

## Example

This example shows the procedure of the calculation of eigenquakes from an earthquake record suite, and the reproduction of the initial earthquake suite from the basis eigenquakes. It is found that the difference between the initial records and their corresponding simulated ones is small.

References:

1. Alimoradi, A., & Beck, J. L. (2014). Machine-learning methods for earthquake ground motion analysis and simulation. Journal of Engineering Mechanics, 141(4), 04014147.
2. Alimoradi, A. (2011). Earthquake ground motion simulation using novel machine learning tools.

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## Install directory

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```
S=mfilename('fullpath');  
f=filesep;  
ind=strfind(S,f);  
S1=S(1:ind(end)-1);  
addpath(genpath(S1));  
cd(S1)
```

## Load earthquake data

---

```
load X
```

## Reduce the earthquake set

---

Specify variance

```
variance = 0.995;
```

Normalize the features according to the formula:  $[X - \text{mean}(X)] / \text{std}(X)$

```
X2=X;  
mu = mean(X2);  
stddev = std(X2);
```

Subtract mean of each feature from original value

```
X2 = bsxfun(@minus,X2,mu);
```

Divide by standard deviation

```
X2 = bsxfun(@rdivide,X2,stddev);
```

Perform eigenquake reduction

```
UReduced = eigQuake(X2,variance);
```

## Simulate the initial earthquake suite

Get data with reduced set of features.

```
reducedData = X2*UReduced;
```

Simulate the original data from the data set with reduced features.

```
XRecovered = reducedData*(UReduced');
```

Perform the inverse of the normalization process that is done in the beginning prior to performing PCA

