Demonstration Of Seismometer

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How earthquake happens?
What are the Seismic Waves?
How can we detect the Seismic Waves/Earthquake?
Analyze the data from Seismometer?

What is an Earthquake?

- An Earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rocks beneath the earth.
- Release of gradually increasing stress results in the sudden, and sometime disastrous shaking… an earthquake.

What causes an Earthquake?

- The sudden slip at the fault causes the earthquake.

- a violent shaking of the Earth when large elastic strain energy released spreads out through seismic waves that travel through the body and along the surface of the Earth.

Seismic Waves

- Energy carrying waves caused by rupturing of the Earth
- Have high speeds
- Their speed depends on the nature of wave and the elastic properties of the Earth
- Higher density and pressure increases the speed

Type Of Seismic Waves

There are two main types of seismic waves:

- Body waves
- Surface waves

BODY WAVES

1) P-waves (primary waves)
2) S-waves (Secondary waves)

Animation

Body waves

P-waves

- Compressional/Longitudinal
- P motion travels fastest in materials so the P-wave is the first arriving energy on a seismogram.
- Have higher frequency than the S and surface waves.

S-waves

- Shear/Transverse
- S waves travel slower than P waves in a solid and, therefore, arrive after the P wave.
- S-waves do not travel through fluids, so do not exist in Earth's liquid outer core or in air or water or molten rock

Detecting the earthquake

- Seismometer
- Amaseis software

Seismometer

- An apparatus used to detect Earthquake
- It works on the principle of inertia
- Components

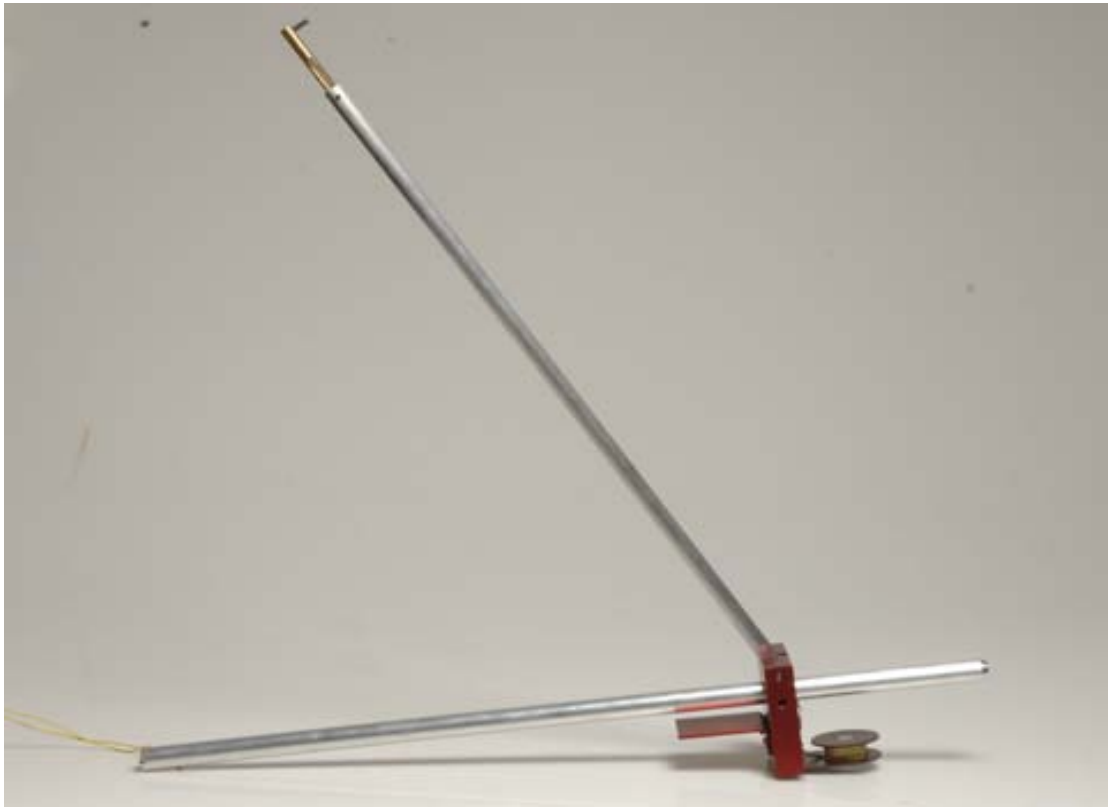
Components

The SEP seismometer consists of the following components

1) Long frame base (with single leveling screw and scale marks)
2) Short frame base (with twin leveling screws)
3) Frame upright (with top suspension point suspension rod and vertical roller bearing)
4) Boom arm (with aluminium damping plate and boom bracket)
5) Sensing coil (with phono plug connector)
6) Sensing magnets (assembled in steel cage)
7) Damping magnets (assembled in steel cage)
8) Brass masses (with locknut)
9) Electronics box, mains adaptor and serial RS232 lead.

Boom Arm

- Tungsten carbide roller
- Sensor coil
- Damping plate
- Suspension rod



- damping magnets
- sensing magnets
- brass masses

Setting up The Seismometer

- Keep in direct contact with the ground (act as a sensitive pendulum)
- Orient North or East
- Protect from air currents
- Connect to the PC

1. Assembling The Seismometer

- Assembling the frame

1. First attach the long frame base to the frame upright with two set screws.
2. Next attach the short frame base to the frame with two set screws.

2. Attaching the boom arm

The seismometer can be set up in two ways:

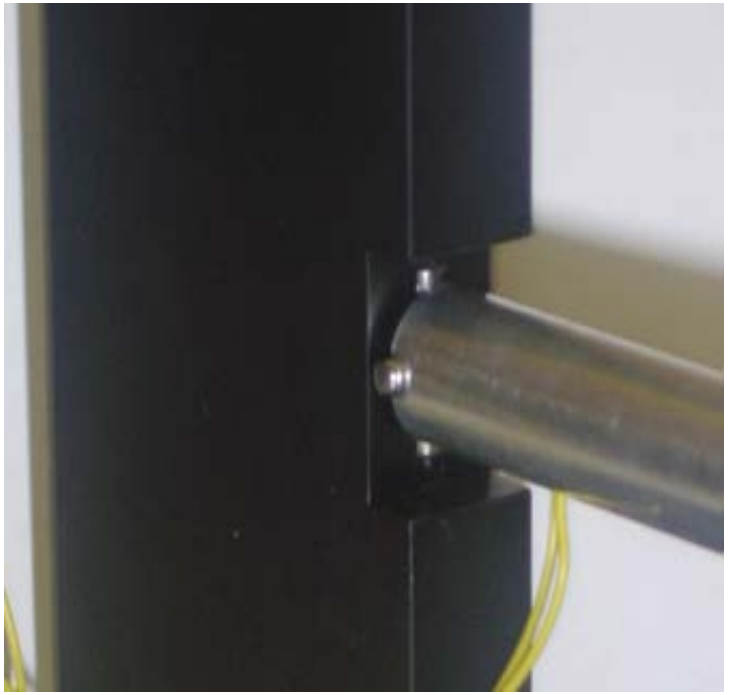
1. moving magnet mode (with the sensor magnet on the boom and the sensor coil on the baseplate)

2. moving coil mode (with the sensor coil on the boom and the magnet on the baseplate).

