COMPUTATIONAL PHYSICS:

WAVE EQUATION PDE SOLUTION

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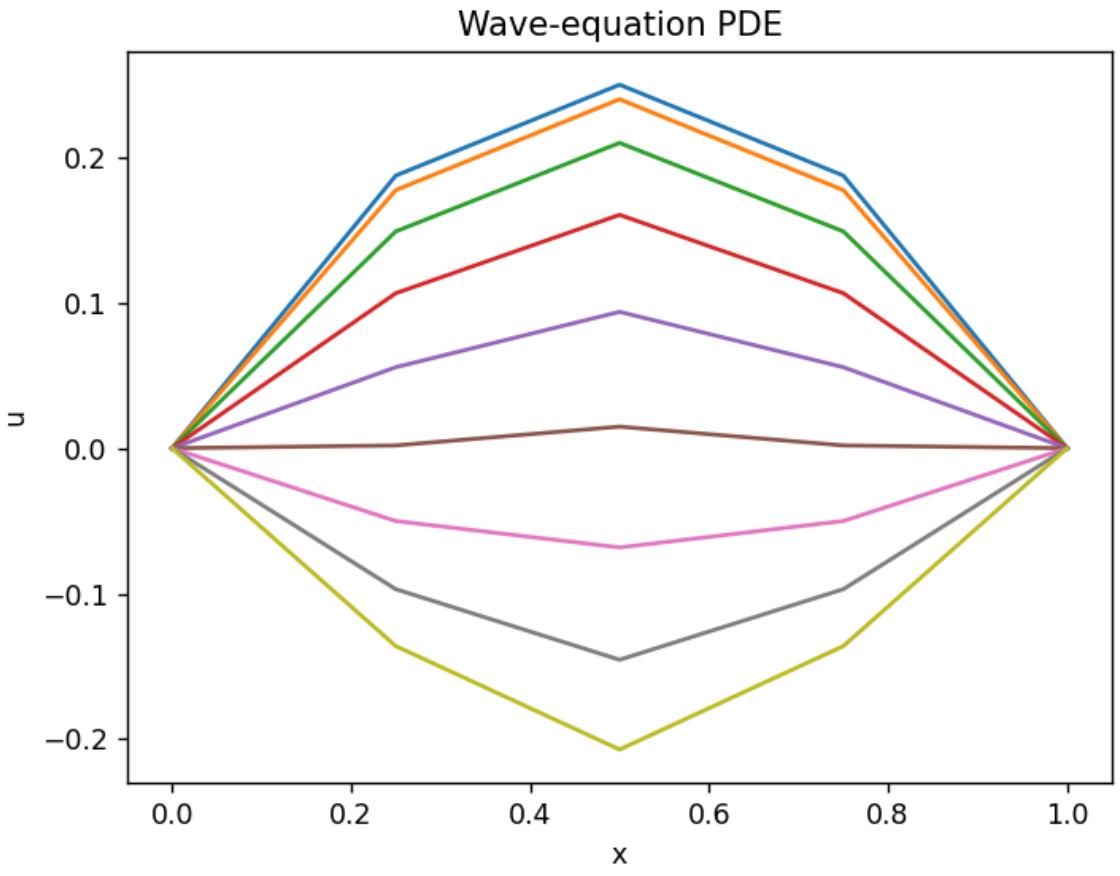
BTech CSE
Minor Engineering Physics

Fixed △t but varying △x: △t=0.1, △x=0.25

```
Given length of string = 1

Enter the value of delta t:0.1

Enter the value of delta x:0.25

Enter the number of iterations:8



------------------------------------------------------------
j = 0   0.000000  0.187500  0.250000  0.187500  0.000000
j = 1   0.000000  0.177500  0.240000  0.177500  0.000000
j = 2   0.000000  0.149100  0.210000  0.149100  0.000000
j = 3   0.000000  0.106588  0.160512  0.106588  0.000000
j = 4   0.000000  0.055650  0.093768  0.055650  0.000000
j = 5   0.000000  0.001907  0.014827  0.001907  0.000000
j = 6   0.000000  -0.050075  -0.068249  -0.050075  0.000000
j = 7   0.000000  -0.096952  -0.145509  -0.096952  0.000000
j = 8   0.000000  -0.136086  -0.207231  -0.136086  0.000000
------------------------------------------------------------
```