```
XRecovered = bsxfun(@times,XRecovered,stddev);  
XRecovered = bsxfun(@plus,XRecovered,mu);
```

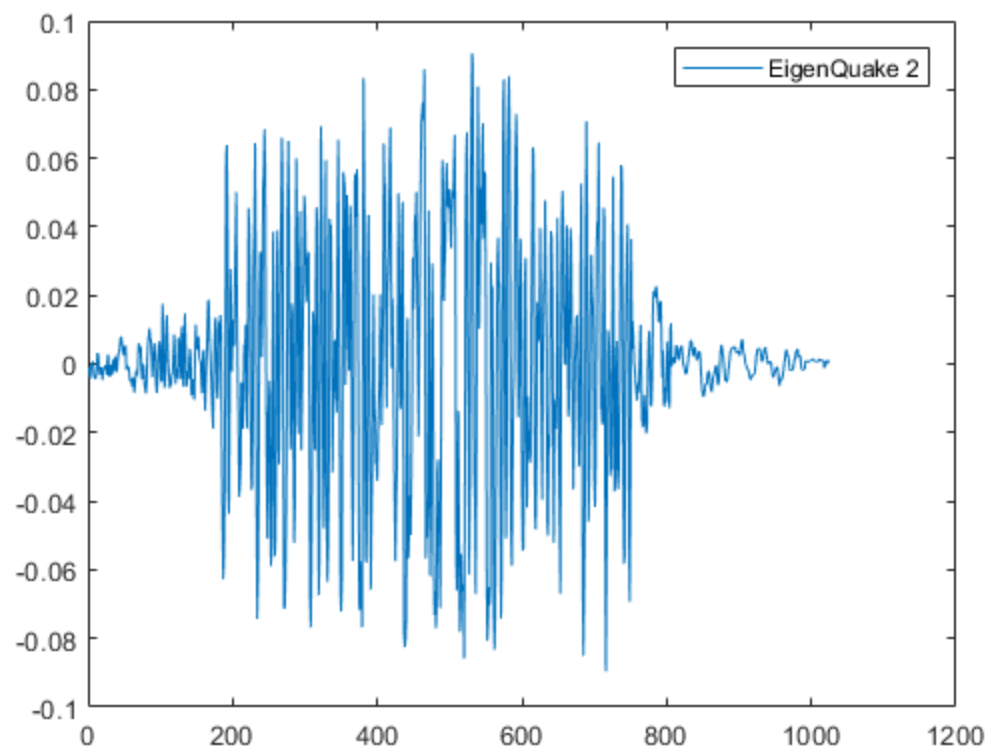
