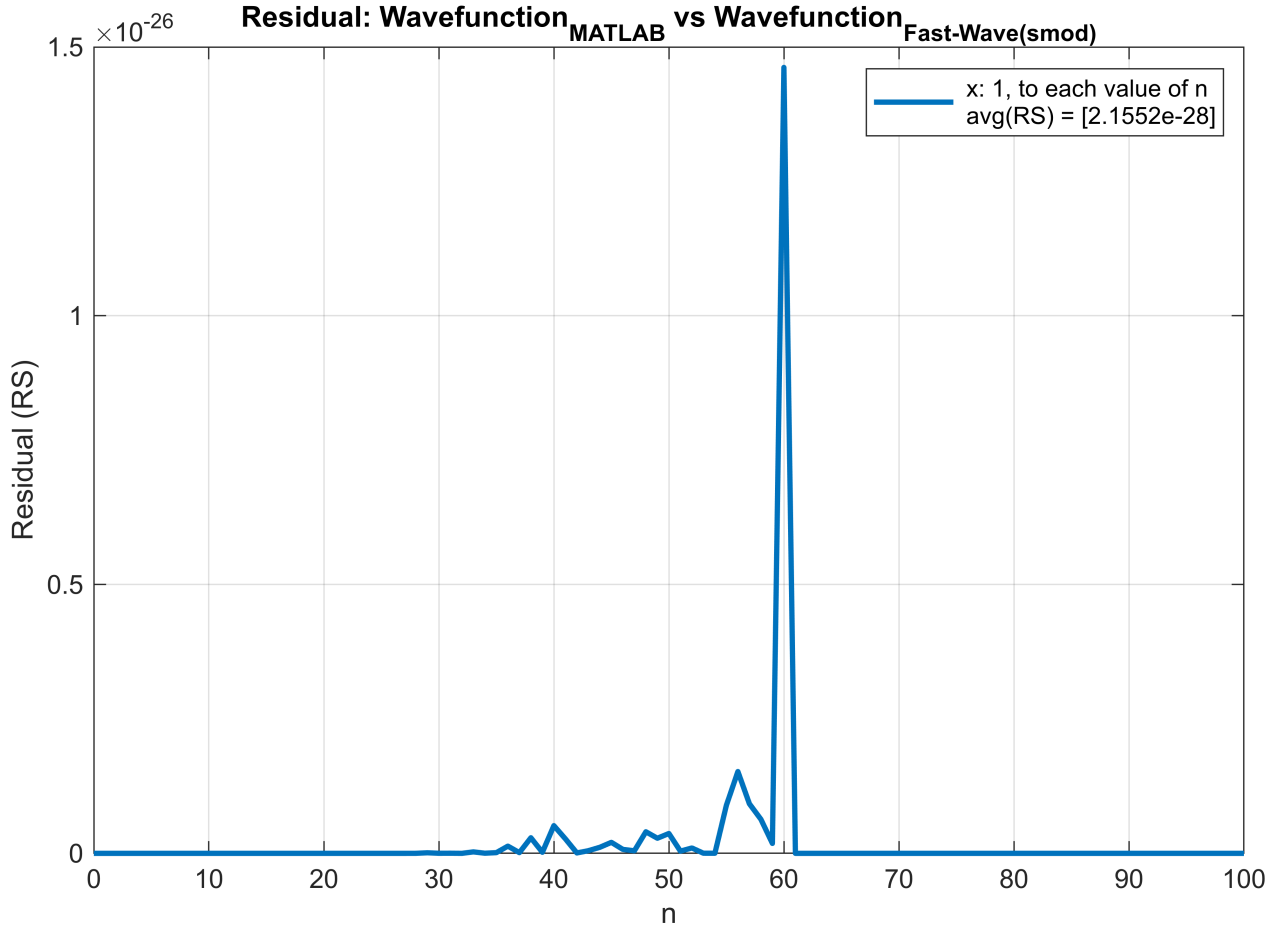
Global Variables

```
prec = 100;
digits(prec);
```