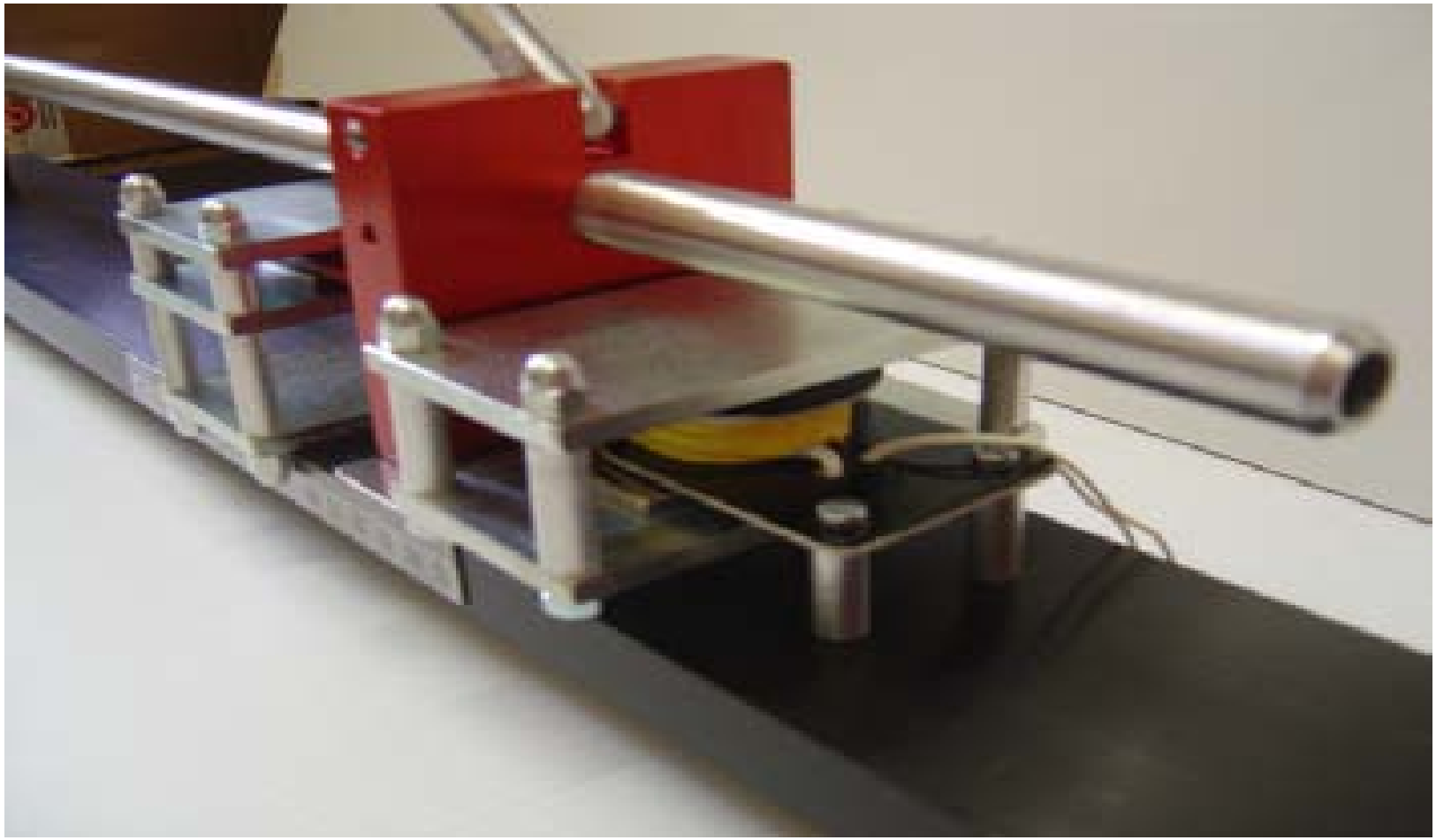
Pivots should be centrally placed

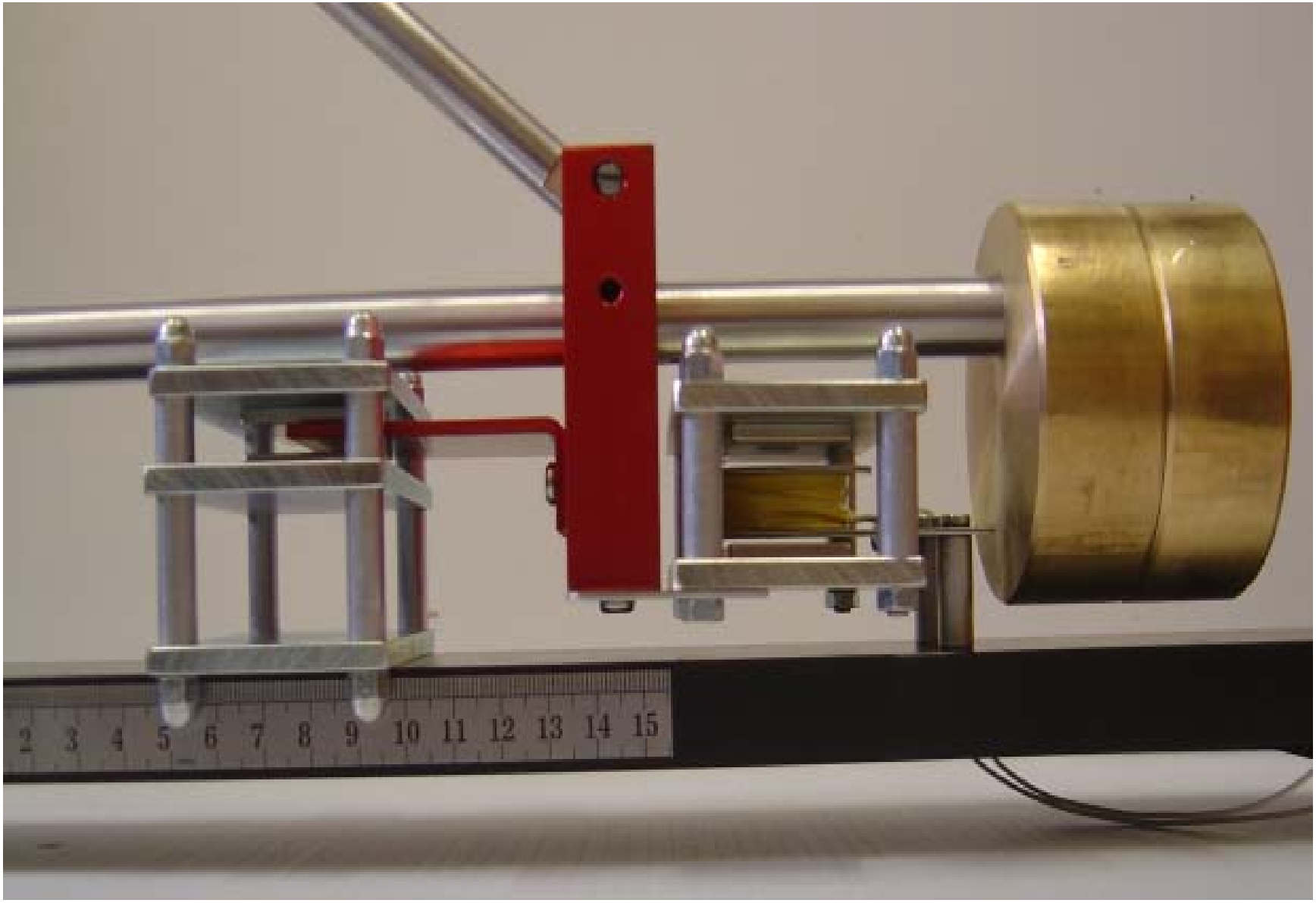
Top pivot

Bottom pivot

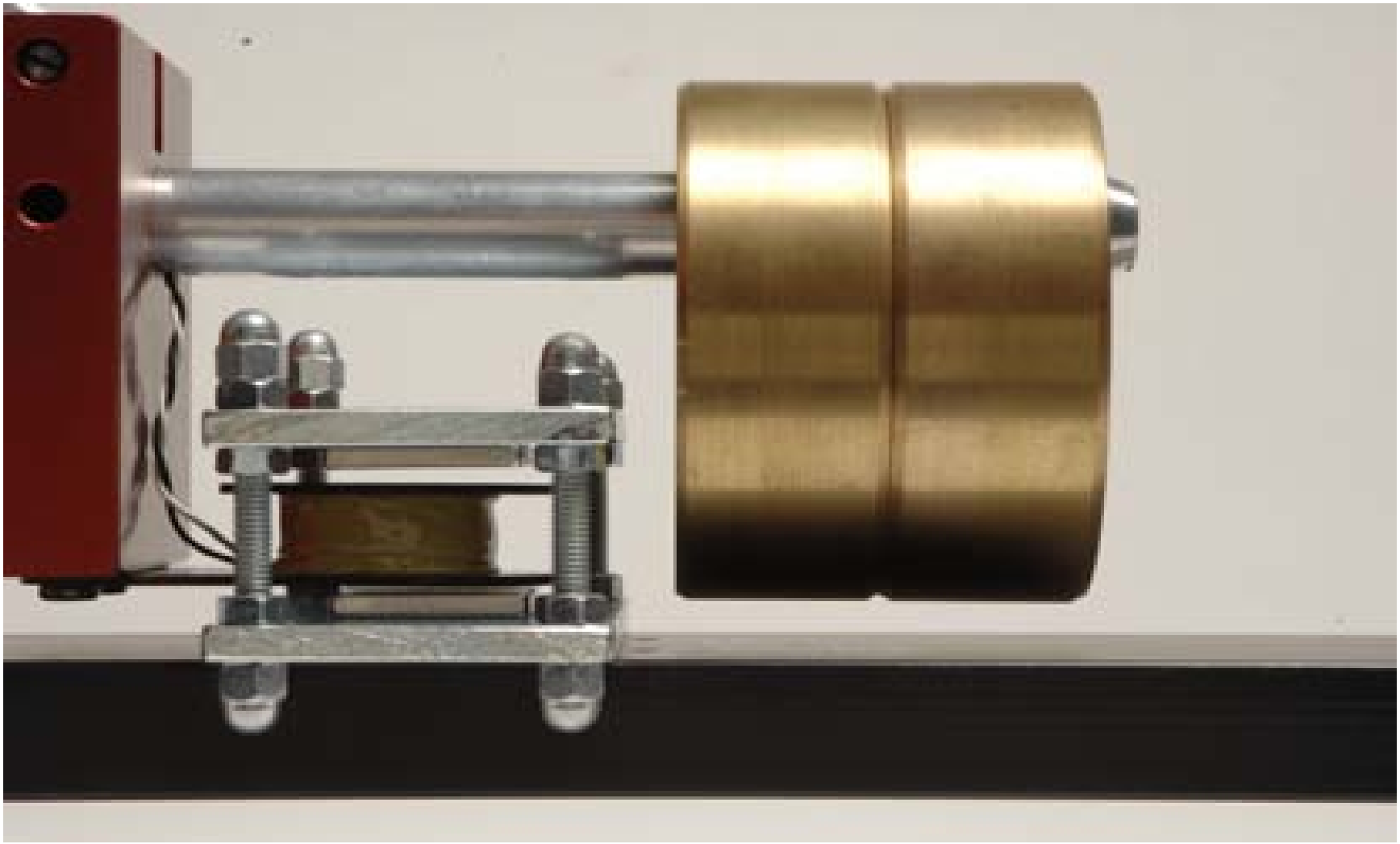


Assembled view of moving magnet setup




2 3 4 5 6 7 8 9 10 11 12 13 14 15

Moving magnet mode



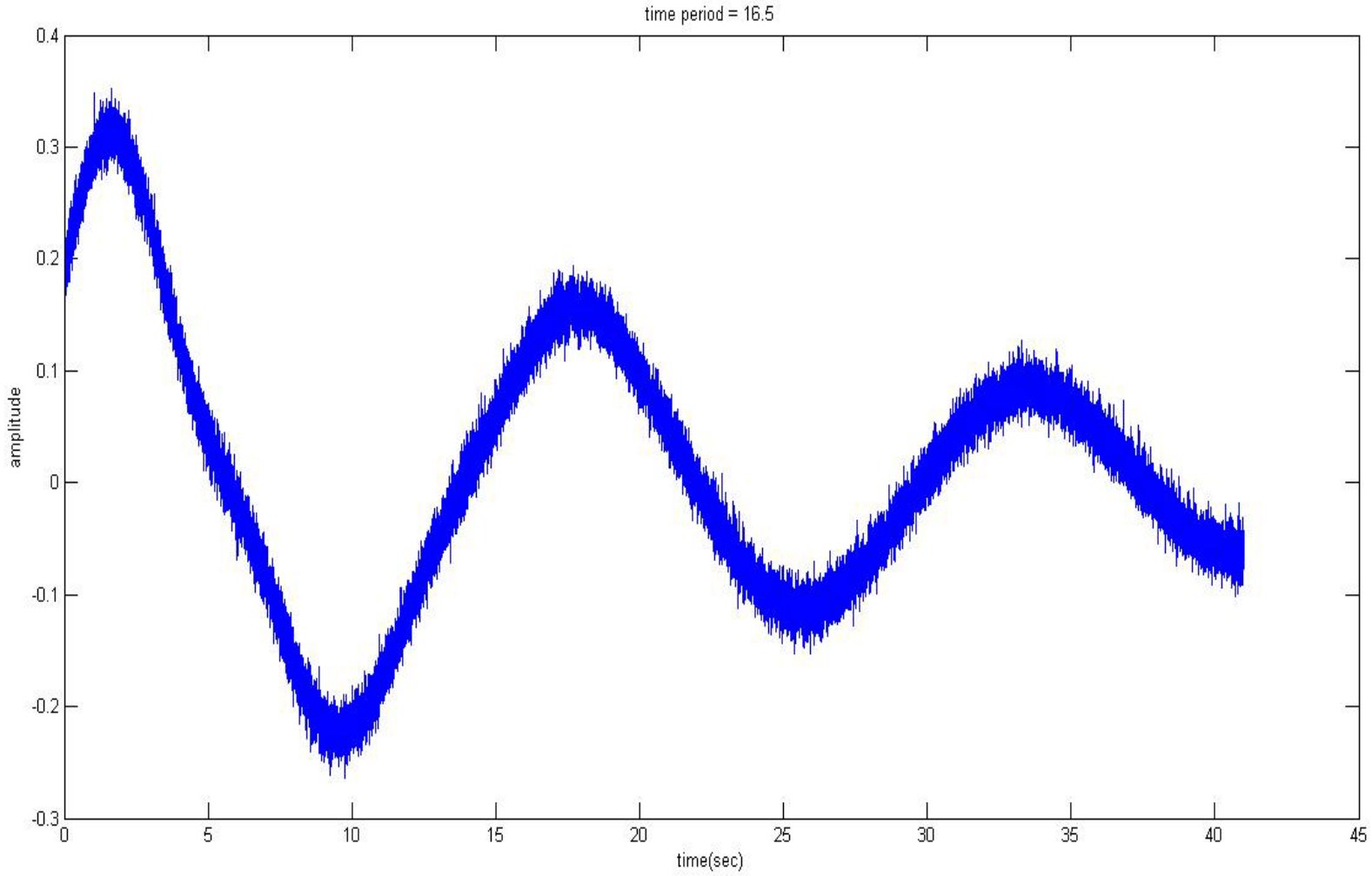
3. Leveling the seismometer

- Leveled by adjusting the screw on short base frame
- Leveled until the mass is swinging freely
- Placed the mass centrally

4. Adjusting the natural period

- Adjust the angle of the line joining the top suspension point and the roller bearing point to the vertical.
- T = 2pi L / g sin(*alpha*)
- Adjust the period by altering the levelling screw on the long frame base (next to the mass).
- Adjust period to 15-20 sec.

