

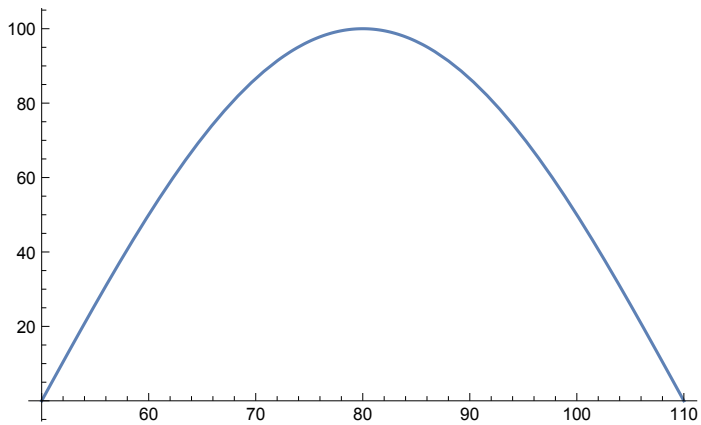
```
ClearAll["Global`*"]
```

# Setup

In[1]:=

```
c = 3002;  
Δx = 1;  
Δt = 0.0015;  
size = 300 / Δx;  
λ =  $\frac{c * (\Delta t)^2}{(\Delta x)^2}$ ;  
Plot[100 Sin[ $\frac{\pi (x - 50)}{60}$ ], {x, 50, 110}]
```

Out[6]=



## Initial Conditions

In[7]=

```

u1 = ConstantArray[0, size];
For[i = 1, i < size + 1, i++,

  If[i ≥ 200 && i ≤ 260,
    u1[[i]] = 100 * Sin[ $\frac{\pi (i - 200)}{60}$ ]
  ]
]

u0 = ConstantArray[0, size];
For[i = 1, i < size + 1, i++,

  If[i ≥ 200 && i ≤ 260,
    u0[[i]] = 100 * Sin[ $\frac{\pi (i - 200)}{60}$ ]
  ]
]

```

## Matrix

In[11]=

```

superDiagonal = SparseArray[{i_, j_} /; i == j - 1 → λ, {size, size}, 0];
subDiagonal = SparseArray[{i_, j_} /; i == j + 1 → λ, {size, size}, 0];
m = superDiagonal + subDiagonal + ((2 - 2 * λ) * IdentityMatrix[size]);

MatrixForm[m];

```

# Iteration

In[15]=

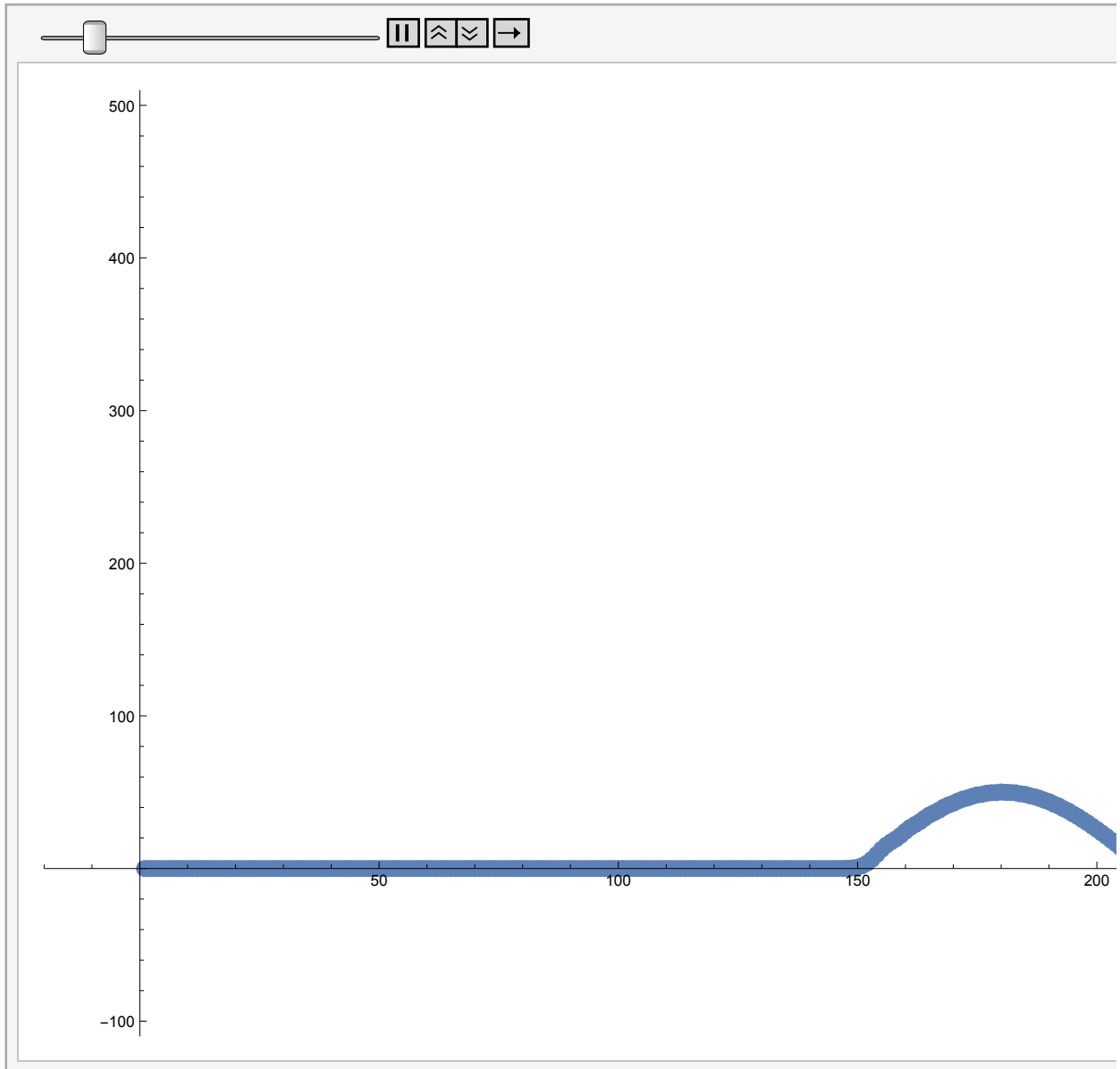
```
record = {};  
  
For[i = 0, i < 2000, i++,  
  next = m.u1 - u0;  
  u0 = ReplacePart[u1, {1 → 0, size → 0}];  
  u1 = ReplacePart[next, {1 → 0, size → 0}];  
  AppendTo[record, u1];  
]
```

# Visualization

In[17]:=

```
ListAnimate[Table[ListPlot[record[[n]],
  PlotRange -> {{-20, 300}, {-110, 510}}, ImageSize -> 900], {n, 1, 1000}]]
```

Out[17]=



```
gif = Table[ListPlot[record[[n]],
  PlotRange -> {{-20, 300}, {-110, 510}}, ImageSize -> 900], {n, 1, 1000, 10}];
```

```
Export["C:\\Users\\Greg\\Desktop\\Mathematica  
Animations\\1Dim2ndOrderWaveEquation.gif",
```

```
gif,
```

```
"DisplayDurations" →  $\frac{1}{10}$ ]
```

```
C:\\Users\\Greg\\Desktop\\Mathematica Animations\\1Dim2ndOrderWaveEquation.gif
```