Tests

Single-Mode and Onedimensional Function with x = 1.0

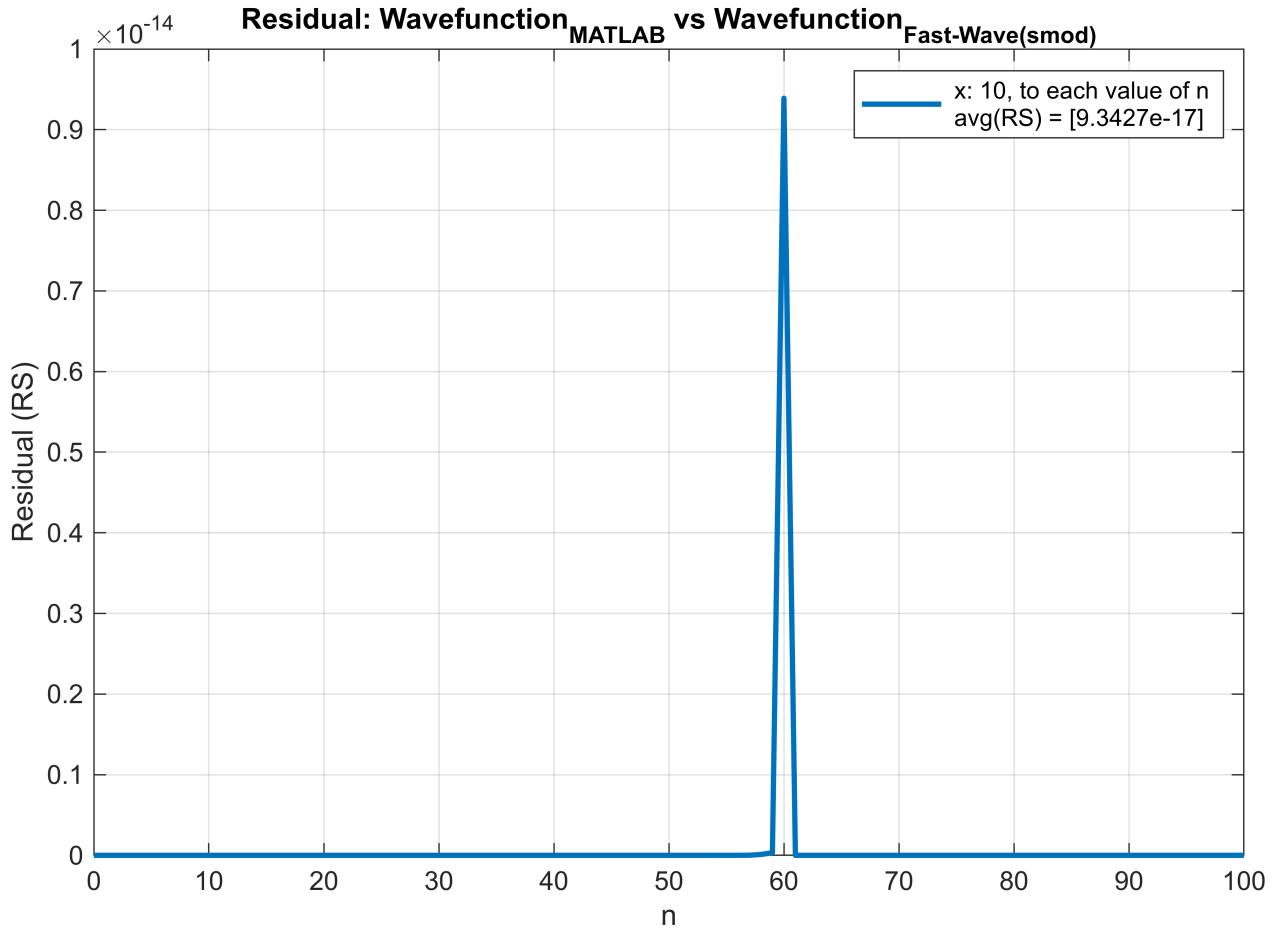
```
import py.fast_wave.wavefunction.wavefunction_smod

N_max = 100;
x = 1.0;

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual(index,:) = (wavefunction_MATLAB_1(index-1, x, prec) -
vpa(wavefunction_smod(uint64(index-1), x)))^2;
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' x: ' + string(x)+', to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(smod)}');
```



Single-Mode and Onedimensional Function with x = 50.0

```
import py.fast_wave.wavefunction.wavefunction_smod

N_max = 100;
x = 10.0;

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual(index,:) = (wavefunction_MATLAB_1(index-1, x, prec) -
vpa(wavefunction_smod(uint64(index-1), x)))^2;
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
```