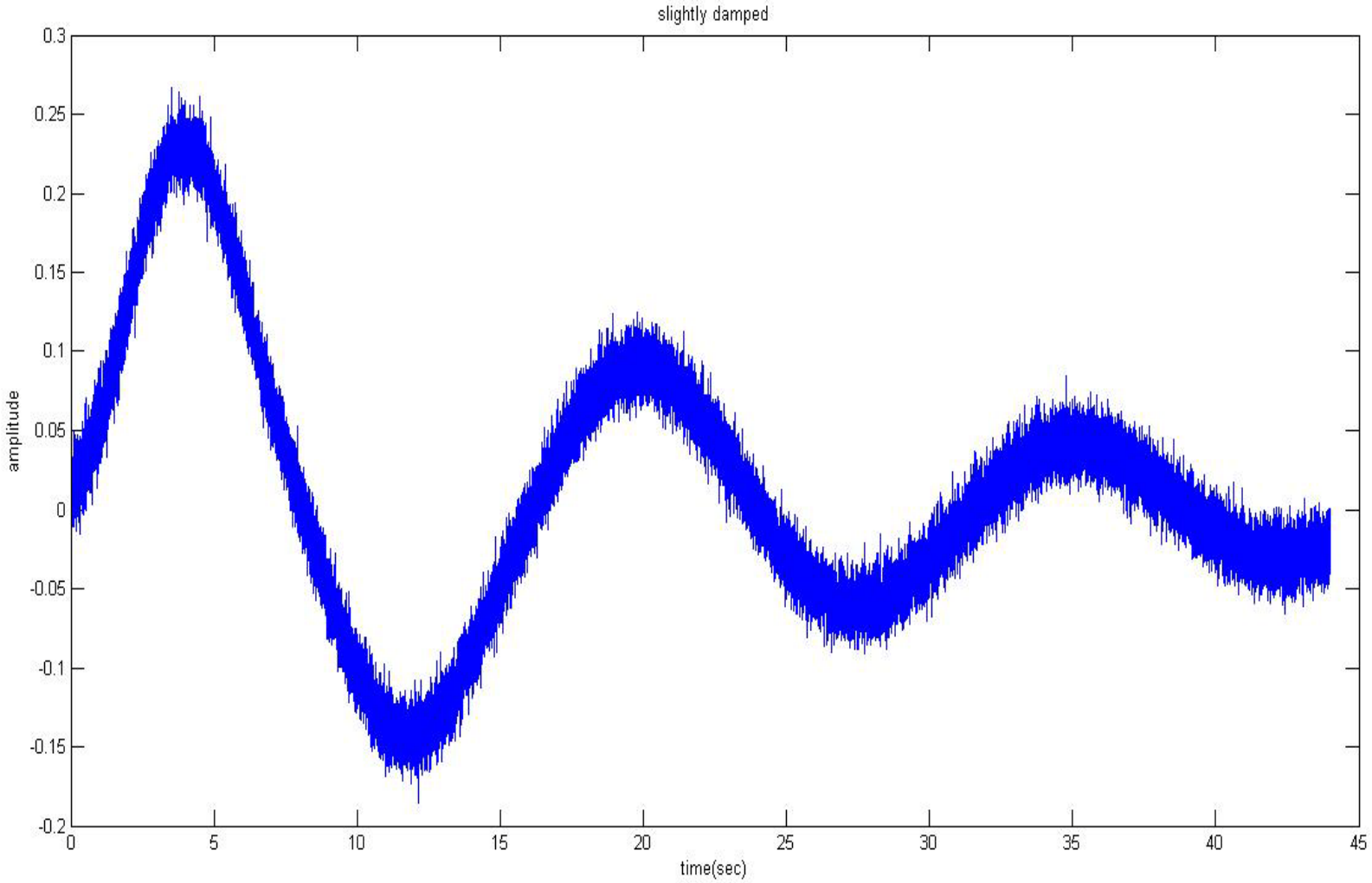
Time period(16.5sec) using lab view



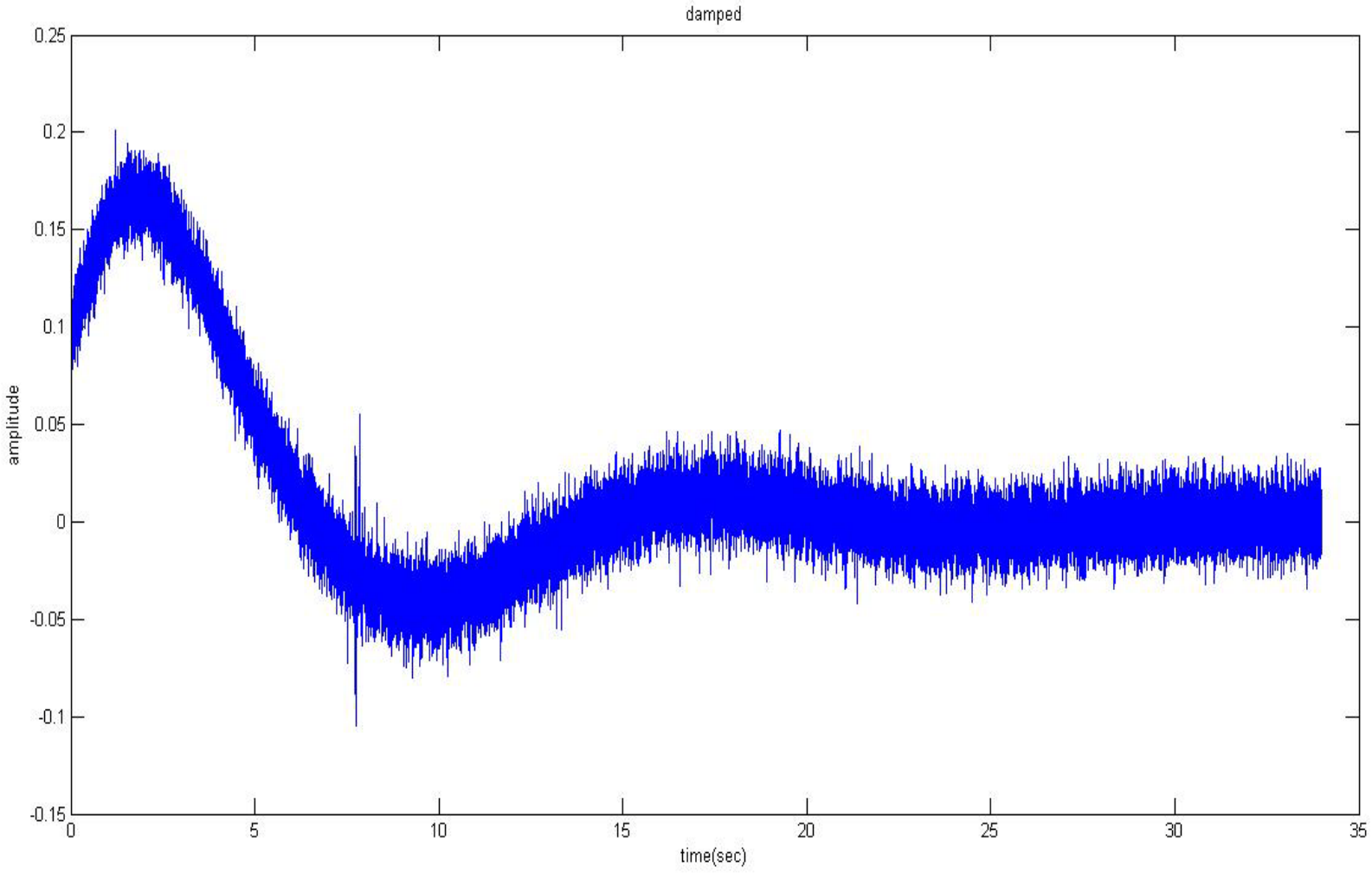
5. Adjust damping

- Slide magnet cage on the base to adjust damping
- Achieve the situation of critical damping
- Using lab view the plots are displayed on the screen

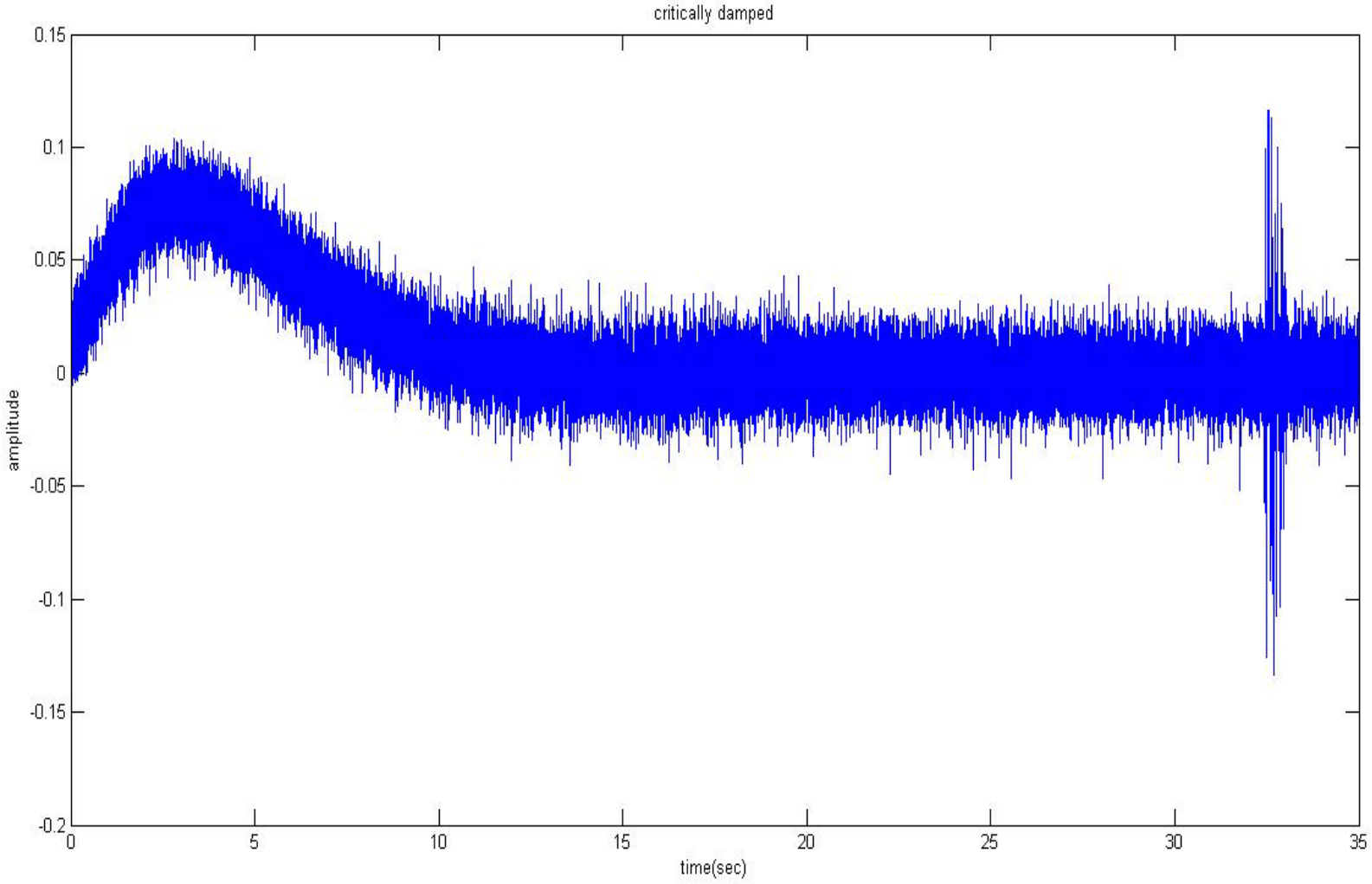
Slightly damped



damped


damped
amplitude
time(sec)
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
5
10
15
20
25
30
35

Critically Damped



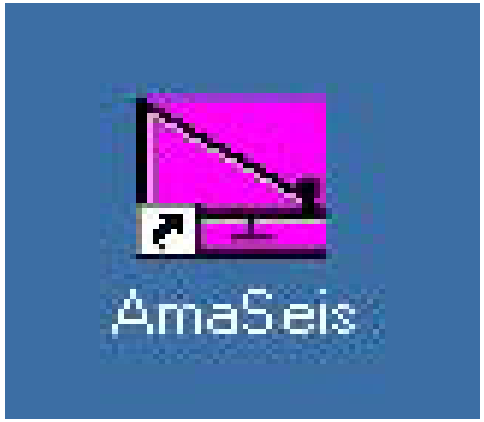
Connecting the seismometer to a computer

- Electronic Box
    1. amplifier
    2. filter circuit
    3. digitiser circuit
- Lead from sensing coil (input)
- COM port

AmaSeis Software

- AmaSeis is the software that records and displays the data generated by the SEP seismometer system.