△t=0.1,△x=0.2

```
Given length of string = 1

Enter the value of delta t:0.1

Enter the value of delta x:0.2

Enter the number of iterations:8



------------------------------------------------------------------------
j = 0   0.000000  0.160000  0.240000  0.240000  0.160000  0.000000
j = 1   0.000000  0.150000  0.230000  0.230000  0.150000  0.000000
j = 2   0.000000  0.122500  0.200000  0.200000  0.122500  0.000000
j = 3   0.000000  0.083750  0.150625  0.150625  0.083750  0.000000
j = 4   0.000000  0.040781  0.084531  0.084531  0.040781  0.000000
j = 5   0.000000  -0.001445  0.007500  0.007500  -0.001445  0.000000
j = 6   0.000000  -0.041074  -0.071768  -0.071768  -0.041074  0.000000
j = 7   0.000000  -0.078108  -0.143362  -0.143362  -0.078108  0.000000
j = 8   0.000000  -0.111928  -0.198643  -0.198643  -0.111928  0.000000
------------------------------------------------------------------------
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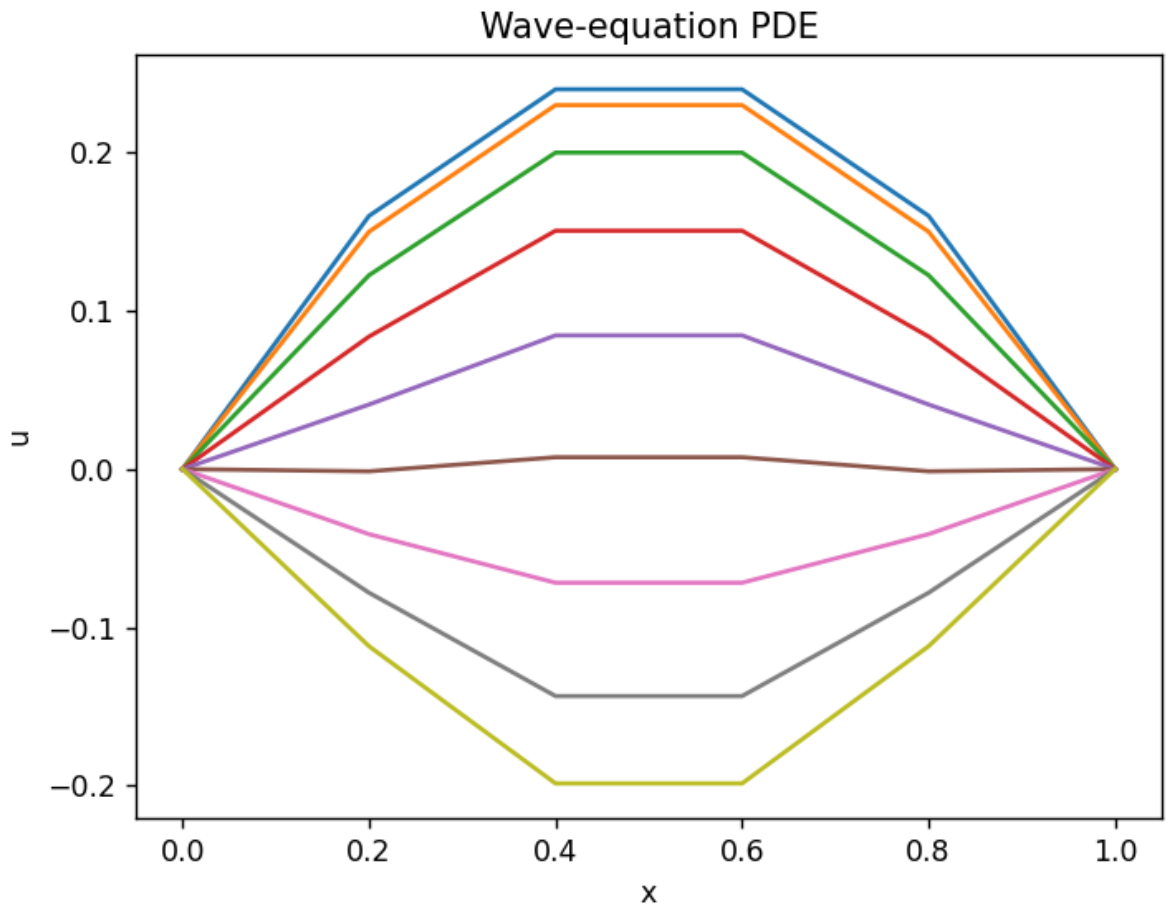

△t=0.1,△x=0.125