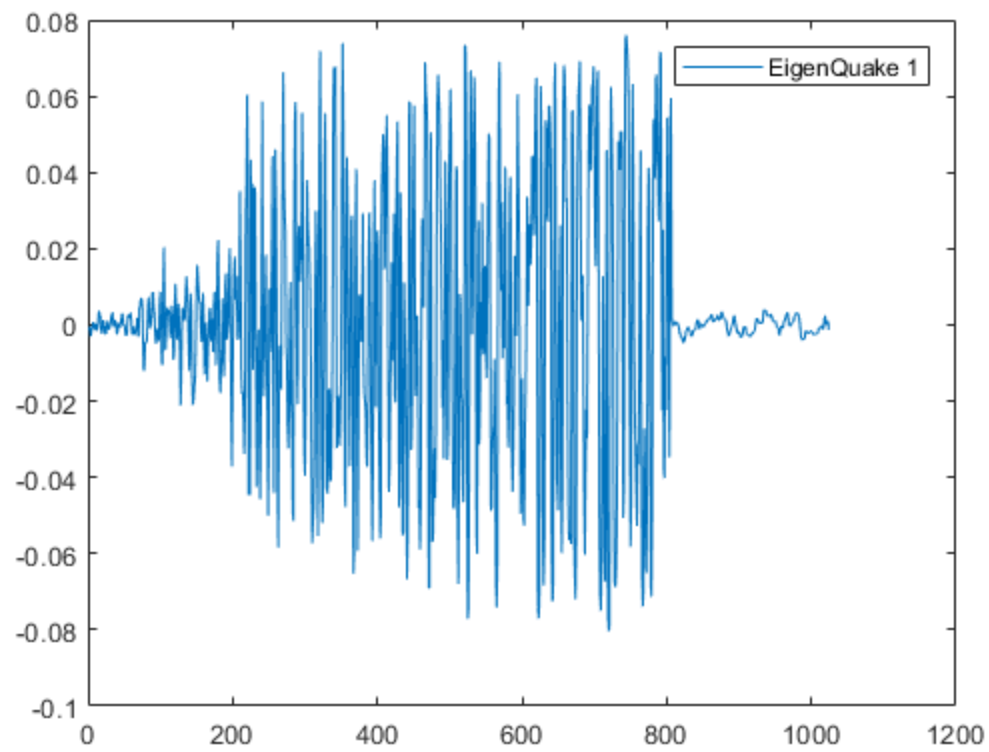
## Plots

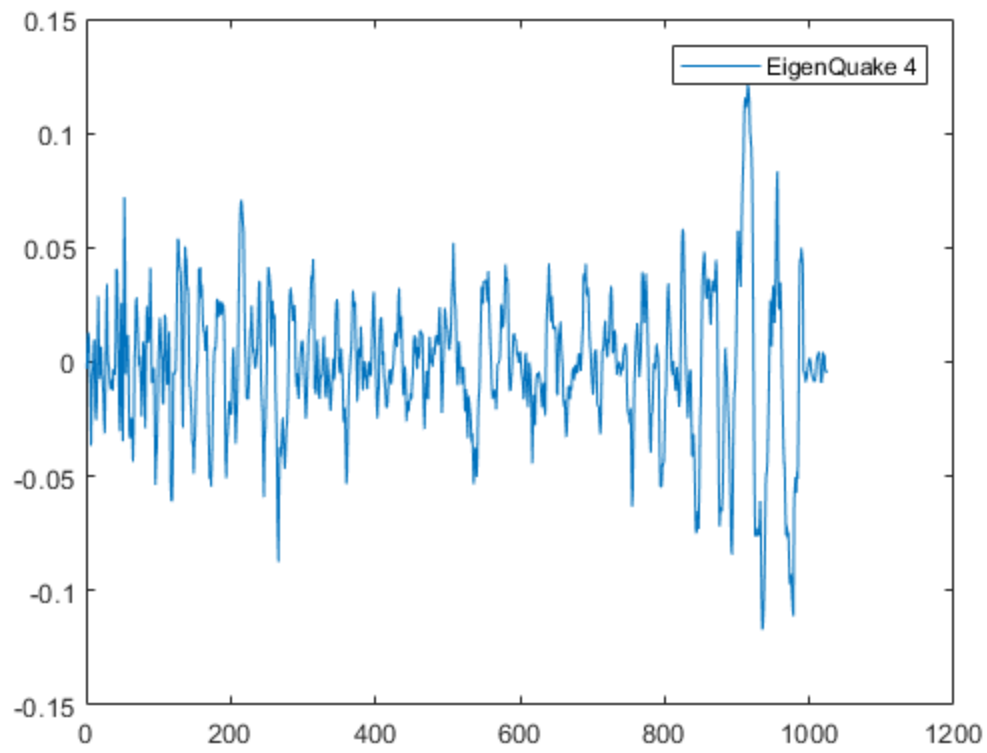
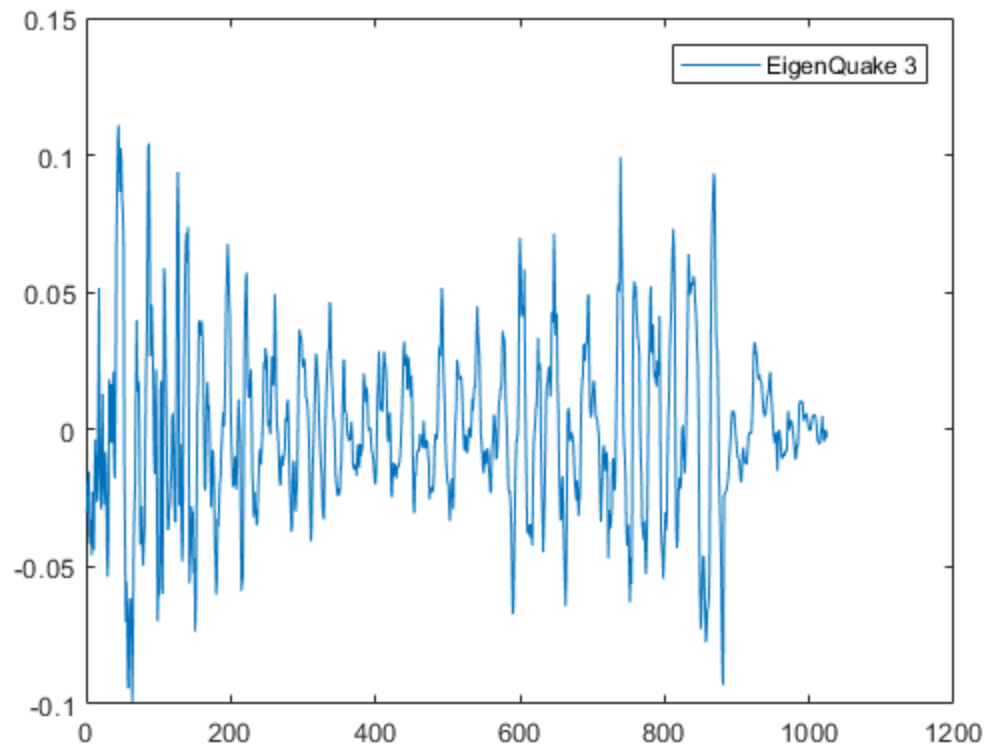