- All settings will be stored in a file *AS1.ini*



Icon for AmaSeis

Device Setting

SEPUK1

COM port 1 or 2 (restart the software)

Station Setting

Station name (Lahore)

Station code (LUMS)

Network ID (LHR)

Longitude and latitude (31.6 and 74.5)

Display Setting

C:\amaseis\2012\06\15

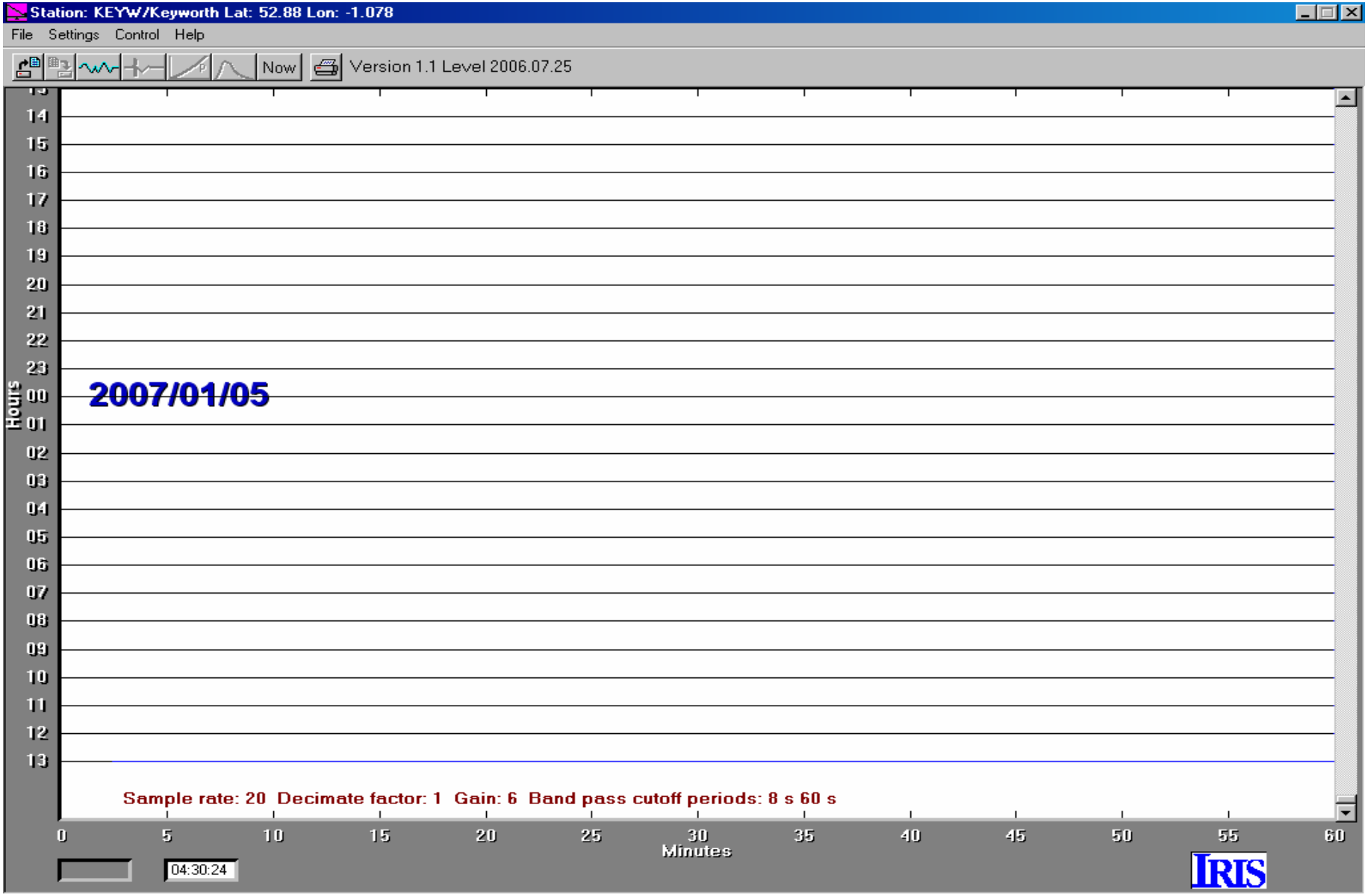
Each hour's folder saved by default as SAC format

