EL-Centro Earthquake 1940 N-S response analysis
by Nasser Abbasi

```
Remove["Global`*"];
SetDirectory["E:/nabbasi/data/nabbasi_web_Page/my_courses/
    UCI_COURSES/CREDIT_COURSES/fall_2006/CEE_247/HWs/HW4"];
```

■ **Load El-Centro data and plot the earthquack recorded accelration**

```
data = Import["el_centro.txt", "Table"];
dataLength = 8 Length[data];

g = Table[{0, 0}, {dataLength}];
t = Table[0, {dataLength}];
u = Table[{0, 0}, {dataLength}];
v = Table[{0, 0}, {dataLength}];
acc = Table[{0, 0}, {dataLength}];

delT = 0.02; (*sec*)
k = 0;
currentTime = 0;
For[i = 1, i ≤ Length[data], i = i + 1,
  For[j = 1, j ≤ 8, j = j + 1,
    {
     k = k + 1;

     g[[k, 1]] = currentTime;
     u[[k, 1]] = currentTime;
     v[[k, 1]] = currentTime;
     acc[[k, 1]] = currentTime;

     g[[k, 2]] = data[[i, j]];

     currentTime = currentTime + delT;
    }
  ]
];

ListPlot[g, PlotJoined → True,
  PlotRange → All, AxesLabel → {"Time sec", "Acc. g"},
  PlotLabel -> "El centro earthquack 1940 N-S"];
```
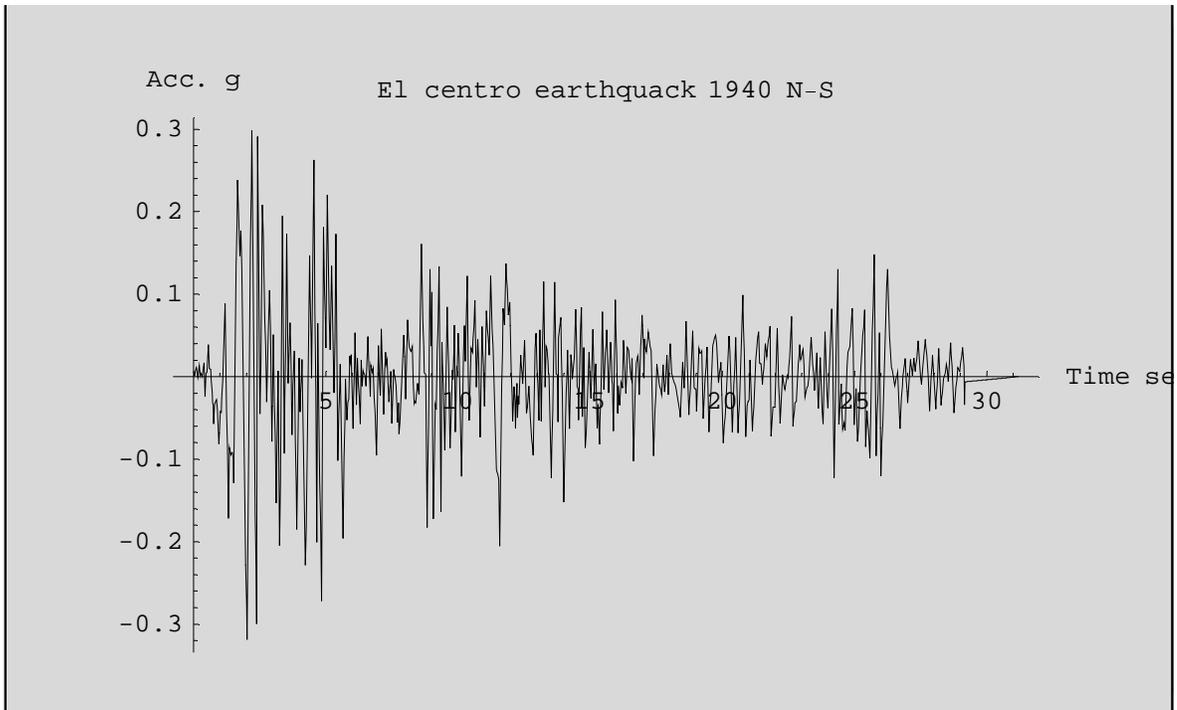
■ Implementation of Linear Accelration step-by-step algorithm

```
u[[1, 2]] = 0.;
v[[1, 2]] = 0.;
acc[[1, 2]] = 0.;

ξ = 0.05;
ω = π;

For[i = 1, i < dataLength, i = i + 1,
  {
    delg = g[[i + 1, 2]] - g[[i, 2]];
    delU = ─────────────────────── (-delg + ──── v[[i, 2]] +
            ω² + ──── + ──────          delT
                 delT²   delT

        3 acc[[i, 2]] + 2 ξ ω (3 v[[i, 2]] + ──── acc[[i, 2]]));
                                              2

    u[[i + 1, 2]] = u[[i, 2]] + delU;


    delV = ──── delU - 3 v[[i, 2]] - ──── acc[[i, 2]];
           delT                        2

    v[[i + 1, 2]] = v[[i, 2]] + delV;
    delAcc = -delg - 2 ξ ω delV - ω² delU;
    acc[[i + 1, 2]] = acc[[i, 2]] + delAcc;
  }
];
```

