CE 4542
Lab Assignment #2

Displacements, velocity, and acceleration

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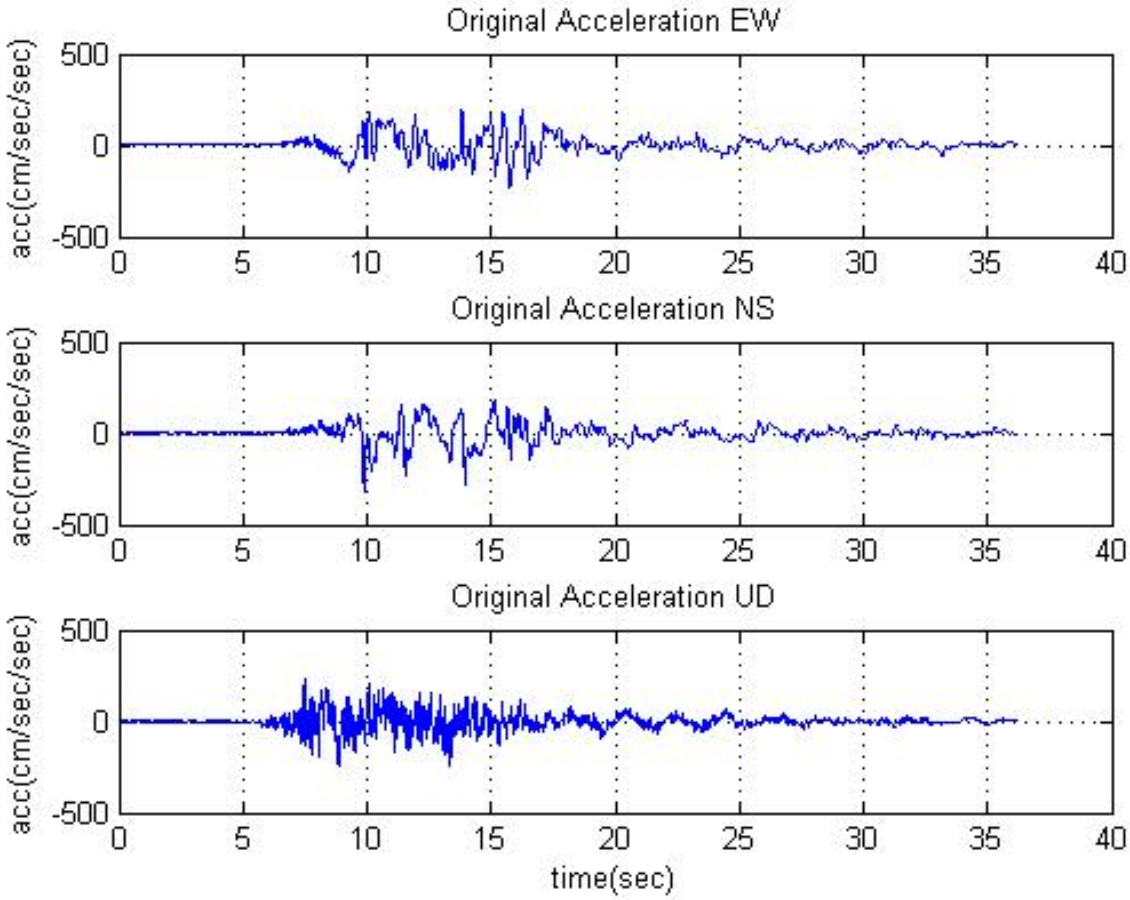
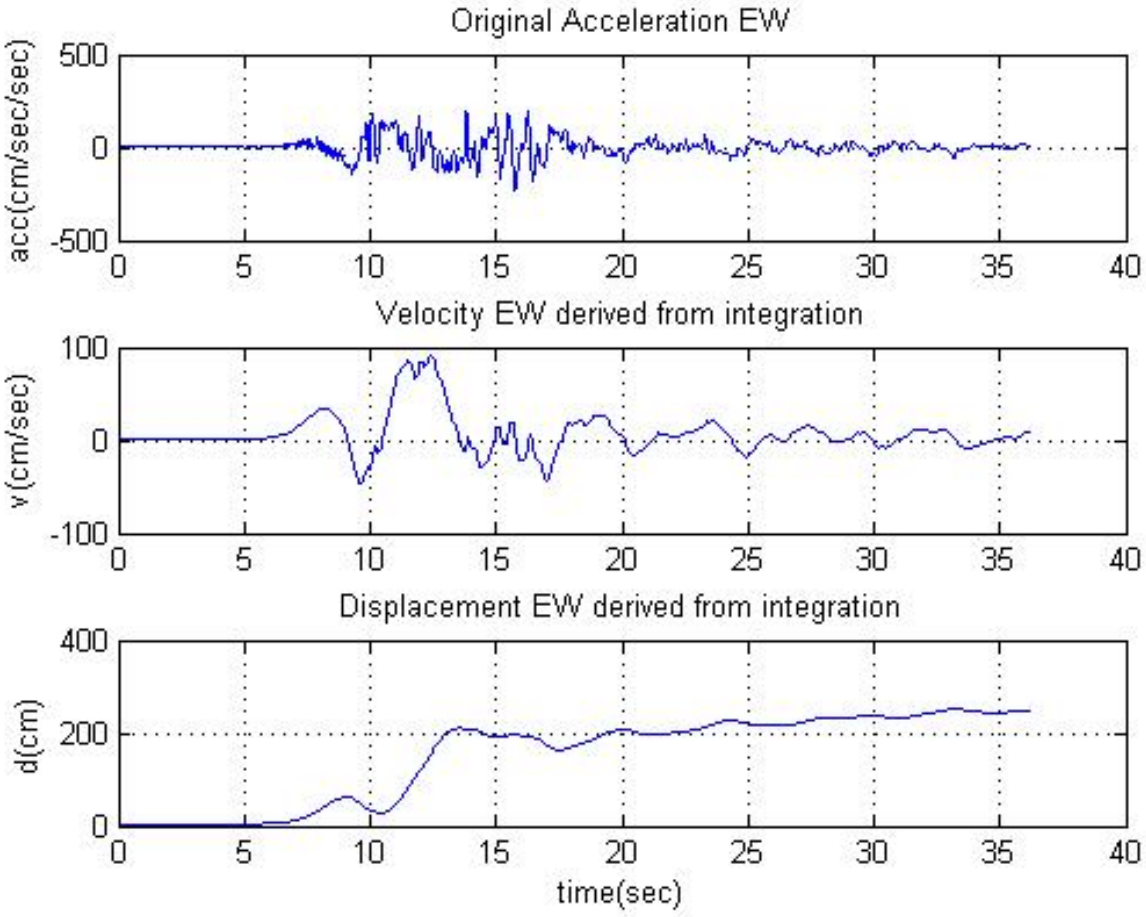
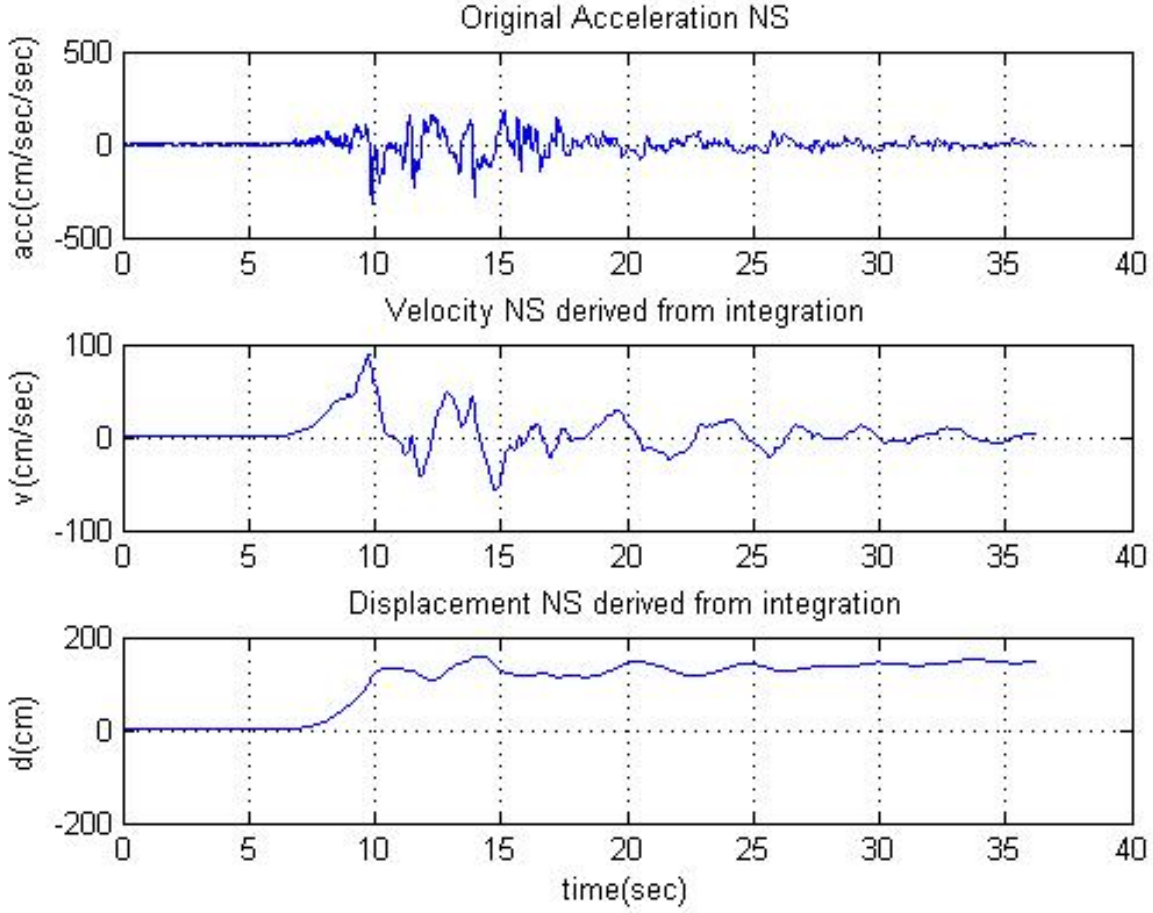
The amplitude of acceleration in all three directions shows a large amount of wave propagation, especially within the first 20 seconds of seismic activity. The Up-Down movement has the highest amount of wave propagation. The velocities also peaked within the first 5-15 seconds, with the greatest peaks in the East-West and North-South directions. The North-South velocity hits its peak around 8 seconds, while the East-West direction experiences a low. However, the peak of the East-West moving wave directly follows that of the North-South velocity. We see the displacement in both the East-West and North-South directions start at 0, and increase with time. The highest amount of displacement happens in the East-West direction, rising sharply around the 10 second mark, with a peak displacement around 2.5 centimeters before it begins to dissipate. The displacement in the North-South direction also rises around the 10 second mark, just slightly before that in the East-West direction. There is a large difference in up-down movement and displacement around the same time (10-second mark), where the ground seems to drop downward and then swiftly push back up towards the surface, before moving in a downward trend with regard to time.