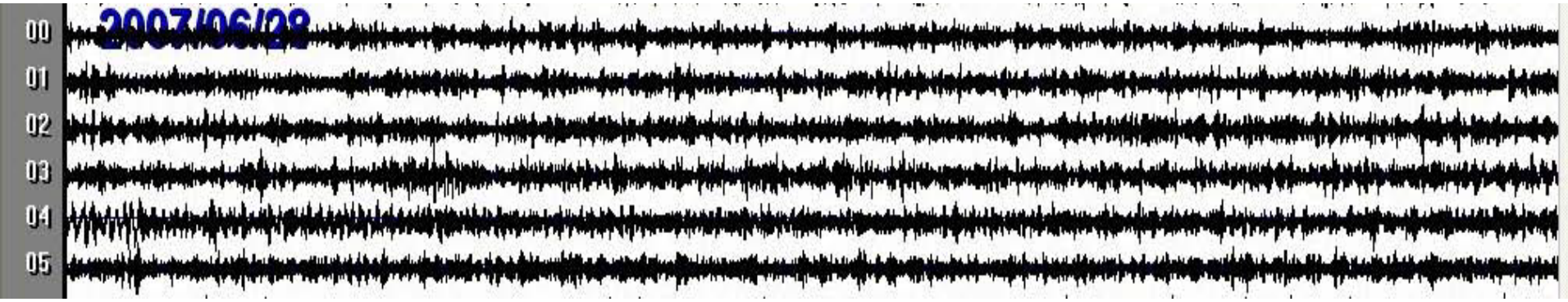
3.2Mbyte per day

Applying filter

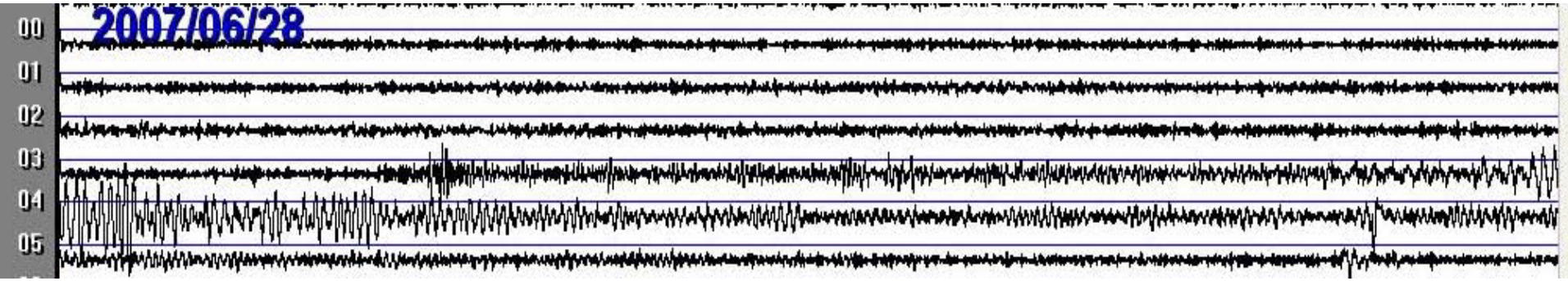
- To emphasis the data from large distant earthquakes and to minimize the data from nearby noise sources, a good filter to apply to the helicorder plots is a 10 second low-pass filter.

Default window of AmaSeis



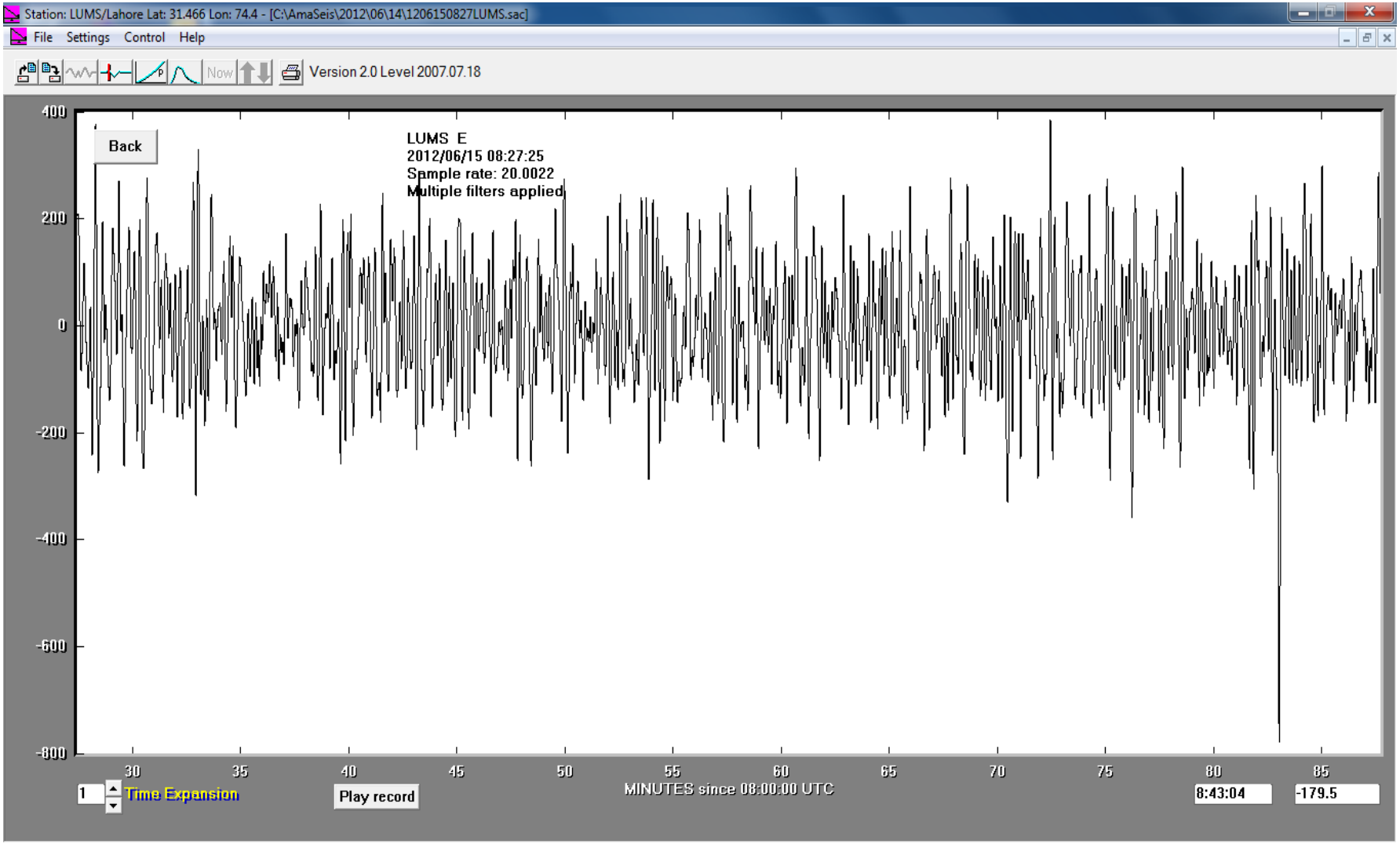


Unfiltered record



Filtering with a low pass the seismic waves filter (10 seconds) shows arriving more clearly.

The data on analysis window with information about the seismic station, showing the seismic waves.



What does a seismogram show

- A seismogram is the wiggly trace that records the vibrations caused by an earthquake at a particular recording station.
- Shows information for a particular Earthquake (latitude and longitude)
- Distance from earthquake to the recording station
- Identified UTC time on horizontal axis

