Motivation I

From source to receiver...

- refractions and reflections
- 'site effects'

- geometrical spreading
- attenuation
- scattering

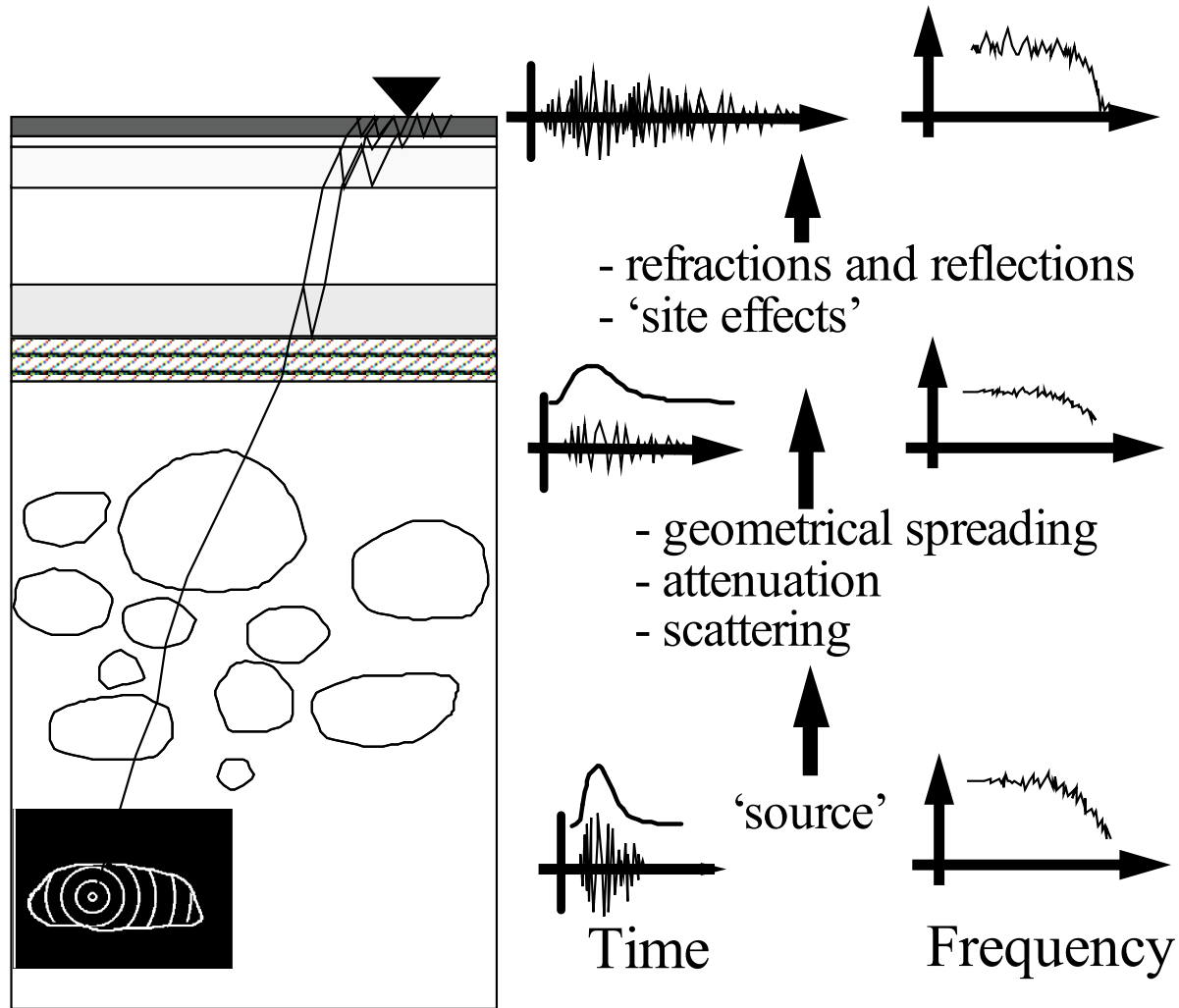'source'