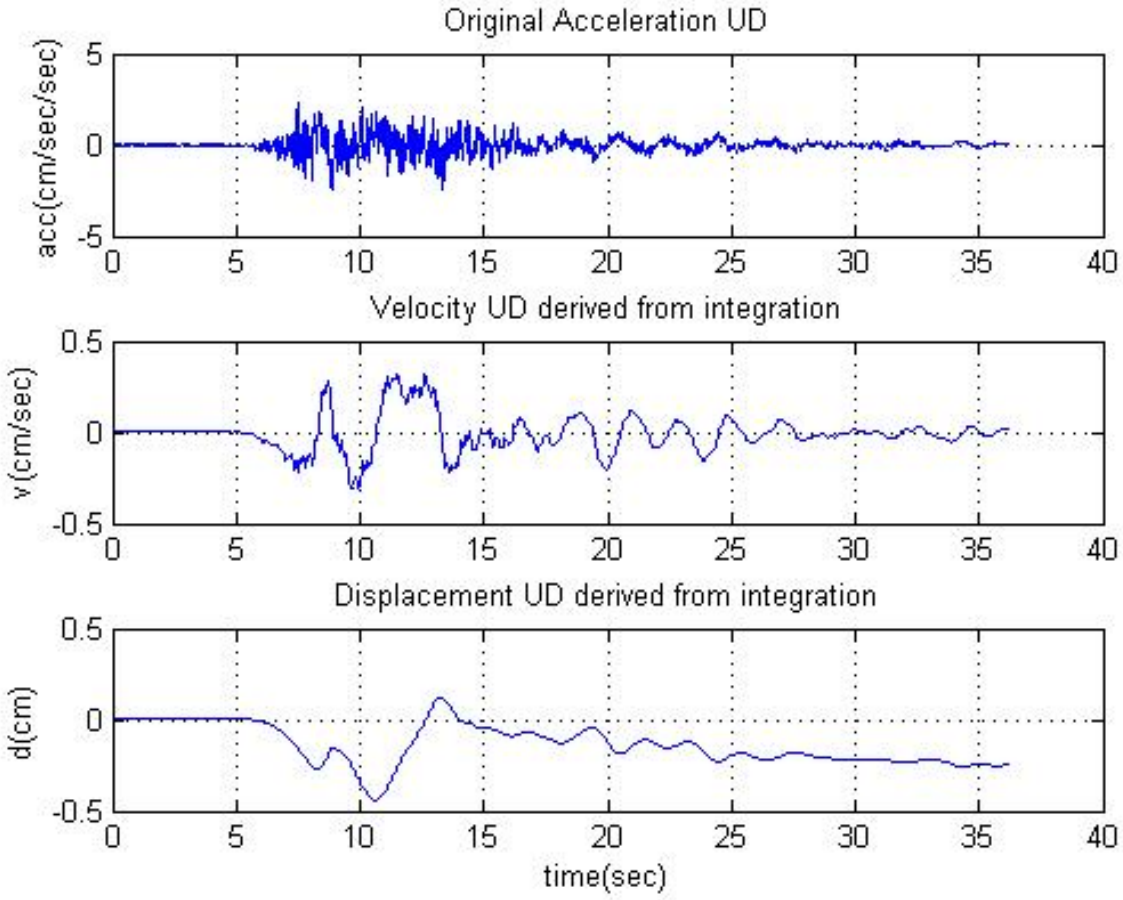
In order to analyze the data, I imported the given excel sheets with ground accelerations into MATLAB. Then, I assigned a variable to each column vector and divided by 100 to get the units in cm/sec/sec. Then I subplotted the three variables (EW, NS, UD), with respect to time to compare the original accelerations in each plane. After, I took the integral of each variable with respect to time by approximating the area under the curve and plotting that. Lastly, I took the result I got for displacement and differentiated twice to derive both the velocity and acceleration in each plane.