Set the number of eigenquakes to be plotted

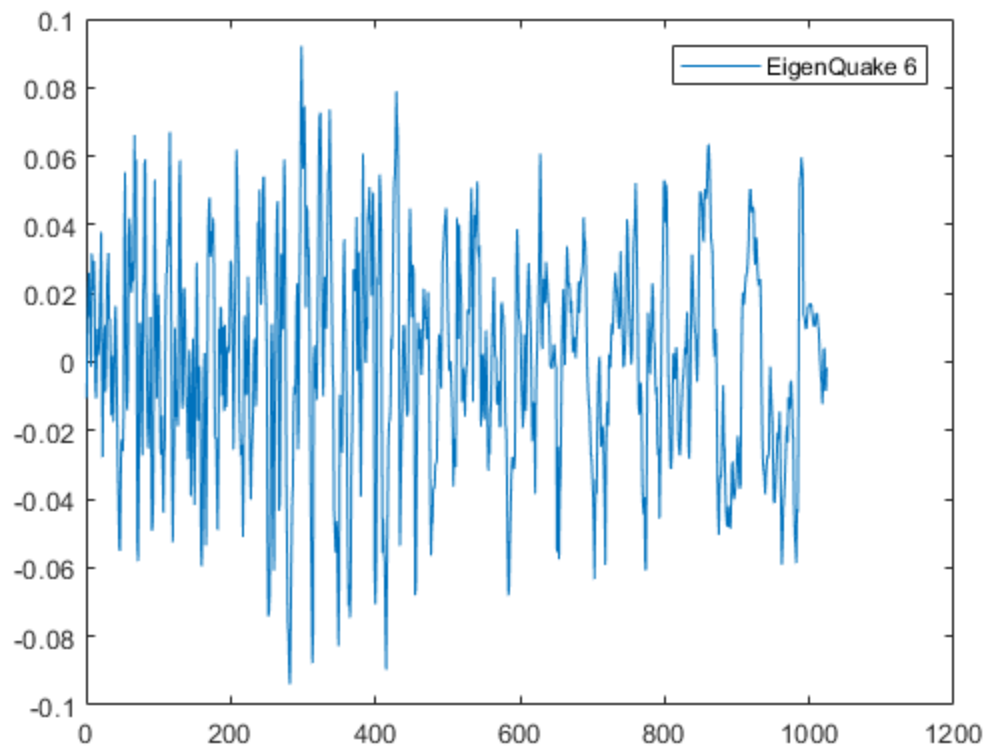
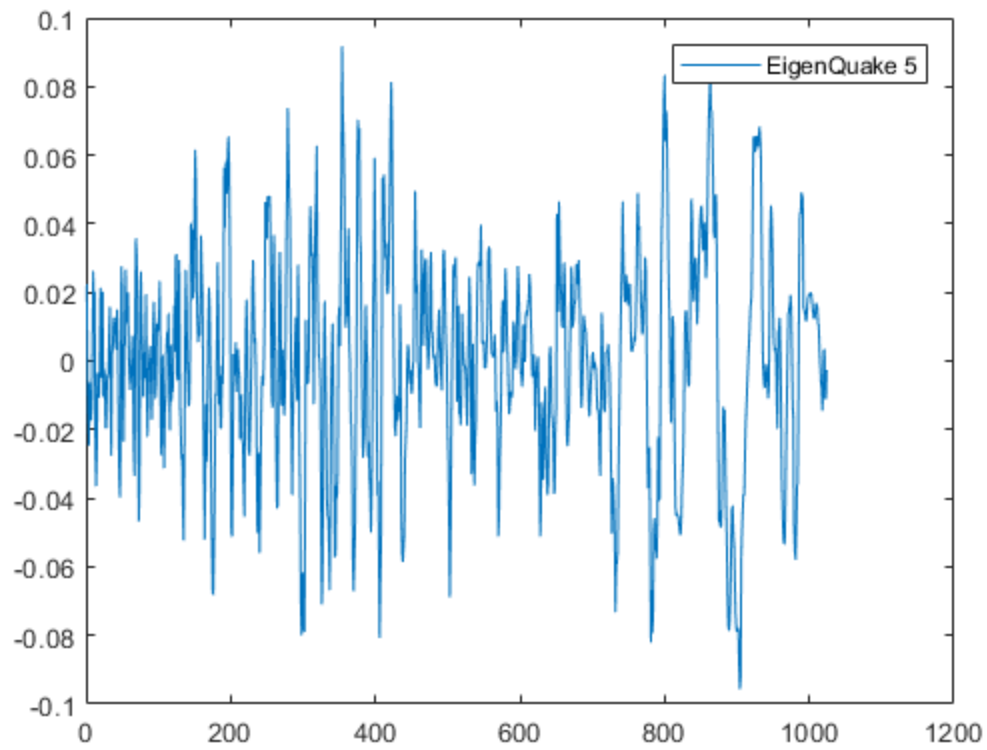
```
nEigQ=6;
```

Plot eigenquakes