Time

Frequency

Fig. 1.1 Signal distortion during wave propagation from the earthquake source to the surface.
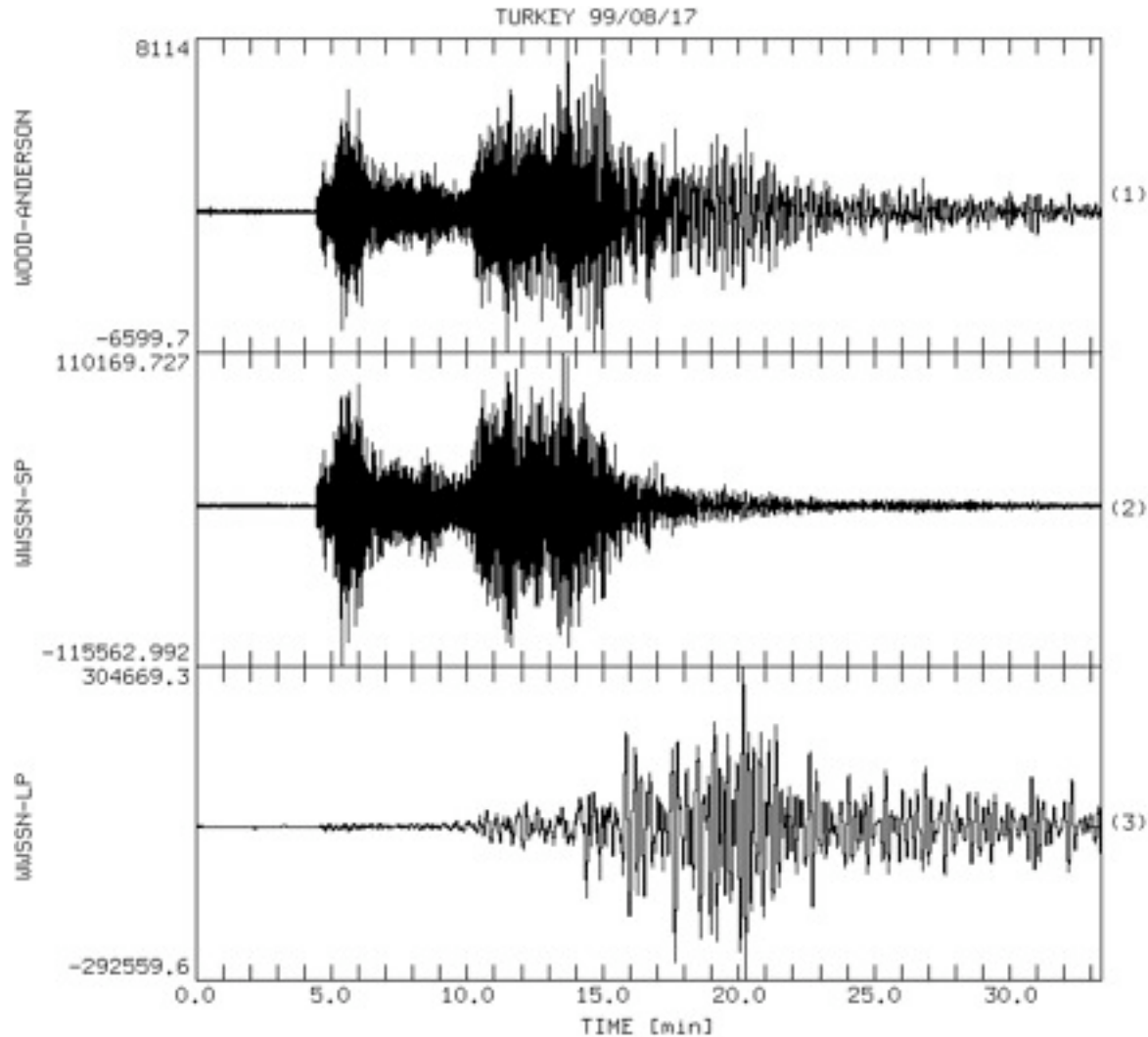
Influence of recording system

Fig. 1.2 Vertical component record of the Izmit earthquake in Turkey (1999/08/17) recorded at station MA13 of the University of Potsdam during a field experiment in Northern Norway. Shown from top to bottom are the vertical component records for a: Wood-Anderson, a WWSSN SP, and a WWSSN LP instrument simulation.