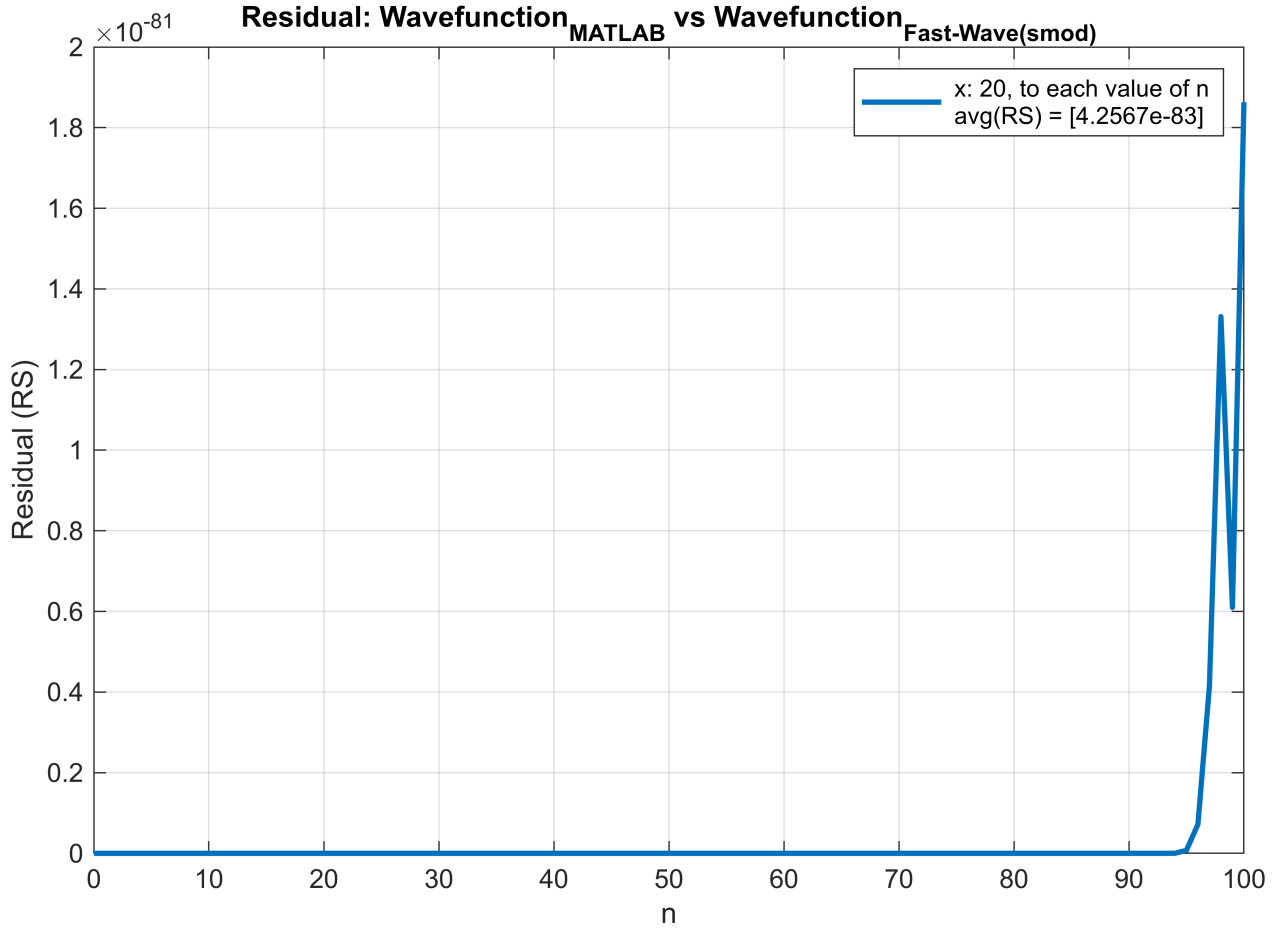
```
ylabel('Residual (RS)');
legend(sprintf(' x: ' + string(x)+', to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(smod)}');
```



Single-Mode and Onedimensional Function with x = 20.0

```
import py.fast_wave.wavefunction.wavefunction_smod

N_max = 100;
x = 20.0;

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual(index,:) = (wavefunction_MATLAB_1(index-1, x, prec) -
vpa(wavefunction_smod(uint64(index-1), x)))^2;
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
```