```
for i=1:nEigQ  
    figure(i)  
    plot(UReduced(:,i));  
    legend({'EigenQuake ',num2str(i)})  
end
```



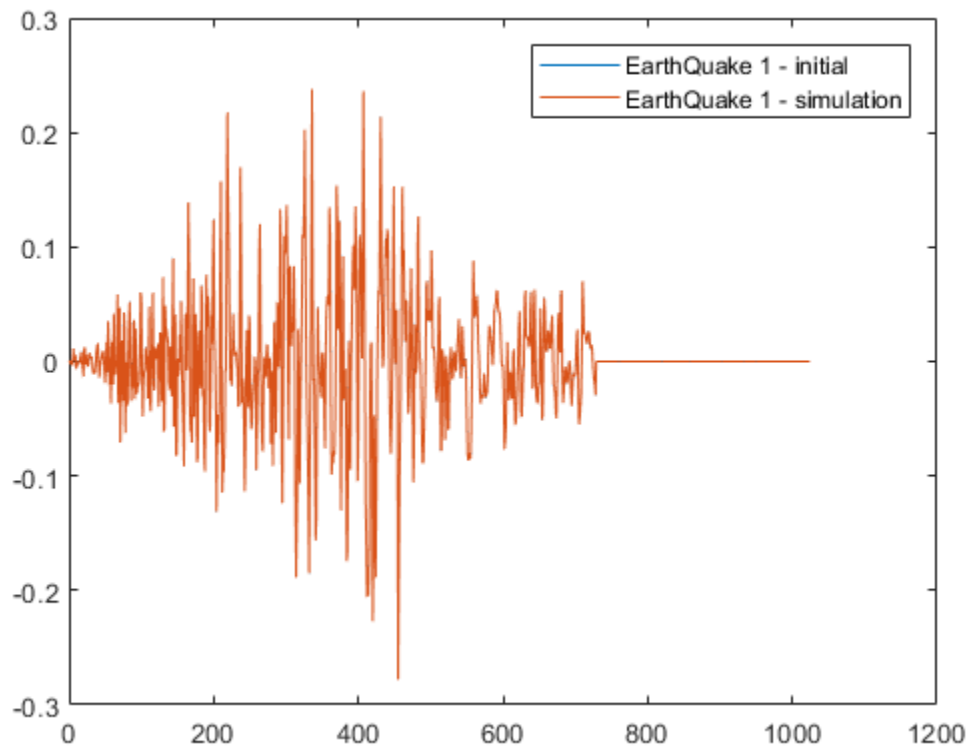


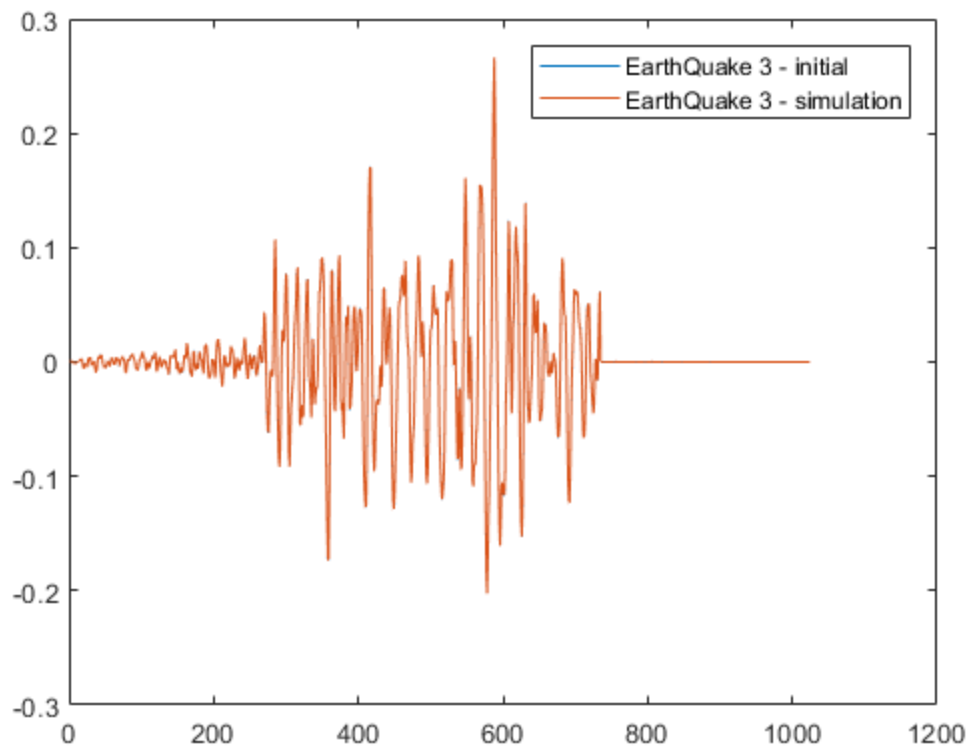
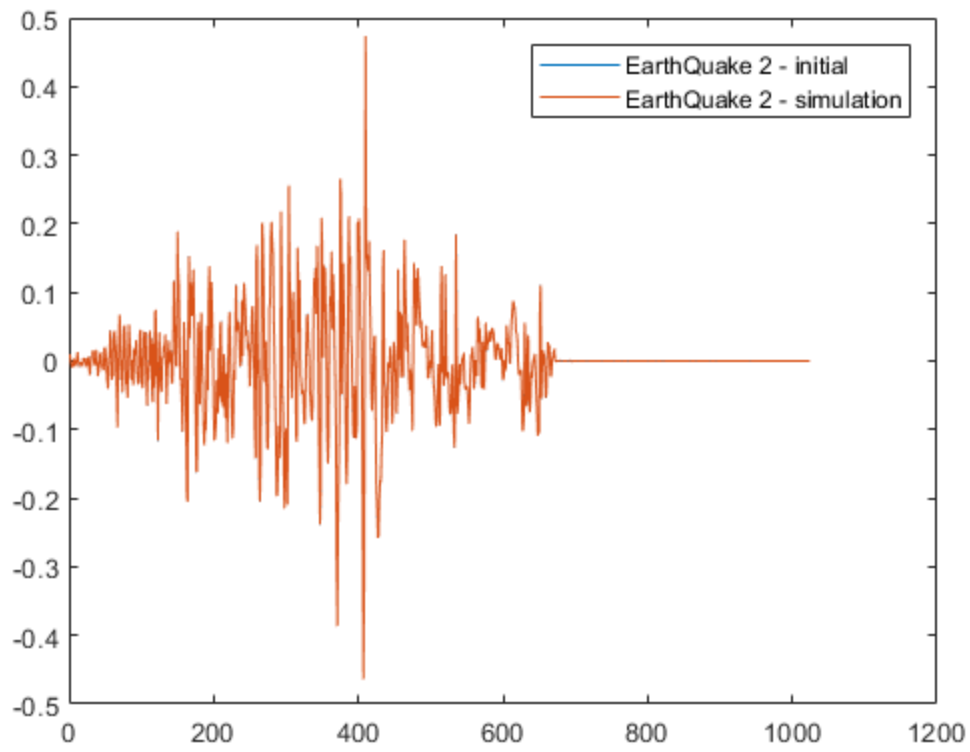