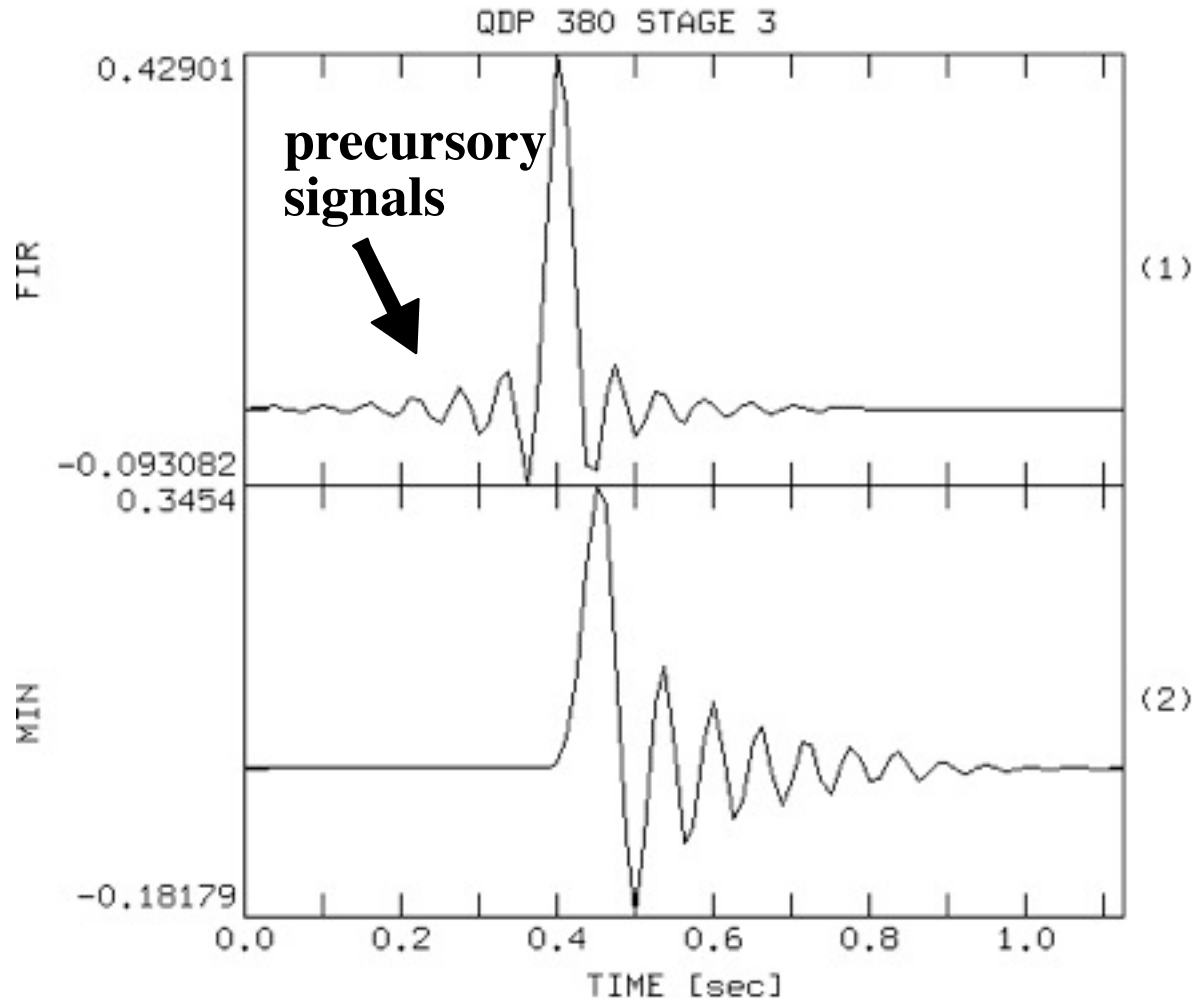Tuesday, September 1, 2009

Sampling process

Fig. 1.3 Impulse response of stage 3 of the two-sided decimation filter incorporated in the Quanterra QDP 380 system (top trace). The bottom trace shows a filter response with an identical amplitude but different phase response.