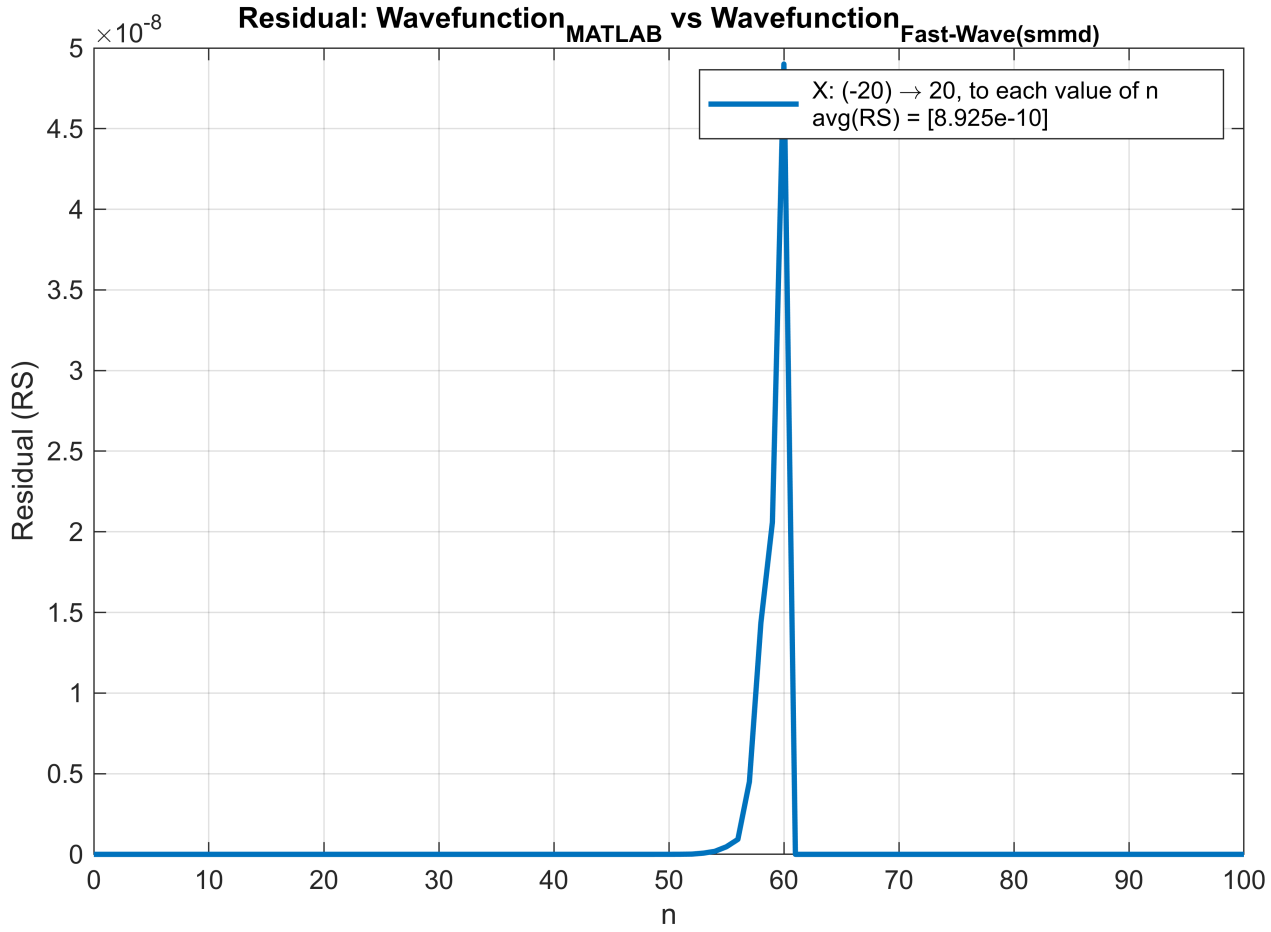
```
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' x: ' + string(x)+', to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(smod)}');
```



Single-Mode and Multidimensional Function with X: (-20) → 20

```
import py.fast_wave.wavefunction.wavefunction_smmd

N_max = 100;
x_max = 20.0;
x_min = -20.0;
x_size = 100;
X = linspace(x_max,x_min,x_size);

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
```