$$\text{delU} = \cfrac{1}{\omega^2 + \frac{6}{\text{delT}^2} + \frac{3*2\,\xi\,\omega}{\text{delT}}} \left(-\text{delg} + \frac{6}{\text{delT}}\,v[[i, 2]] + 3\,\text{acc}[[i, 2]] + 2\,\xi\,\omega\left(3\,v[[i, 2]] + \frac{\text{delT}}{2}\,\text{acc}[[i, 2]]\right)\right);$$

$$\text{delV} = \frac{3}{\text{delT}}\,\text{delU} - 3\,v[[i, 2]] - \frac{\text{delT}}{2}\,\text{acc}[[i, 2]];$$

■ Plot results

```
ListPlot[u, PlotJoined → True,
  PlotRange → All, AxesLabel → {"Time sec", "u(t) inch"},
  PlotLabel -> "Displacment from El centro earthquack 1940 N-S"];
```
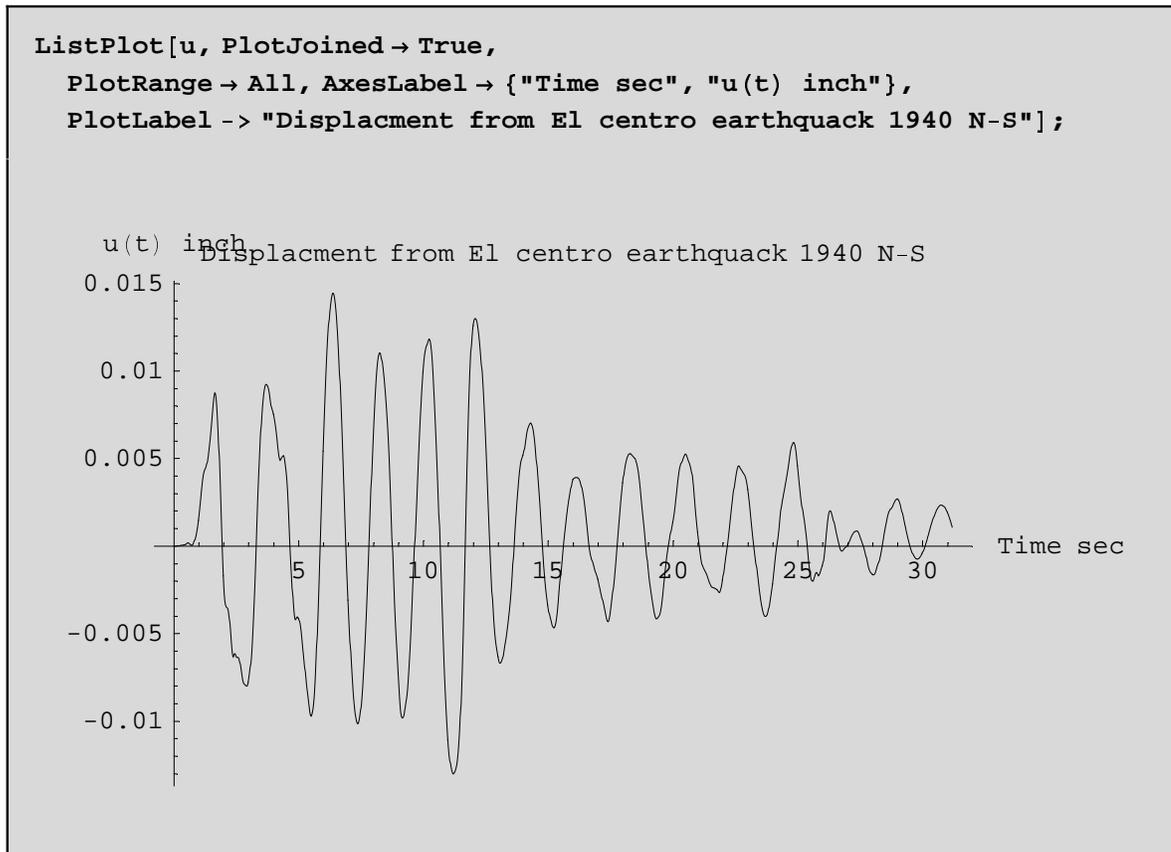
```
ListPlot[v, PlotJoined → True,
  PlotRange → All, AxesLabel → {"Time sec", "v(t) in/sec"},
  PlotLabel -> "speed from El centro earthquack 1940 N-S"];
```
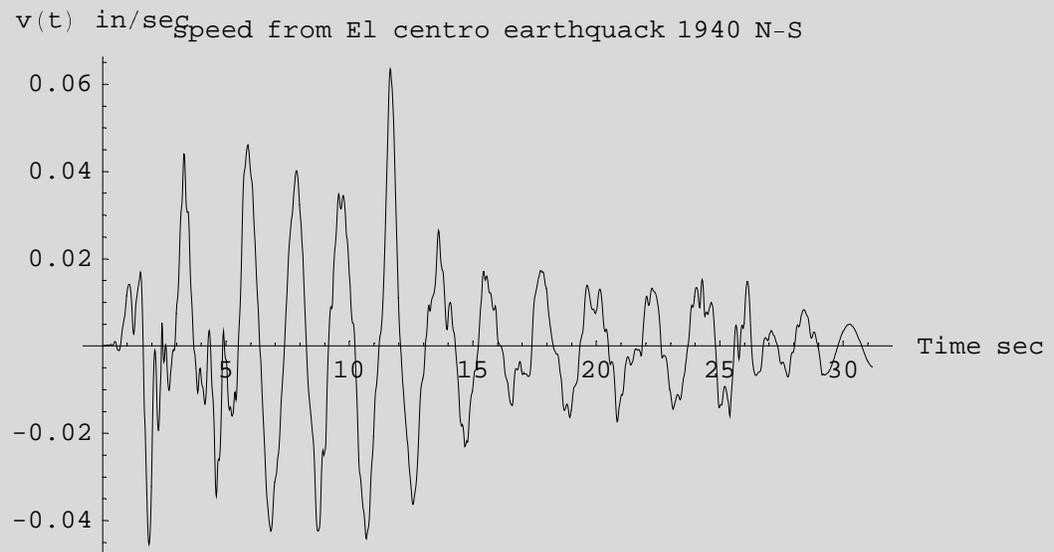


```
ListPlot[acc, PlotJoined → True,
  PlotRange → All, AxesLabel → {"Time sec", "v(t) in/s²"},
  PlotLabel -> "accelaration from El centro earthquack 1940 N-S"];
```