Tuesday, September 1, 2009
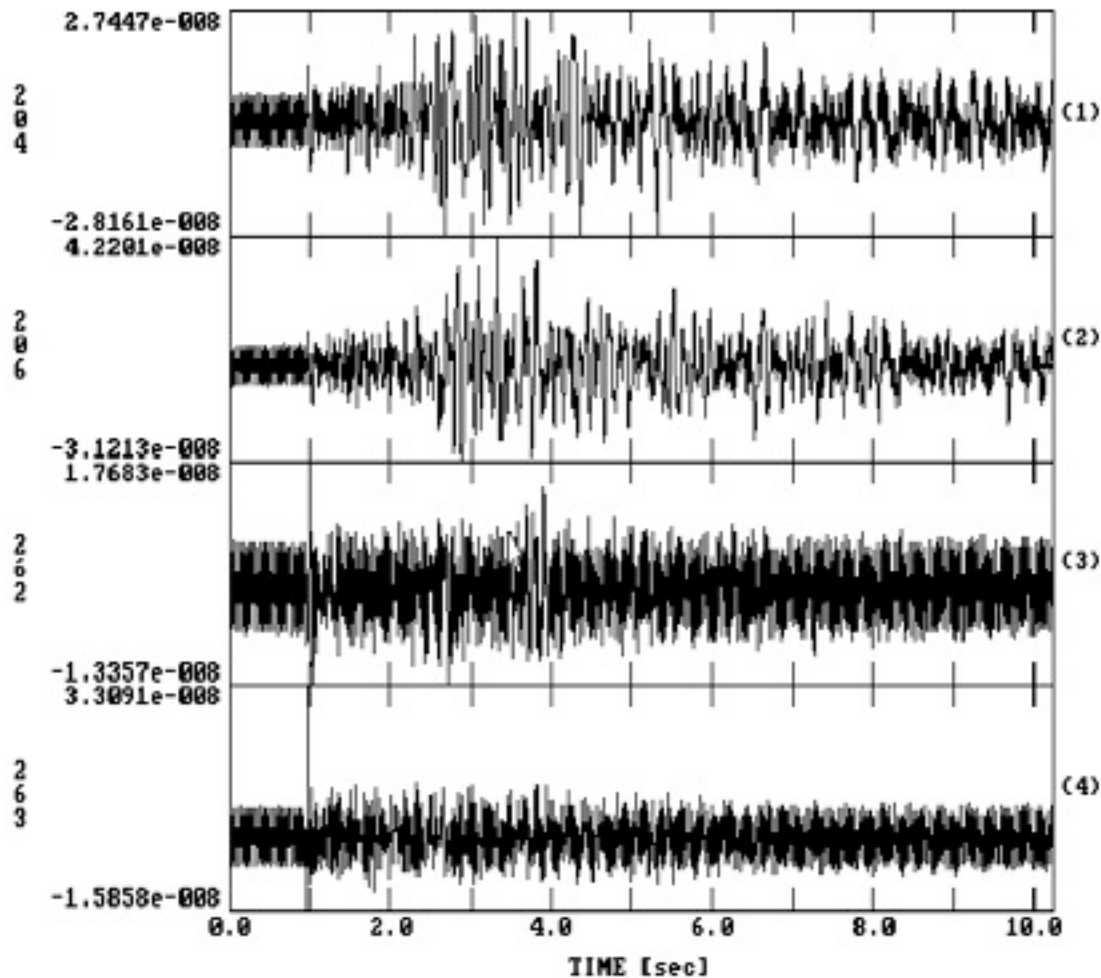
How to obtain source parameters