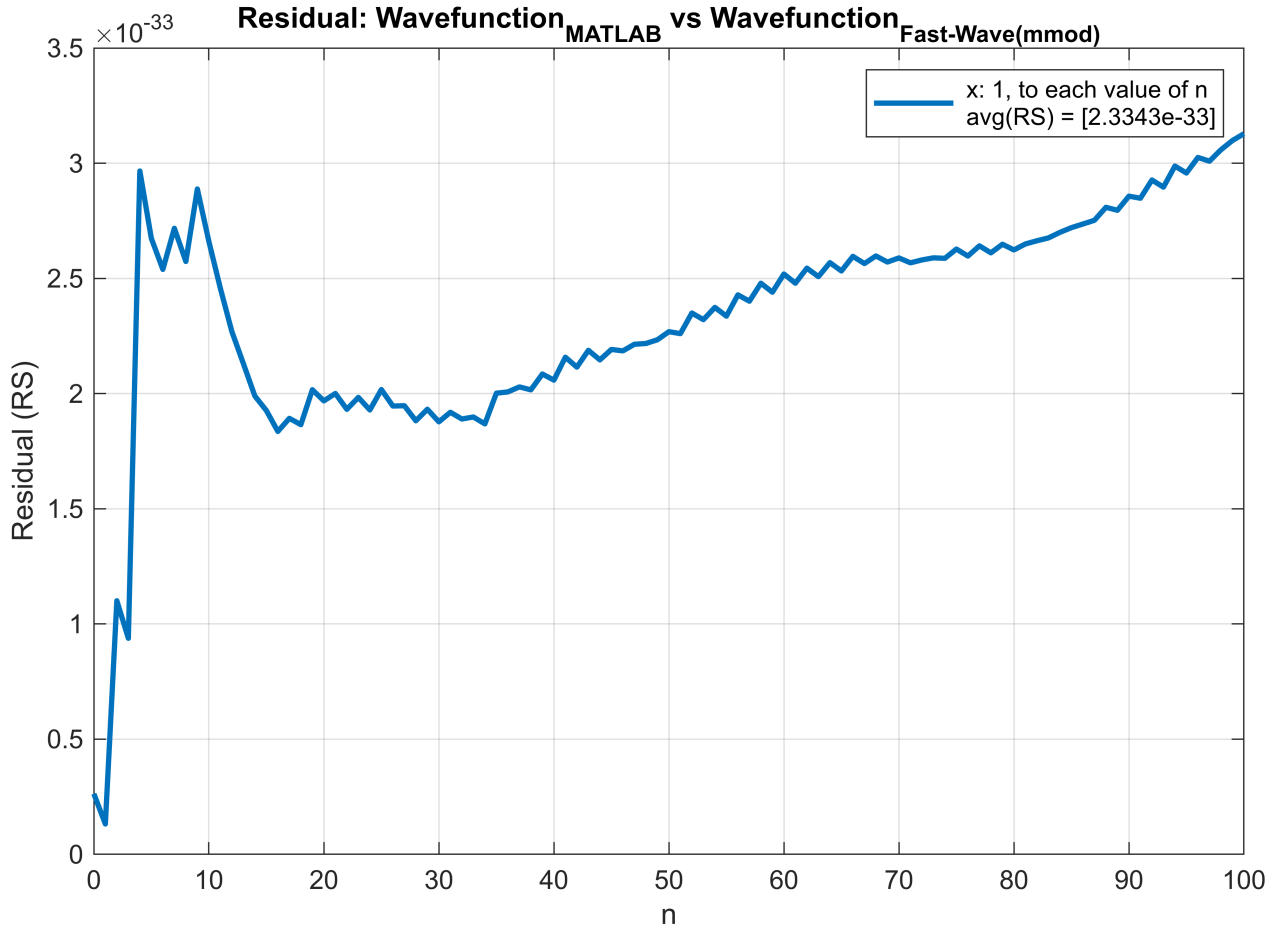
```
    Residual(index,:) = mean((wavefunction_MATLAB_1(index-1, X, prec) -
vpa(double(wavefunction_smmd(uint64(index-1), py.tuple(X))))).^2);
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' X: (-20) \\rightarrow 20, to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(smmd)}');
```



Multi-Mode and Onedimensional Function with x = 1.0

```
import py.fast_wave.wavefunction.wavefunction_mmod

N_max = 100;
x = 1.0;

Residual = vpa(zeros(N_max+1, 1));
```