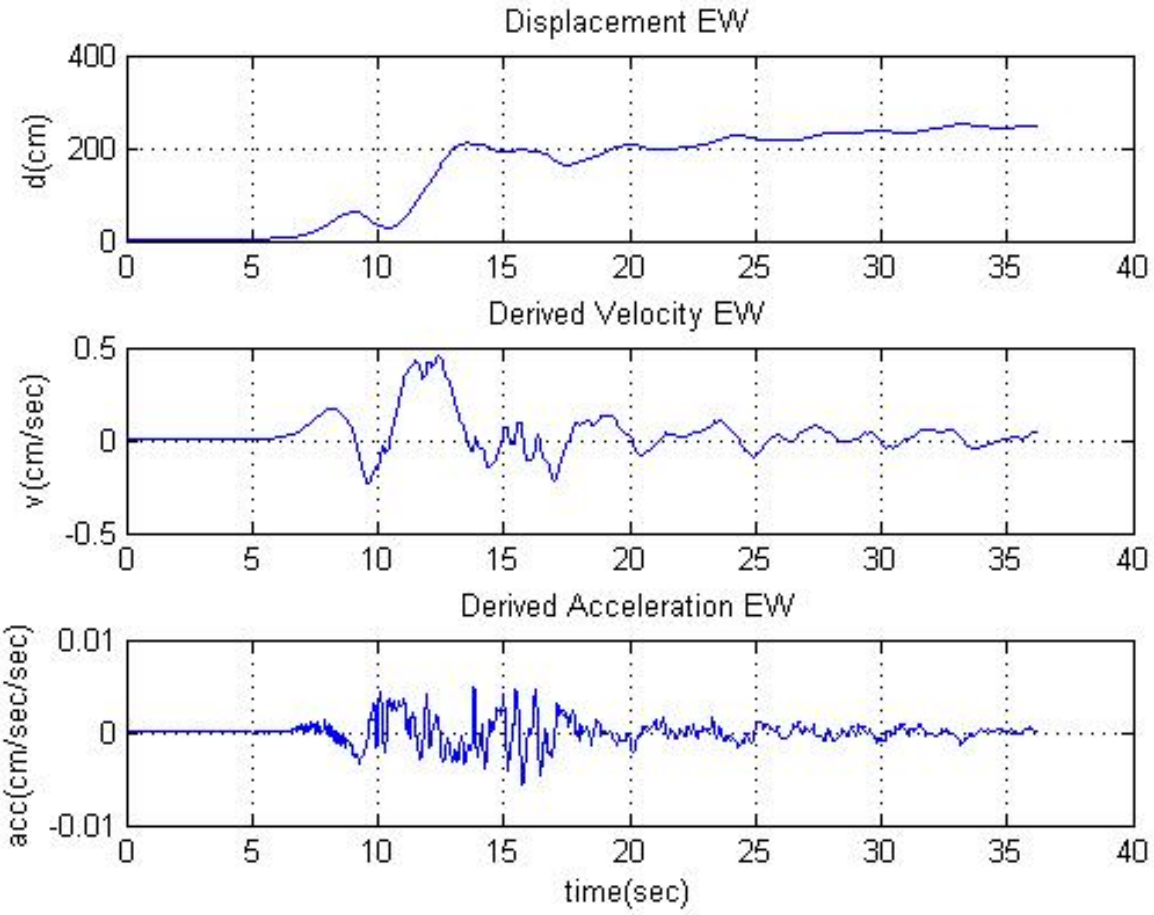
There is a slight difference between the results of the original accelegram compared to the one after integration and differentiation. This is because the matrix size changes when you take integrals and derivatives. In addition, the data given was for acceleration. When analyzing this data, we take a trace which gives an approximation, rather than a definite integral, of the area under the curve. For this reason, when you differentiate in the opposite direction, the ground displacement is approximated, compared to the original data which is exact. For this reason, the derived acceleration values may be slightly different than the original values. This is partially due to integrating and deriving based on true values rather than a given equation.