Fig. 1.4 Vertical component, velocity records of stations 204, 206, 262, and 263, respectively of event 4 of the Chalfant Valley aftershock sequence (cf. Luzitano, 1988). Notice the monochromatic noise that has been artificially superimposed on the data to simulate the effects of crosstalk.
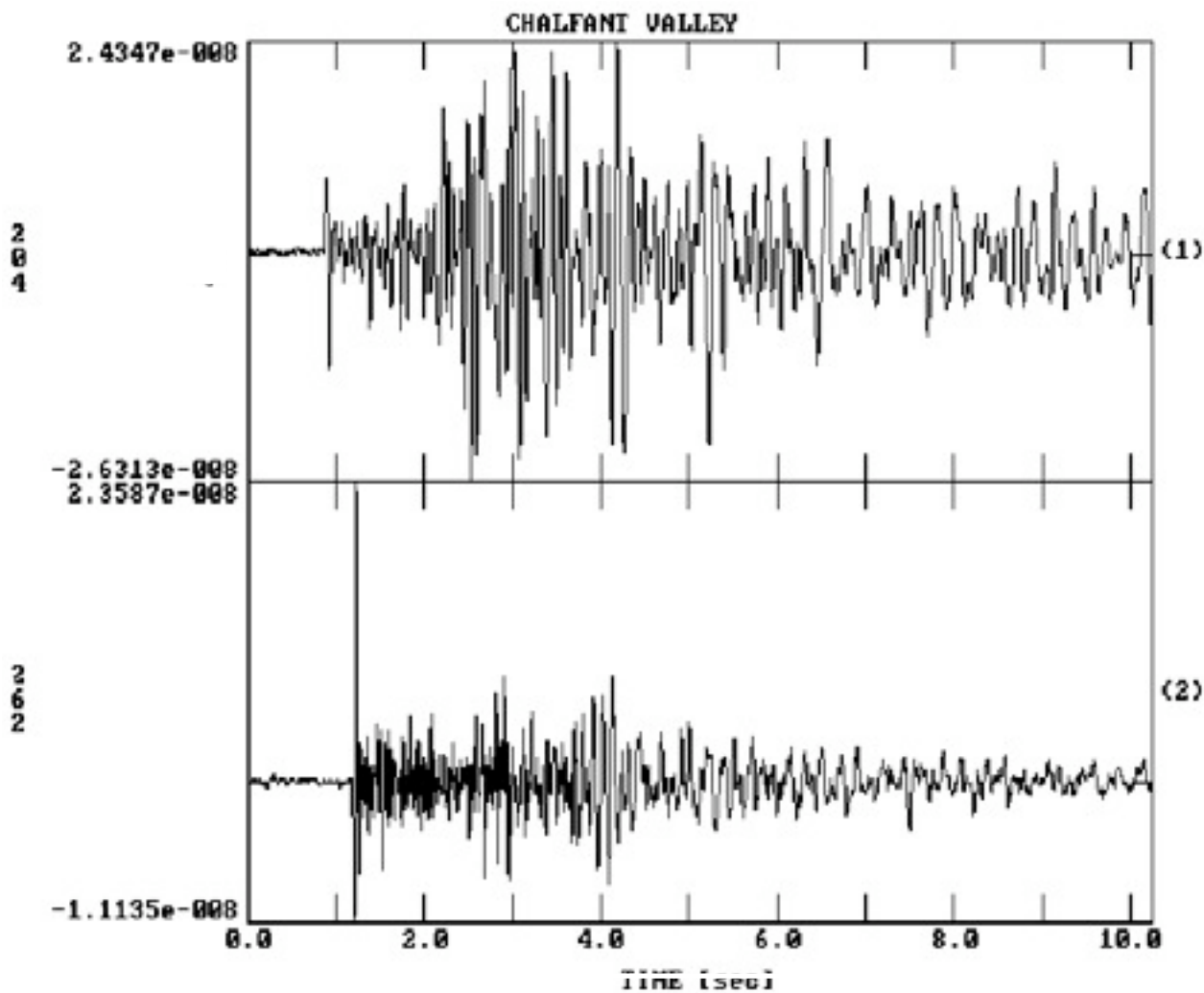
Noise removal