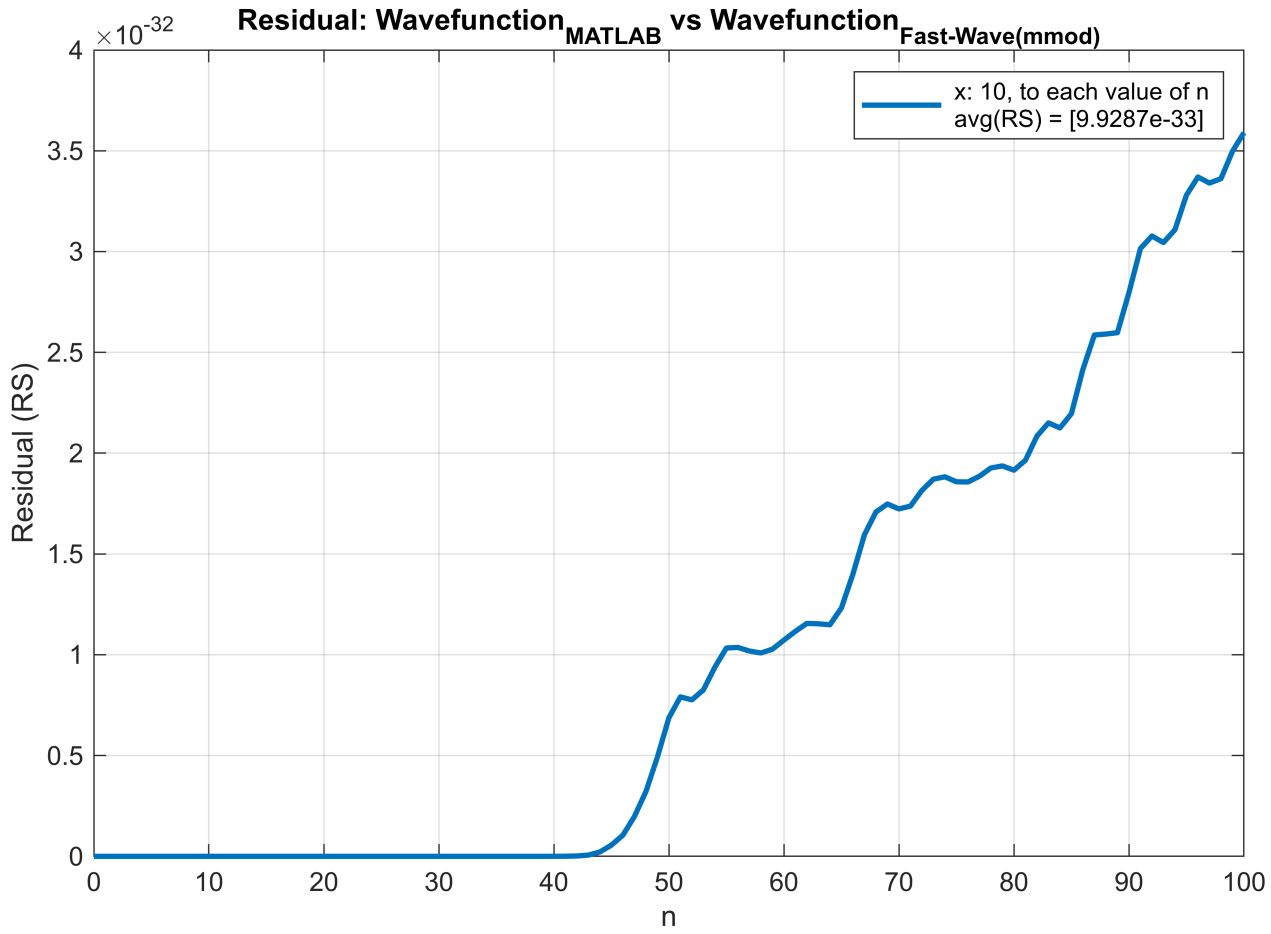
```
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual(index,:) = mean((wavefunction_MATLAB_3(index-1, x, prec) -
vpa(double(wavefunction_mmod(uint64(index-1), x)))).^2);
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' x: '+string(x)+', to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(mmod)}');
```



