subplot(2,1,2);

plot(plotX,U2n2Plot);

title('Parity parameter');

set(gca, 'XTick',0:0.2:pi);

axis([0 pi -1.2 1]);

grid on;

xlabel('x');

ylabel('U2n+2');

legend({'n = 0','n = 1','n = 2','n = 3'},'Location','southwest');

legend('boxoff');

% find elementary wawe coeficient A2n1 and B2n2 for some function\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

syms m;

assume(m >= 0);

%analysis main function \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

%myFunction = sqrt(2/pi)\*sin(m\*x); %%

myFunction =sqrt(2/pi)\*((x\*(pi-x))^0.1) \* sin(m\*x);

myFunctionDX = diff(myFunction,x);

myFunctionIntegral = int(myFunction ,x,0.001,pi-0.001);

spaceMFunction = 2:2:6;

spaceXFunction = linspace(0.001, pi-0.001, 200);

myFunctionPlot = zeros(length(spaceMFunction),length(spaceXFunction));

myFunctionDXPlot = zeros(length(spaceMFunction),length(spaceXFunction));

functionX = subs(myFunction,x,spaceXFunction);

functionDX = subs(myFunctionDX,x,spaceXFunction);

for i=1:length(spaceMFunction)

myFunctionPlot(i,:) = subs(functionX,m,spaceMFunction(i));

myFunctionDXPlot(i,:) = subs(functionDX,m,spaceMFunction(i));

end

figure('Name','my function','NumberTitle','off');

subplot(3,1,1);

% plot my function

plot(spaceXFunction,myFunctionPlot);

title('my function');

set(gca, 'XTick',0:0.2:pi);

axis([0 pi -1 1]);

grid on;

xlabel('x')

ylabel('f(x)')

legend({'m = 2','m = 4','m = 6'},'Location','southwest');

legend('boxoff');

subplot(3,1,2);

% plot my function

plot(spaceXFunction,myFunctionDXPlot);

title('my function differential');

set(gca, 'XTick',0:0.2:pi);

axis([0 pi -5 5]);

grid on;

xlabel('x')

ylabel('f ''(x)')

legend({'m = 2','m = 4','m = 6'},'Location','southwest');

legend('boxoff');

spaceMFunctionIntegral = linspace(0.001, 6, 100);

myFunctionIntPlot = zeros(length(spaceMFunctionIntegral),1);

for i=1:length(spaceMFunctionIntegral)

myFunctionIntPlot(i) = subs(myFunctionIntegral,m,spaceMFunctionIntegral(i));

end

subplot(3,1,3);

plot(spaceMFunctionIntegral,myFunctionIntPlot);

title('my function integral');

set(gca, 'XTick',0:0.5:6);

grid on;

xlabel('m')

ylabel('integral')

%\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

integralNotParityFunction = myFunction \* U2n1;

integralParityFunction = myFunction \* U2n2;

integralSpaceM = 2:2:6;

integralSpaceN = 0:1:7;

notParityEWPcoeficients = zeros(length(integralSpaceM),length(integralSpaceN));

parityEWPcoeficients = zeros(length(integralSpaceM),length(integralSpaceN));

integralNotParityFunctionN = subs(integralNotParityFunction,n,integralSpaceN);

integralParityFunctionN = subs(integralParityFunction,n,integralSpaceN);

% find A2n1 and B2n2 in cycle and put to 2-dimensional array

for i=1:length(integralSpaceM)

notParityEWPcoeficients(i,:)=int(subs(integralNotParityFunctionN,m,integralSpaceM(i)) ,x,0.001,pi-0.001);

parityEWPcoeficients(i,:)=int(subs(integralParityFunctionN,m,integralSpaceM(i)) ,x,0.001,pi-0.001);

end

figure('Name','Non-parity and parity EWP coeficients','NumberTitle','off');

% plot non parity EWP coeficient

subplot(2,1,1);

plot(integralSpaceN,notParityEWPcoeficients,'-s','MarkerIndices',1:1:length(notParityEWPcoeficients));

title('Non-parity EWP coeficient');

grid on;

xlabel('n')

ylabel('A2n+1')

legend('m = 2','m = 4','m = 6');

legend('boxoff');

% plot parity EXP coeficient

subplot(2,1,2);

plot(integralSpaceN,parityEWPcoeficients,'-s','MarkerIndices',1:1:length(notParityEWPcoeficients));

title('Parity EWP coeficient');

grid on;

xlabel('n')

ylabel('B2n+2')

legend({'m = 2','m = 4','m = 6'},'Location','northwest');

legend('boxoff');