Fig. 1.5 Velocity records of stations 204, and 262, respectively, of event 4 of the Chalfant Valley aftershock sequence after noise removal.
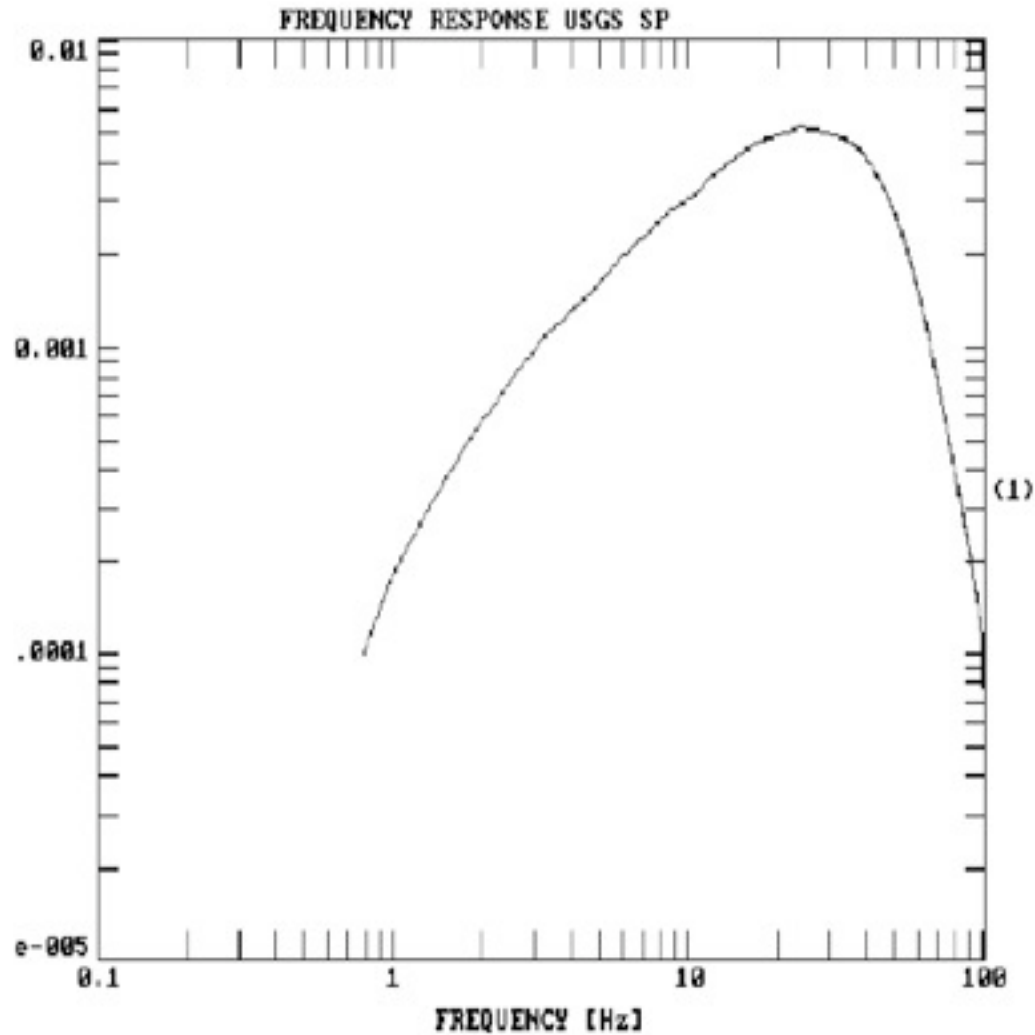
Frequency response