Multi-Mode and Onedimensional Function with x = 10.0

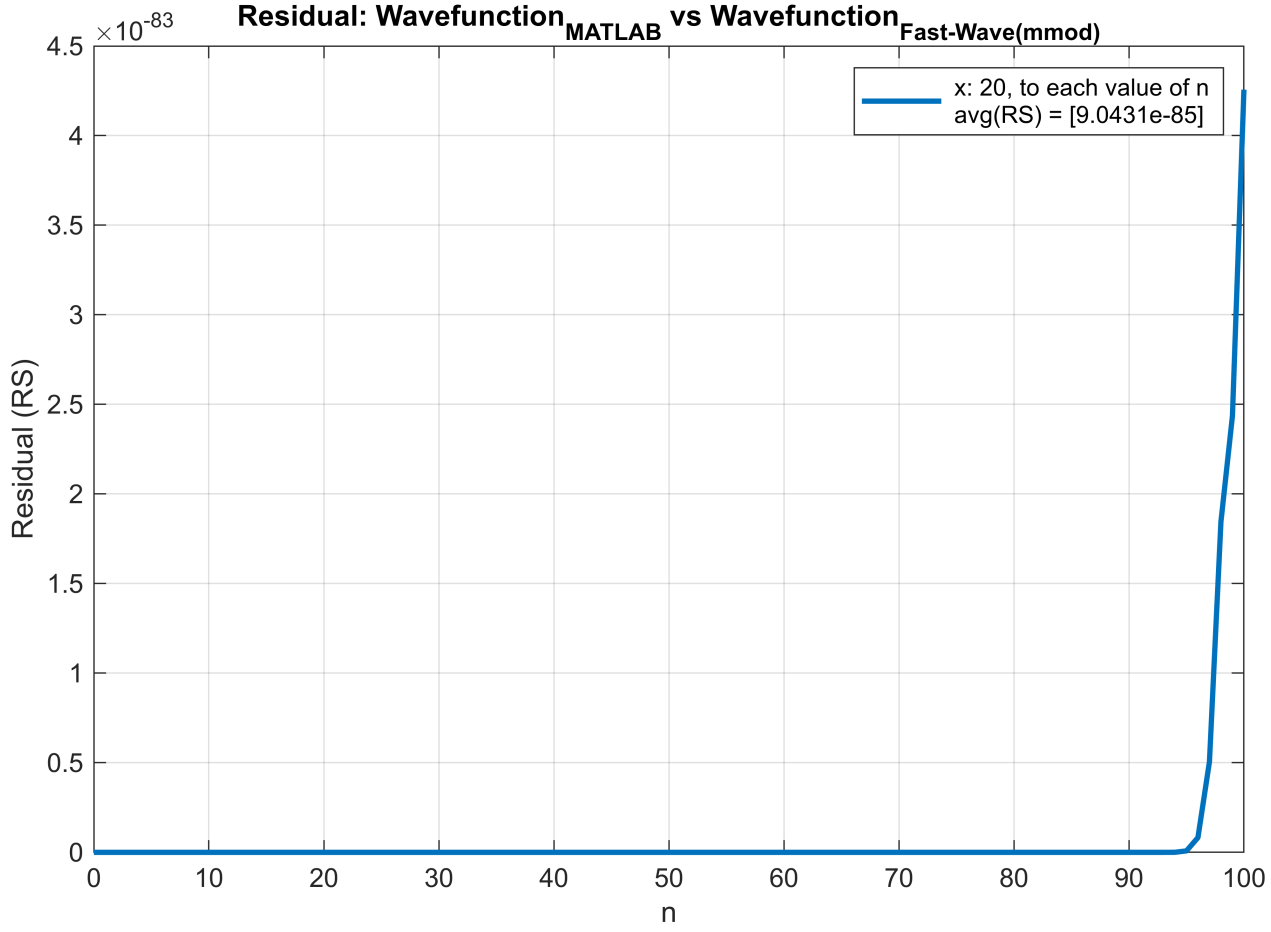
```
import py.fast_wave.wavefunction.wavefunction_mmod

N_max = 100;
```

```
x = 10.0;

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual(index,:) = mean((wavefunction_MATLAB_3(index-1, x, prec) -
vpa(double(wavefunction_mmod(uint64(index-1), x))))).^2);
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' x: '+string(x)+', to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(mmod)}');
```