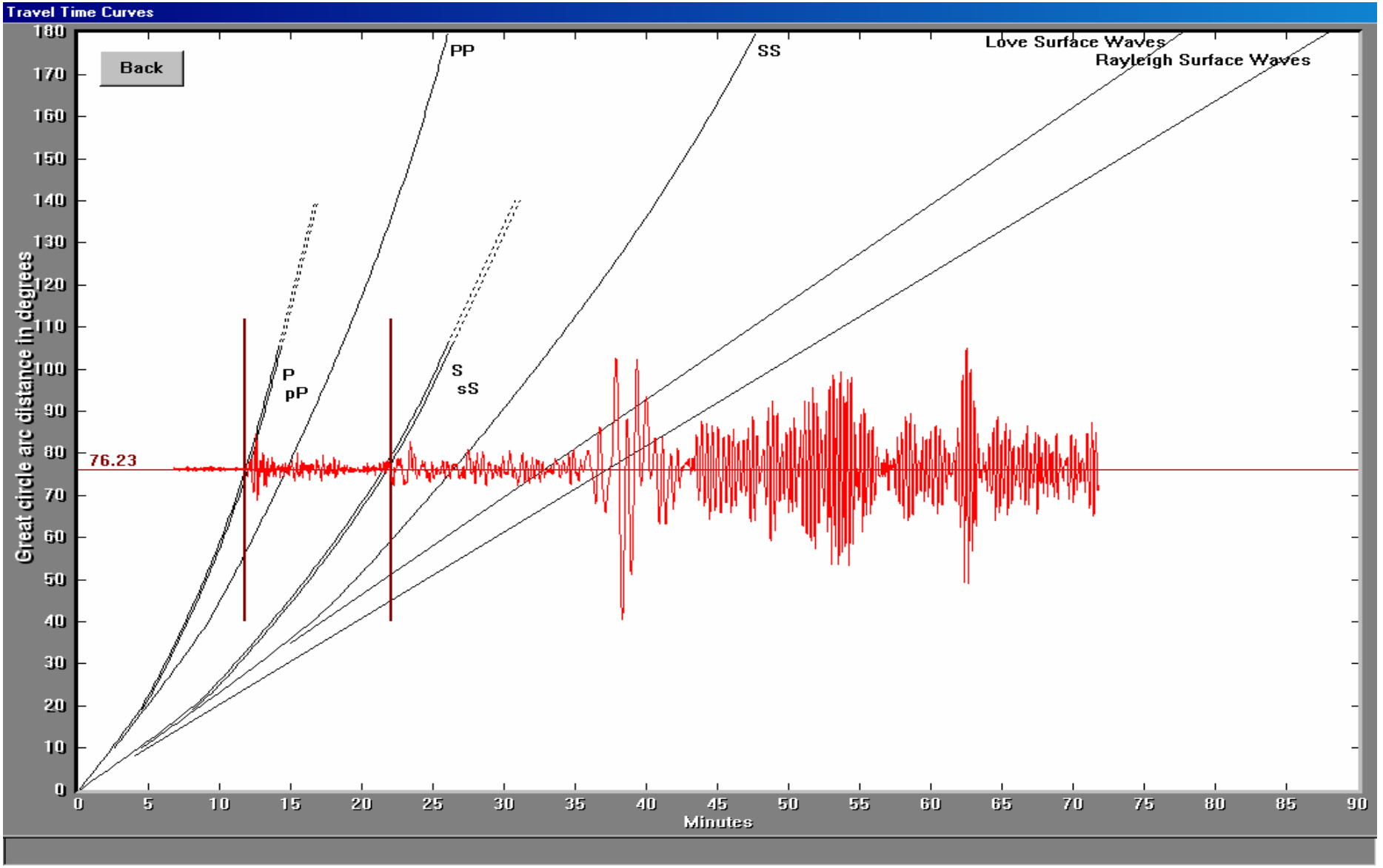
Identify the phases of seismic waves

- P and S
- PP and SS
- PcP and ScS…..etc

Locate the epicenter

- using data from three different station we can place epicenter

Seismogram on Travel time curve



Results

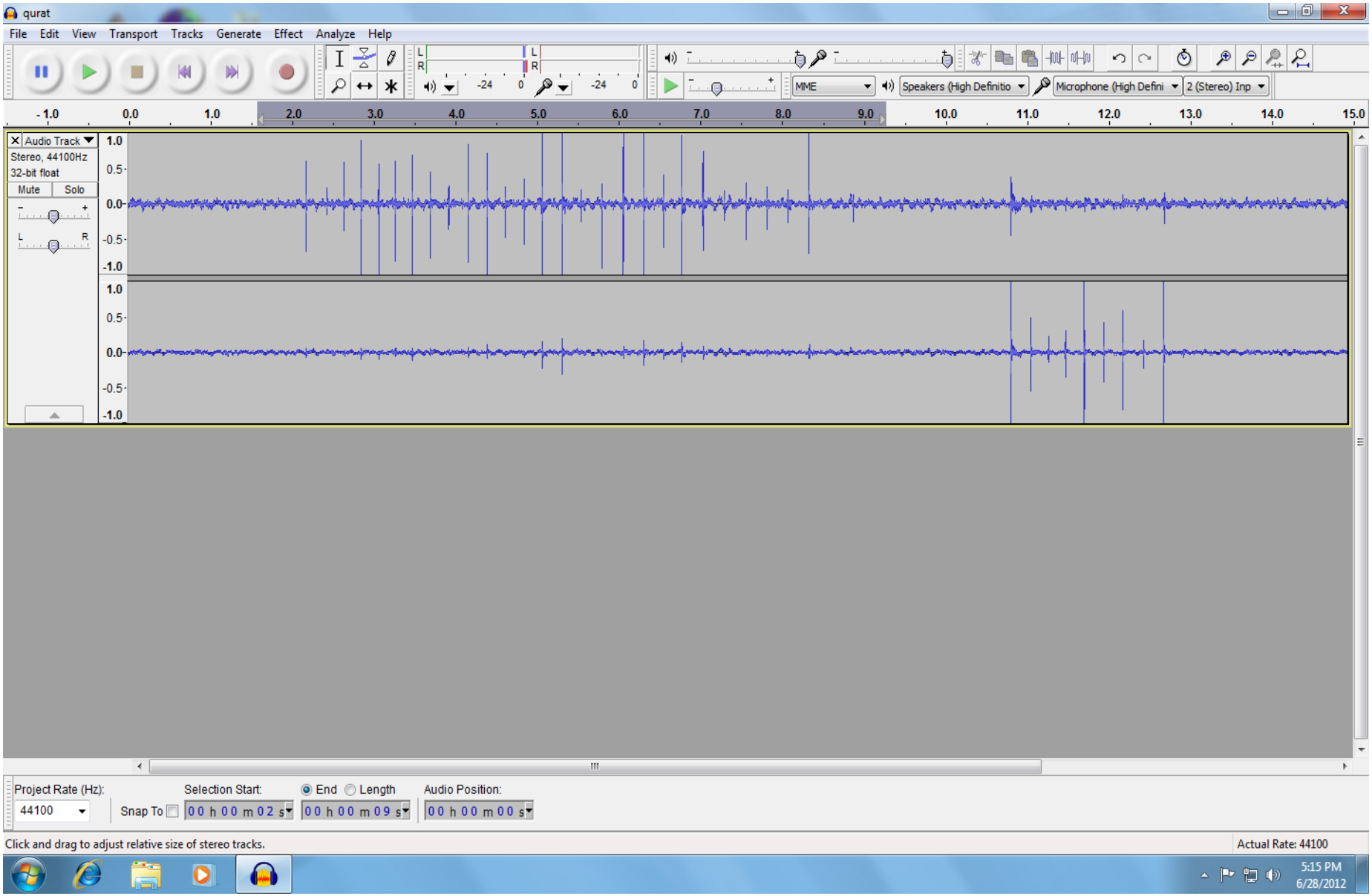
- Distance to the epicenter is 76.49
- Phases Arrival time

  P 8:55

  PP 8:58

  S 9:05

  SS 9:10


qurat
File Edit View Transport Tracks Generate Effect Analyze Help
MME
Speakers (High Definitio
Microphone (High Defini
2 (Stereo) Inp
Audio Track
Stereo, 44100Hz
32-bit float
Mute Solo
Project Rate (Hz):
44100
Snap To
Selection Start:
End Length
Audio Position:
00 h 00 m 02 s
00 h 00 m 09 s
00 h 00 m 00 s
Click and drag to adjust relative size of stereo tracks.
Actual Rate: 44100
5:15 PM
6/28/2012

Refrence

manual instruction of SEP seismometer

http://cse.ssl.berkeley.edu/lessons/indiv/davis/inprogress/reading.html

http://www.geo.mtu.edu/UPSeis/waves.html