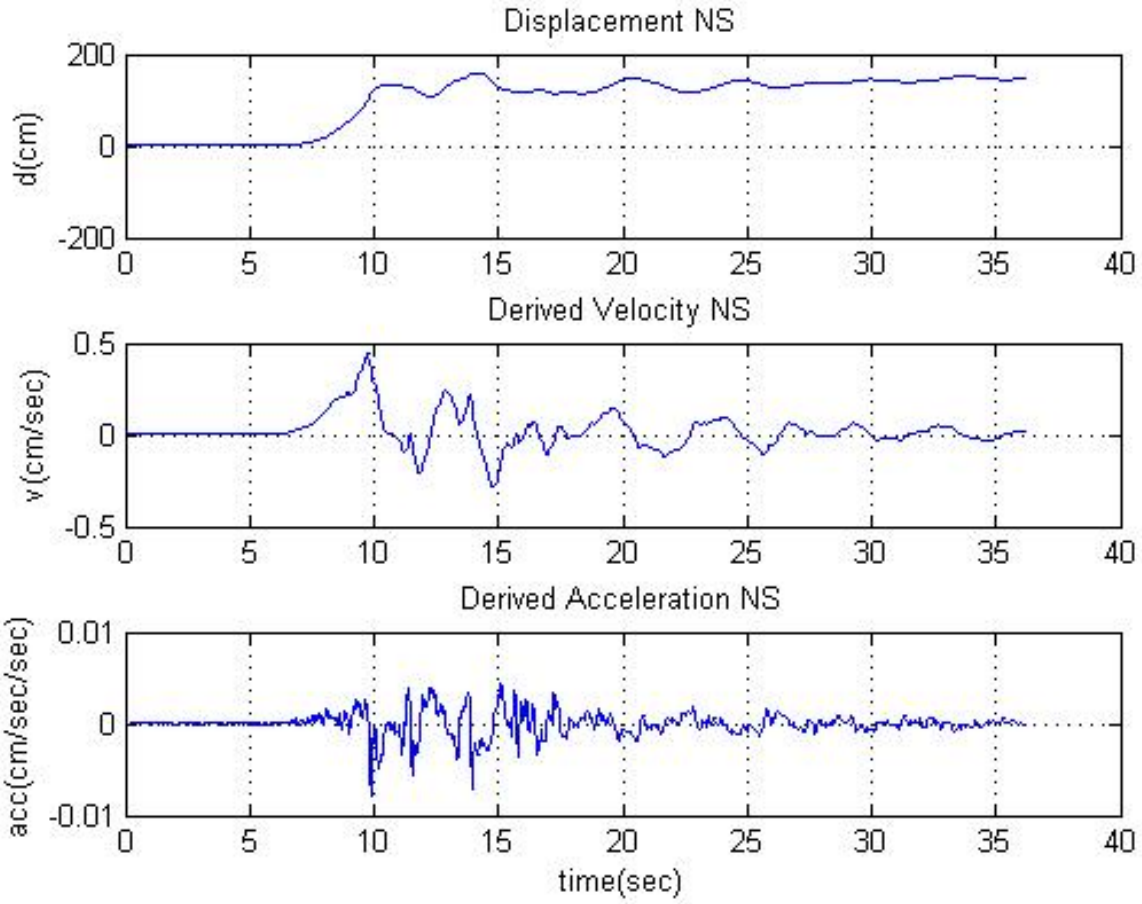

Original Acceleration EW
acc(cm/sec/sec)
500
0
-500
0
5
10
15
20
25
30
35
40
Original Acceleration NS
acc(cm/sec/sec)
500
0
-500
0
5
10
15
20
25
30
35
40
Original Acceleration UD
acc(cm/sec/sec)
500
0
-500
0
5
10
15
20
25
30
35
40
time(sec)