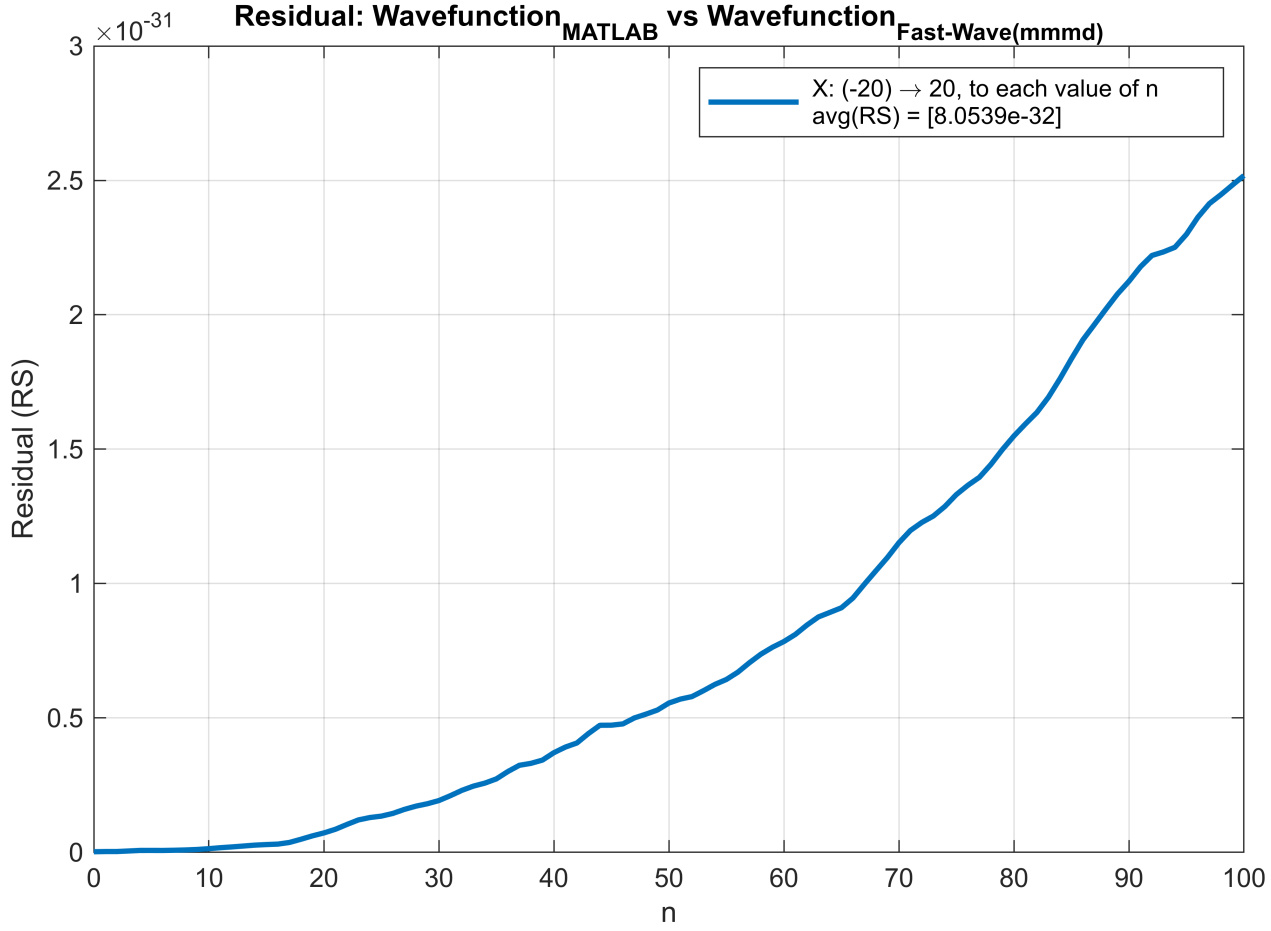
Multi-Mode and Onedimensional Function with x = 20.0

```
import py.fast_wave.wavefunction.wavefunction_mmod

N_max = 100;
x = 20.0;

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual(index,:) = mean((wavefunction_MATLAB_3(index-1, x, prec) -
vpa(double(wavefunction_mmod(uint64(index-1), x))))).^2);
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' x: '+string(x)+', to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(mmod)}');
```



Multi-Mode and Multidimensional Function with X: (-20) → 20

```
import py.fast_wave.wavefunction.wavefunction_mmmd

N_max = 100;
x_max = 20.0;
x_min = -20.0;
x_size = 100;
X = linspace(x_max,x_min,x_size);

Residual = vpa(zeros(N_max+1, 1));
x_axi_plot = linspace(0,N_max,N_max+1);

for index = 1:N_max+1
    Residual_Matrix = ( wavefunction_MATLAB_4(index-1, X, prec) -
vpa(double(wavefunction_mmmd(uint64(index-1), py.tuple(X)))) ).^2;
    Residual(index,:) = mean(Residual_Matrix(:));
end

figure('Position', [100, 100, 1200, 800]);
plot(x_axi_plot, Residual, 'LineWidth', 2);
grid on;

xlabel('n');
ylabel('Residual (RS)');
legend(sprintf(' X: (-20) \\rightarrow 20, to each value of n \n avg(RS) = ['+
string(double(mean(Residual)))+']'));
title('Residual: Wavefunction_{MATLAB} vs Wavefunction_{Fast-Wave(mmmd)}');
```


Residual: Wavefunction MATLAB vs Wavefunction Fast-Wave(mmmd)
×10-31
X: (-20) → 20, to each value of n
avg(RS) = [8.0539e-32]
Residual (RS)
n
0
0.5
1
1.5
2
2.5
3
0
10
20
30
40
50
60
70
80
90
100