```
Given length of string = 1

Enter the value of delta t:0.1

Enter the value of delta x:0.125

Enter the number of iterations:8



-------------------------------------------------------------------------------------------
j = 0   0.000000  0.109375  0.187500  0.234375  0.250000  0.234375  0.187500  0.109375  0.000000
j = 1   0.000000  0.099375  0.177500  0.224375  0.240000  0.224375  0.177500  0.099375  0.000000
j = 2   0.000000  0.075775  0.147500  0.194375  0.210000  0.194375  0.147500  0.075775  0.000000
j = 3   0.000000  0.049583  0.101596  0.144375  0.160000  0.144375  0.101596  0.049583  0.000000
j = 4   0.000000  0.024946  0.049782  0.076996  0.090000  0.076996  0.049782  0.024946  0.000000
j = 5   0.000000  0.000239  -0.000509  0.000523  0.003355  0.000523  -0.000509  0.000239  0.000000
j = 6   0.000000  -0.025100  -0.049661  -0.074798  -0.086915  -0.074798  -0.049661  -0.025100  0.000000
j = 7   0.000000  -0.050094  -0.099182  -0.141787  -0.161676  -0.141787  -0.099182  -0.050094  0.000000
j = 8   0.000000  -0.074444  -0.144553  -0.194237  -0.210979  -0.194237  -0.144553  -0.074444  0.000000
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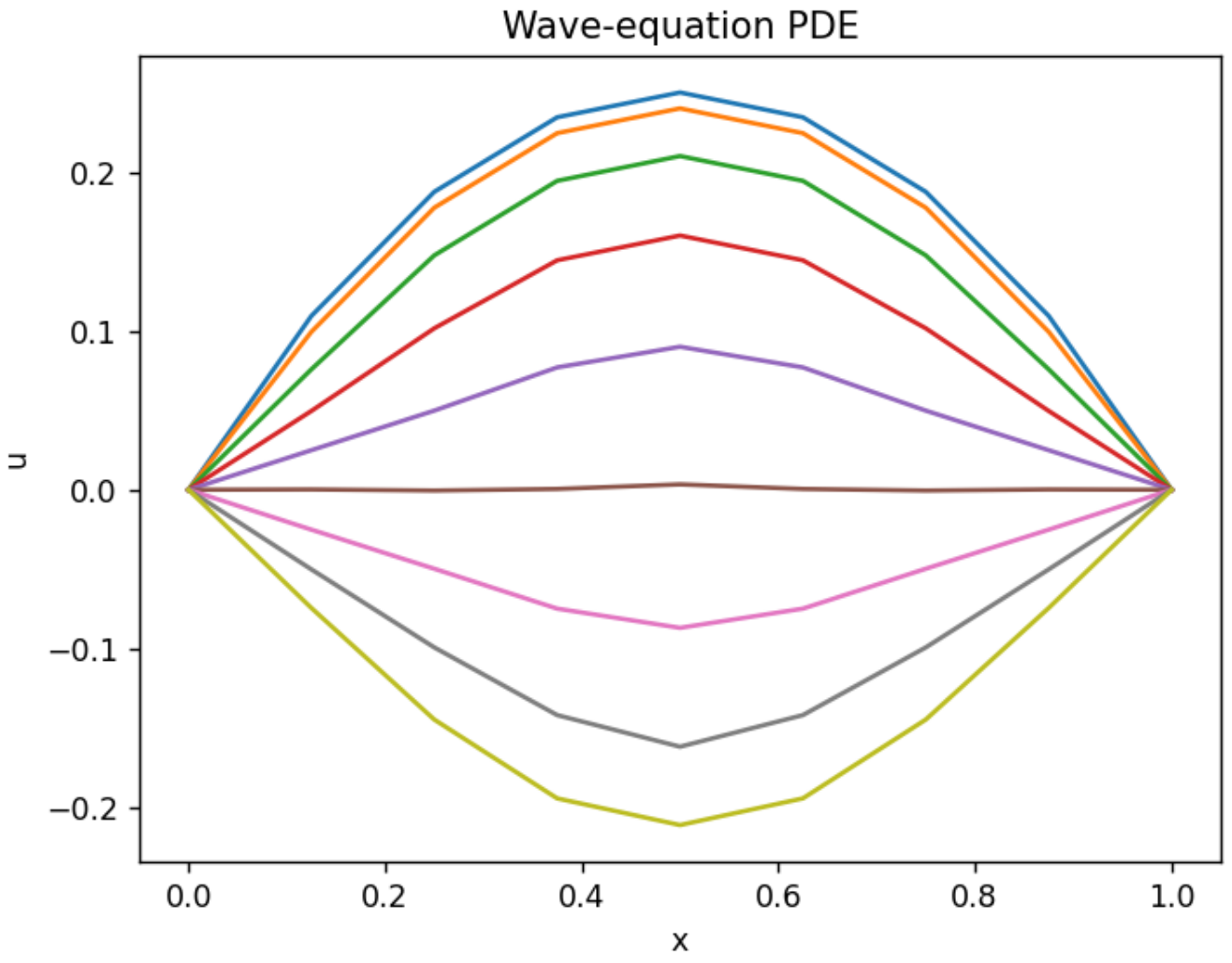