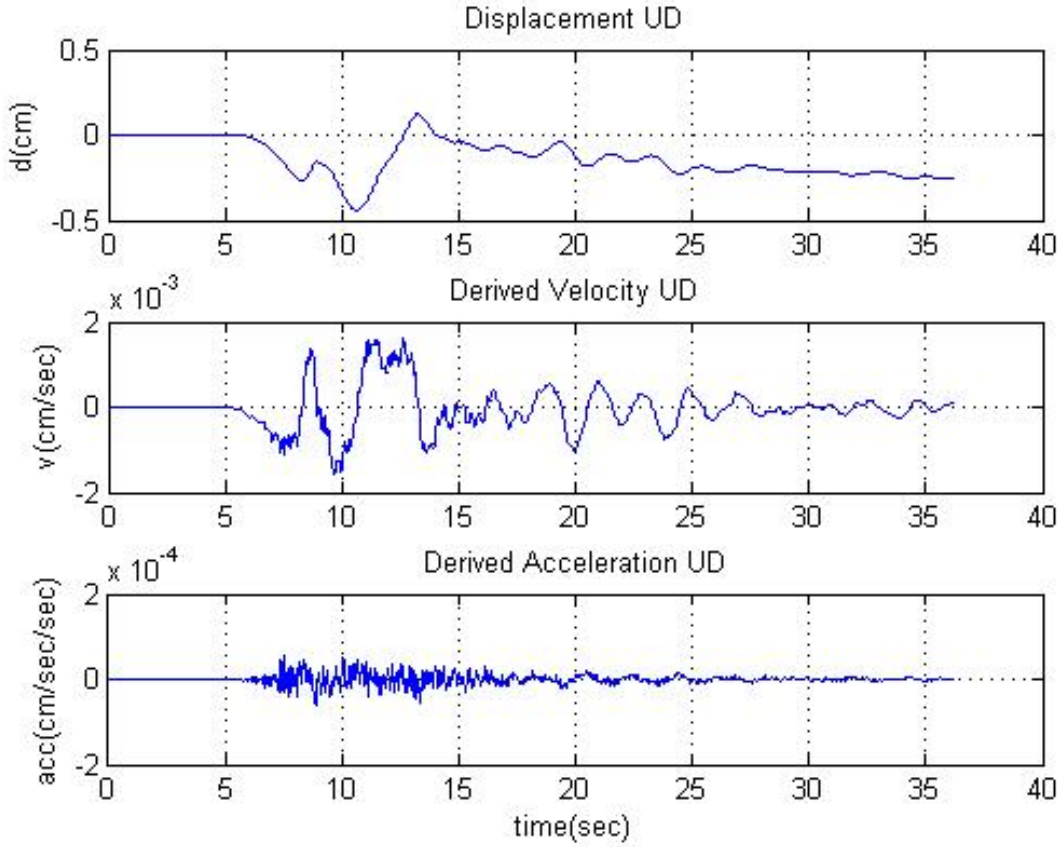

Original Acceleration EW
acc(cm/sec/sec)
500
0
-500
0
5
10
15
20
25
30
35
40
Velocity EW derived from integration
v(cm/sec)
100
0
-100
0
5
10
15
20
25
30
35
40
Displacement EW derived from integration
d(cm)
400
200
0
0
5
10
15
20
25
30
35
40
time(sec)