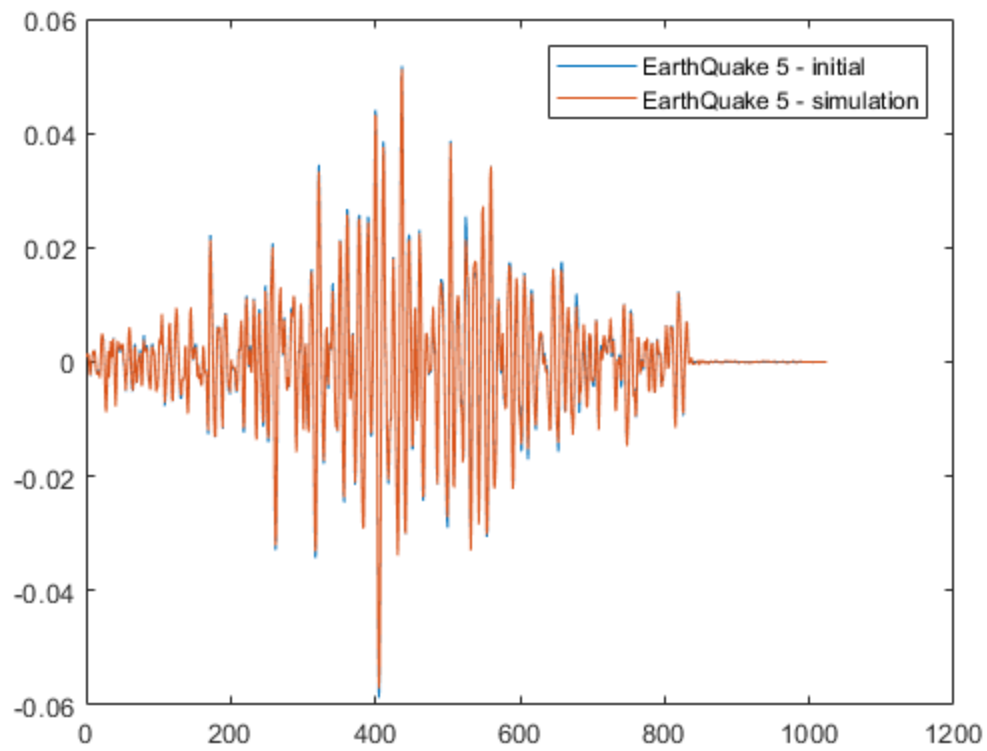
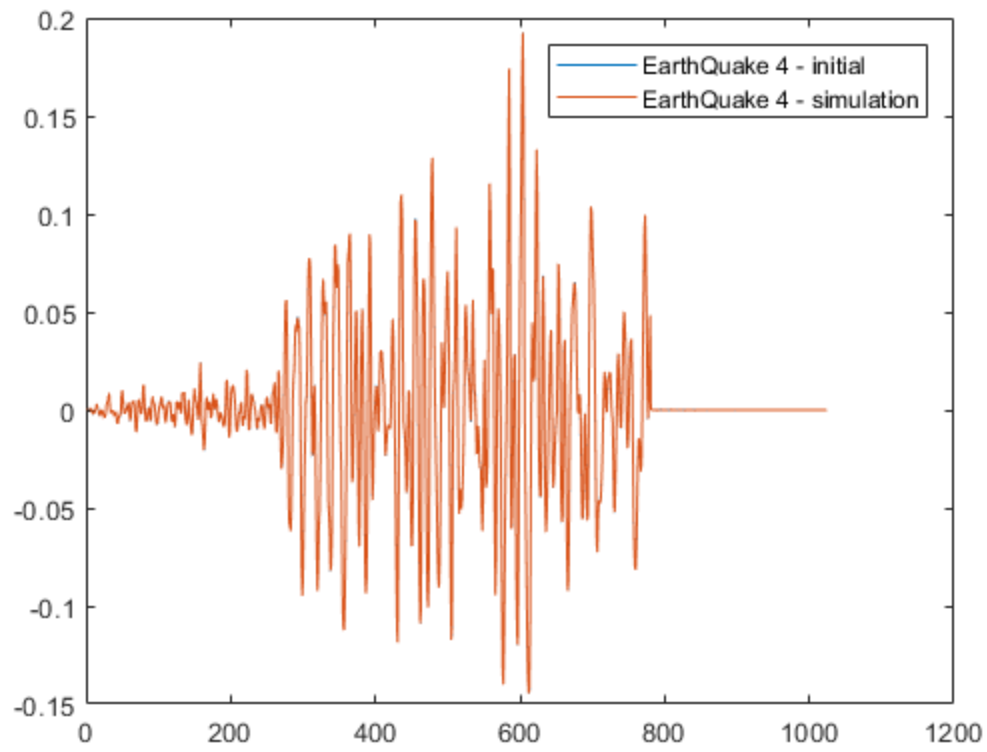
Plot original and recovered earthquakes