△t=0.1,△x=0.1

```
Given length of string = 1

Enter the value of delta t:0.1

Enter the value of delta x:0.1

Enter the number of iterations:8


-------------------------------------------------------------------------------------------
j = 0   0.000000  0.090000  0.160000  0.210000  0.240000  0.250000  0.240000  0.210000  0.160000  0.090000  0.000000
j = 1   0.000000  0.080000  0.150000  0.200000  0.230000  0.240000  0.230000  0.200000  0.150000  0.080000  0.000000
j = 2   0.000000  0.060000  0.120000  0.170000  0.200000  0.210000  0.200000  0.170000  0.120000  0.060000  0.000000
j = 3   0.000000  0.040000  0.080000  0.120000  0.150000  0.160000  0.150000  0.120000  0.080000  0.040000  0.000000
j = 4   0.000000  0.020000  0.040000  0.060000  0.080000  0.090000  0.080000  0.060000  0.040000  0.020000  0.000000
j = 5   0.000000  0.000000  -0.000000  0.000000  -0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
j = 6   0.000000  -0.020000  -0.040000  -0.060000  -0.080000  -0.090000  -0.080000  -0.060000  -0.040000  -0.020000  0.000000
j = 7   0.000000  -0.040000  -0.080000  -0.120000  -0.150000  -0.160000  -0.150000  -0.120000  -0.080000  -0.040000  0.000000
j = 8   0.000000  -0.060000  -0.120000  -0.170000  -0.200000  -0.210000  -0.200000  -0.170000  -0.120000  -0.060000  0.000000
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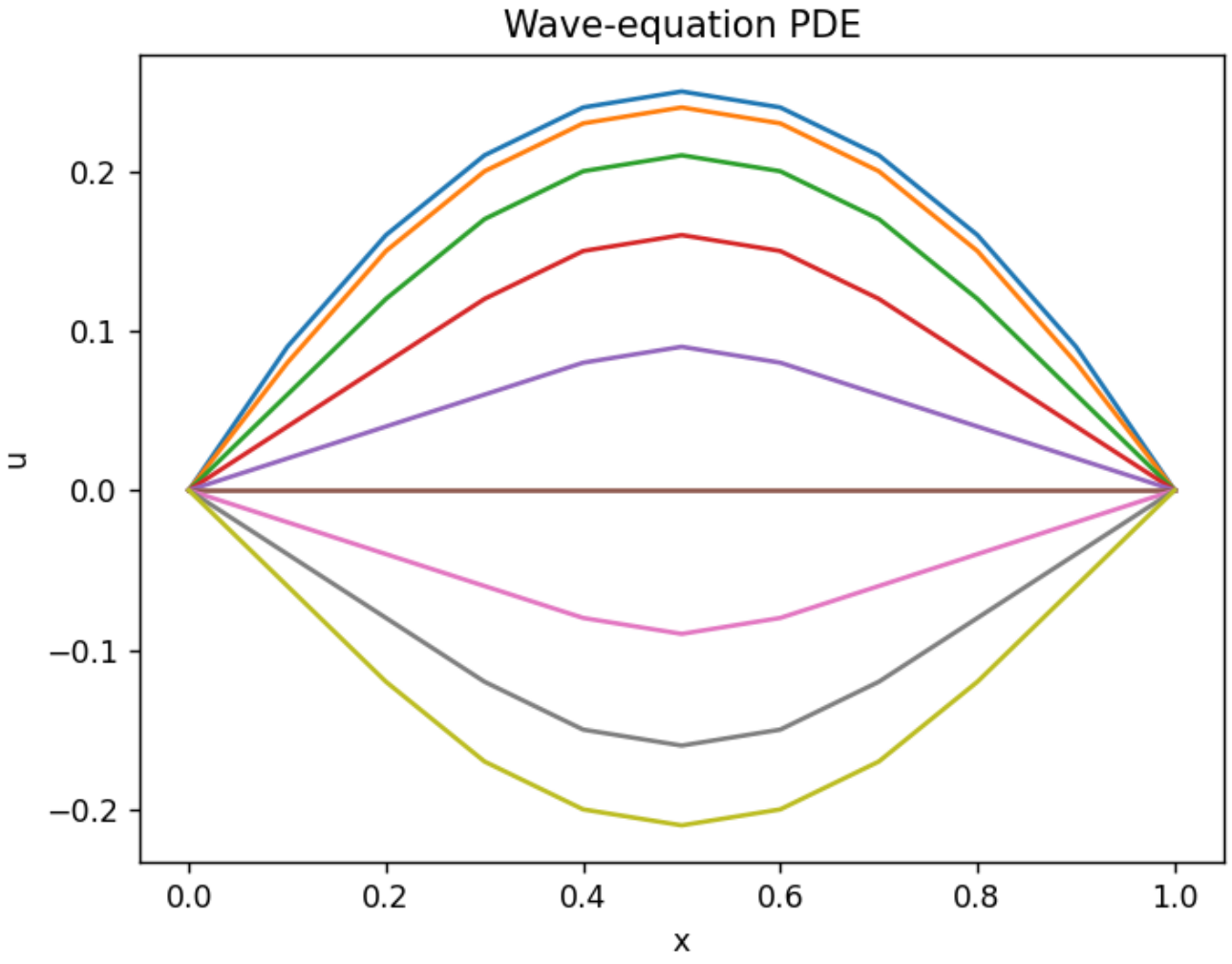

Fixed △x but varying △t: △x=0.1,△t=0.05