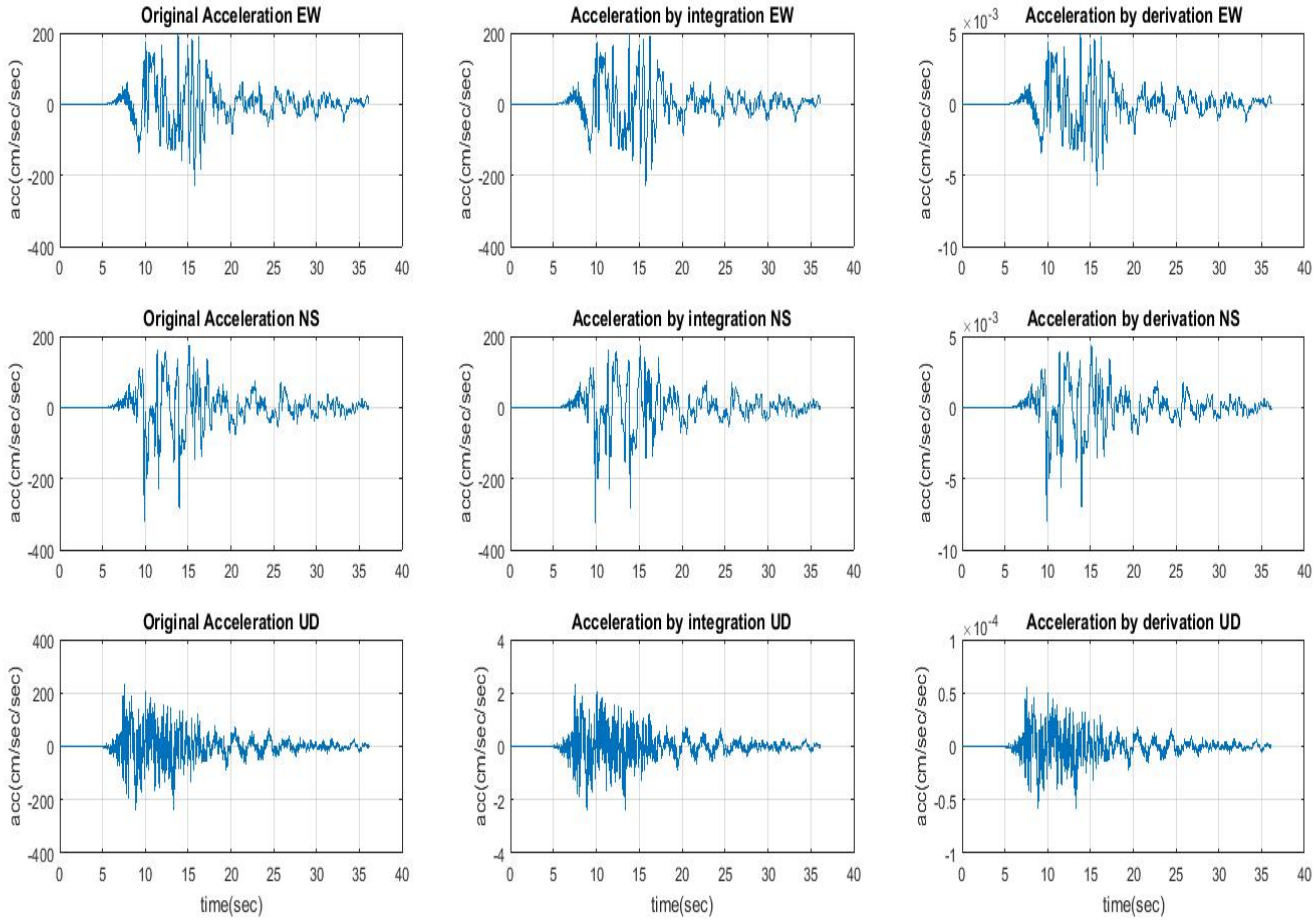

Original Acceleration NS
acc(cm/sec/sec)
500
0
-500
0
5
10
15
20
25
30
35
40
Velocity NS derived from integration
v(cm/sec)
100
0
-100
0
5
10
15
20
25
30
35
40
Displacement NS derived from integration
d(cm)
200
0
-200
0
5
10
15
20
25
30
35
40
time(sec)


Original Acceleration UD
acc(cm/sec/sec)
5
0
-5
0
5
10
15
20
25
30
35
40
Velocity UD derived from integration
v(cm/sec)
0.5
0
-0.5
0
5
10
15
20
25
30
35
40
Displacement UD derived from integration
d(cm)
0.5
0
-0.5
0
5
10
15
20
25
30
35
40
time(sec)


Displacement EW
d(cm)
400
200
0
0
5
10
15
20
25
30
35
40
Derived Velocity EW
v(cm/sec)
0.5
0
-0.5
Derived Acceleration EW
acc(cm/sec/sec)
0.01
0
-0.01
time(sec)


Displacement NS
d(cm)
200
0
-200
0
5
10
15
20
25
30
35
40
Derived Velocity NS
v(cm/sec)
0.5
0
-0.5
Derived Acceleration NS
acc(cm/sec/sec)
0.01
0
-0.01
time(sec)


Displacement UD
d(cm)
0.5
0
-0.5
0
5
10
15
20
25
30
35
40
Derived Velocity UD
x 10^-3
v(cm/sec)
2
0
-2
Derived Acceleration UD
x 10^-4
acc(cm/sec/sec)
time(sec)


Original Acceleration EW
Acceleration by integration EW
Acceleration by derivation EW
Original Acceleration NS
Acceleration by integration NS
Acceleration by derivation NS
Original Acceleration UD
Acceleration by integration UD
Acceleration by derivation UD
acc(cm/sec/sec)
time(sec)
×10^-3
×10^-4