```
for i=1:nEigQ
```

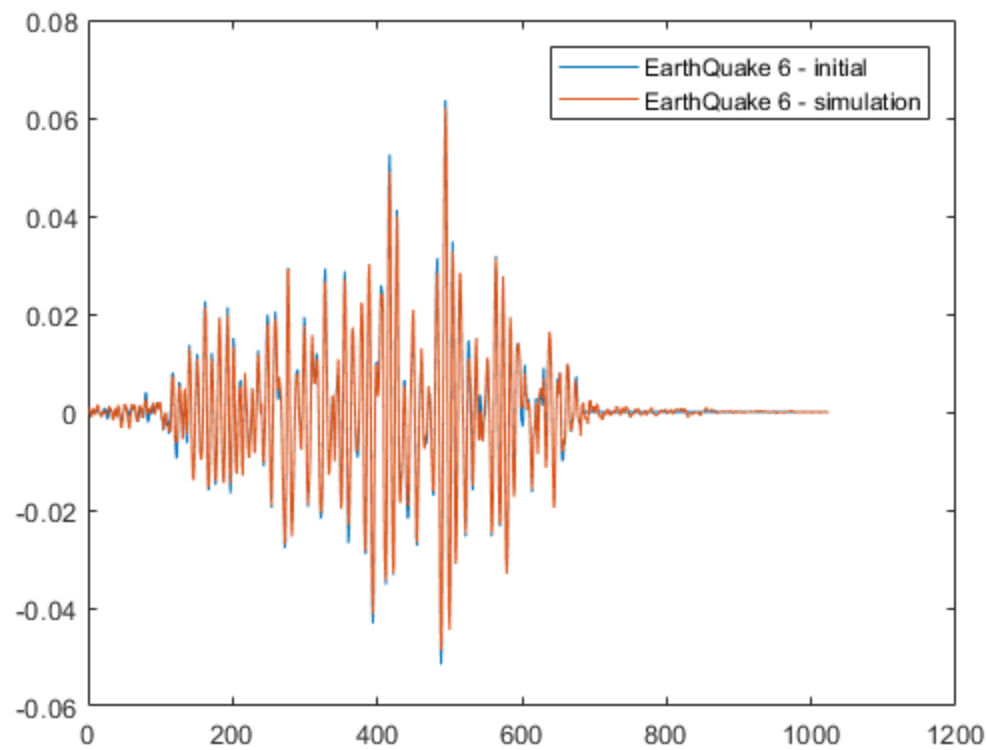
```
figure(nEigQ+i)
plot(X(i,:))
hold on
plot(XRecovered(i,:))
legend(['EarthQuake ',num2str(i),' - initial'],...
       ['EarthQuake ',num2str(i),' - simulation'])
end
```











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