```
Given length of string = 1

Enter the value of delta t:0.05

Enter the value of delta x:0.1

Enter the number of iterations:8



-------------------------------------------------------------------------------------------------
j = 0   0.000000  0.090000  0.160000  0.210000  0.240000  0.250000  0.240000  0.210000  0.160000  0.090000  0.000000
j = 1   0.000000  0.087500  0.157500  0.207500  0.237500  0.247500  0.237500  0.207500  0.157500  0.087500  0.000000
j = 2   0.000000  0.080625  0.150000  0.200000  0.230000  0.240000  0.230000  0.200000  0.150000  0.080625  0.000000
j = 3   0.000000  0.070937  0.137656  0.187500  0.217500  0.227500  0.217500  0.187500  0.137656  0.070938  0.000000
j = 4   0.000000  0.060195  0.121094  0.170039  0.200000  0.210000  0.200000  0.170039  0.121094  0.060195  0.000000
j = 5   0.000000  0.049629  0.101543  0.147832  0.177510  0.187500  0.177510  0.147832  0.101543  0.049629  0.000000
j = 6   0.000000  0.039634  0.080586  0.121472  0.150098  0.160005  0.150098  0.121472  0.080586  0.039634  0.000000
j = 7   0.000000  0.029968  0.059612  0.092047  0.118006  0.127556  0.118006  0.092047  0.059612  0.029968  0.000000
j = 8   0.000000  0.020222  0.039337  0.061003  0.081812  0.090332  0.081812  0.061003  0.039337  0.020222  0.000000
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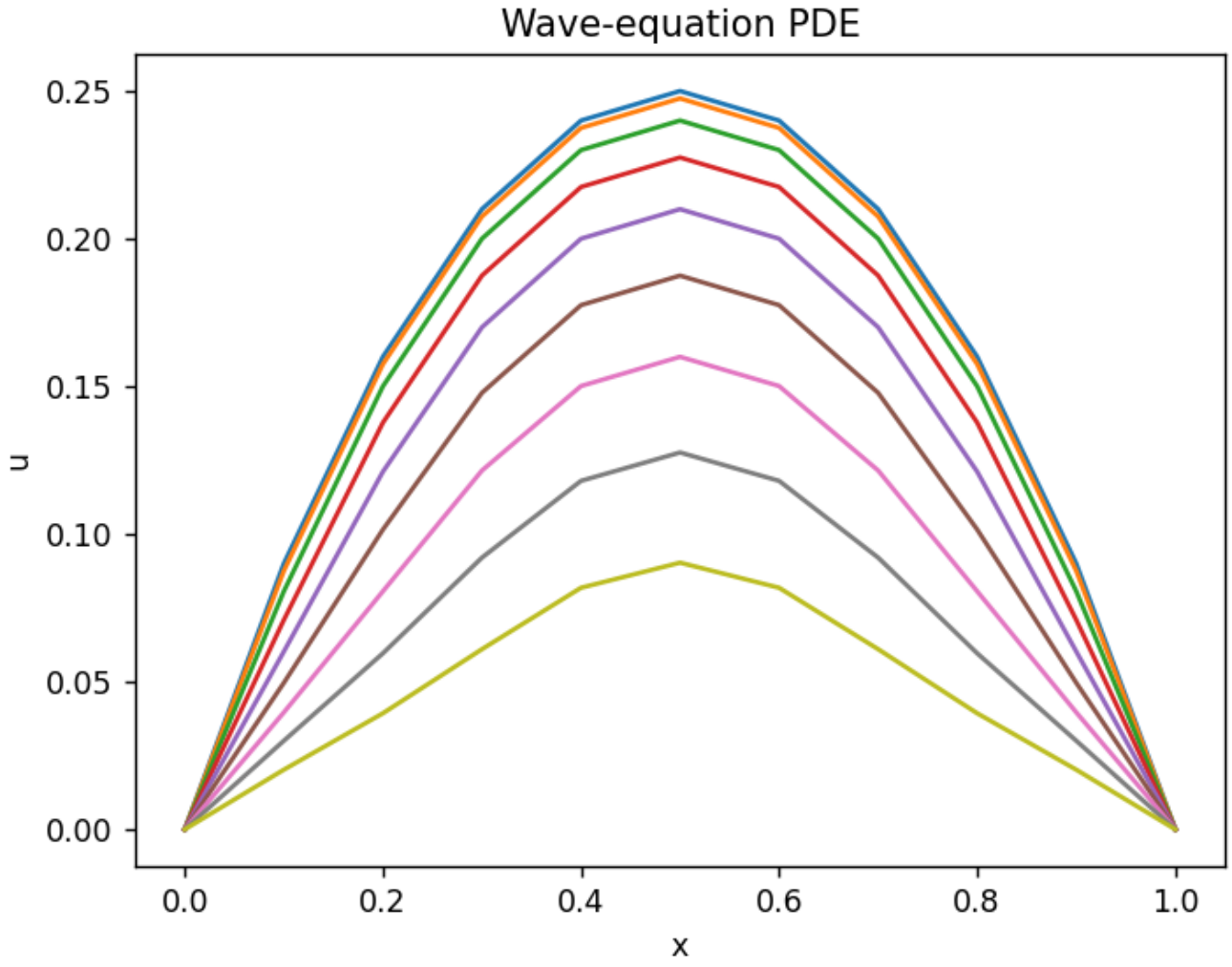

△x=0.1,△t=0.0125

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Given length of string = 1

Enter the value of delta t:0.0125

Enter the value of delta x:0.1

Enter the number of iterations:8



-------------------------------------------------------------------------------------------
j = 0   0.000000  0.090000  0.160000  0.210000  0.240000  0.250000  0.240000  0.210000  0.160000  0.090000  0.000000
j = 1   0.000000  0.089844  0.159844  0.209844  0.239844  0.249844  0.239844  0.209844  0.159844  0.089844  0.000000
j = 2   0.000000  0.089377  0.159375  0.209375  0.239375  0.249375  0.239375  0.209375  0.159375  0.089377  0.000000
j = 3   0.000000  0.088608  0.158594  0.208594  0.238594  0.248594  0.238594  0.208594  0.158594  0.088608  0.000000
j = 4   0.000000  0.087548  0.157500  0.207500  0.237500  0.247500  0.237500  0.207500  0.157500  0.087548  0.000000
j = 5   0.000000  0.086213  0.156095  0.206094  0.236094  0.246094  0.236094  0.206094  0.156095  0.086213  0.000000
j = 6   0.000000  0.084623  0.154379  0.204375  0.234375  0.244375  0.234375  0.204375  0.154379  0.084623  0.000000
j = 7   0.000000  0.082800  0.152354  0.202344  0.232344  0.242344  0.232344  0.202344  0.152354  0.082800  0.000000
j = 8   0.000000  0.080771  0.150024  0.200000  0.230000  0.240000  0.230000  0.200000  0.150024  0.080771  0.000000
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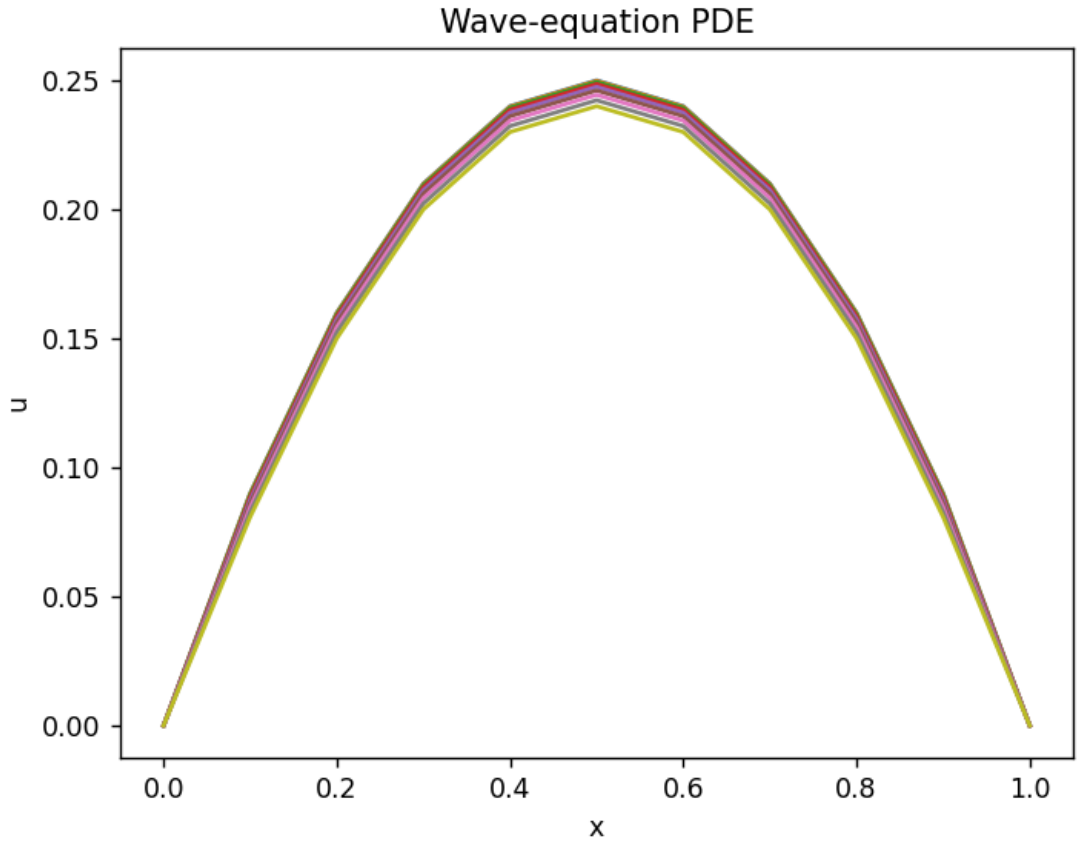

We see that by reducing the value △x while keeping △t constant, we get the values of the wave displacement at greater number of points for a wire of fixed length and hence our accuracy of measuring the displacement at some time t for different x's increases!

Whereas, by reducing △t while keeping △x constant, we can increase our accuracy of measuring the displacement of some x at different times (t's) !