Fig. 1.6 The theoretical frequency response function (modulus) for the USGS short- period refraction system (normalized response to ground displacement). After Luzitano (1988).
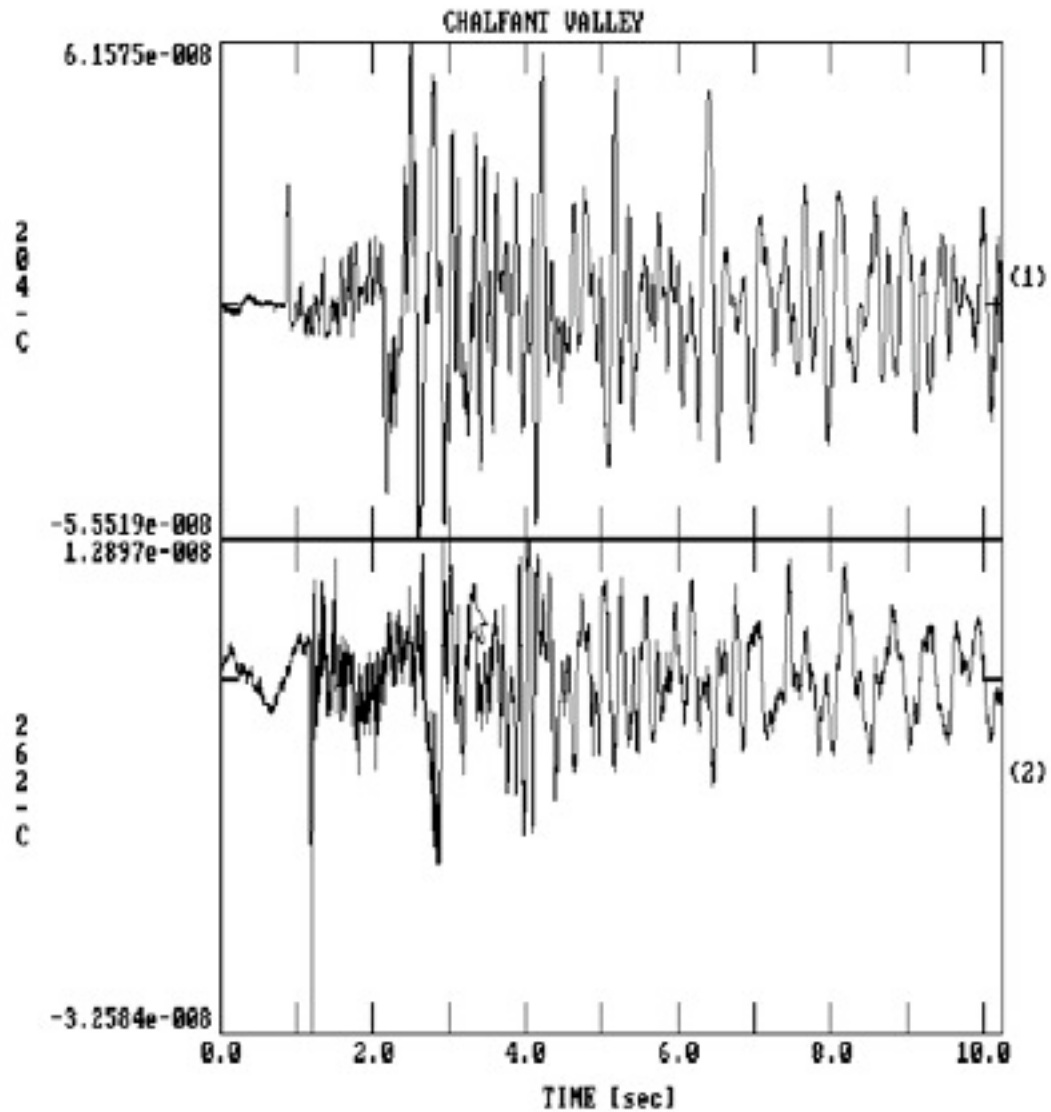
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Displacement record

Fig. 1.7 Instrument corrected displacement records of the signals shown in Fig. 1.5.

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Displacement spectrum

spectral plateau

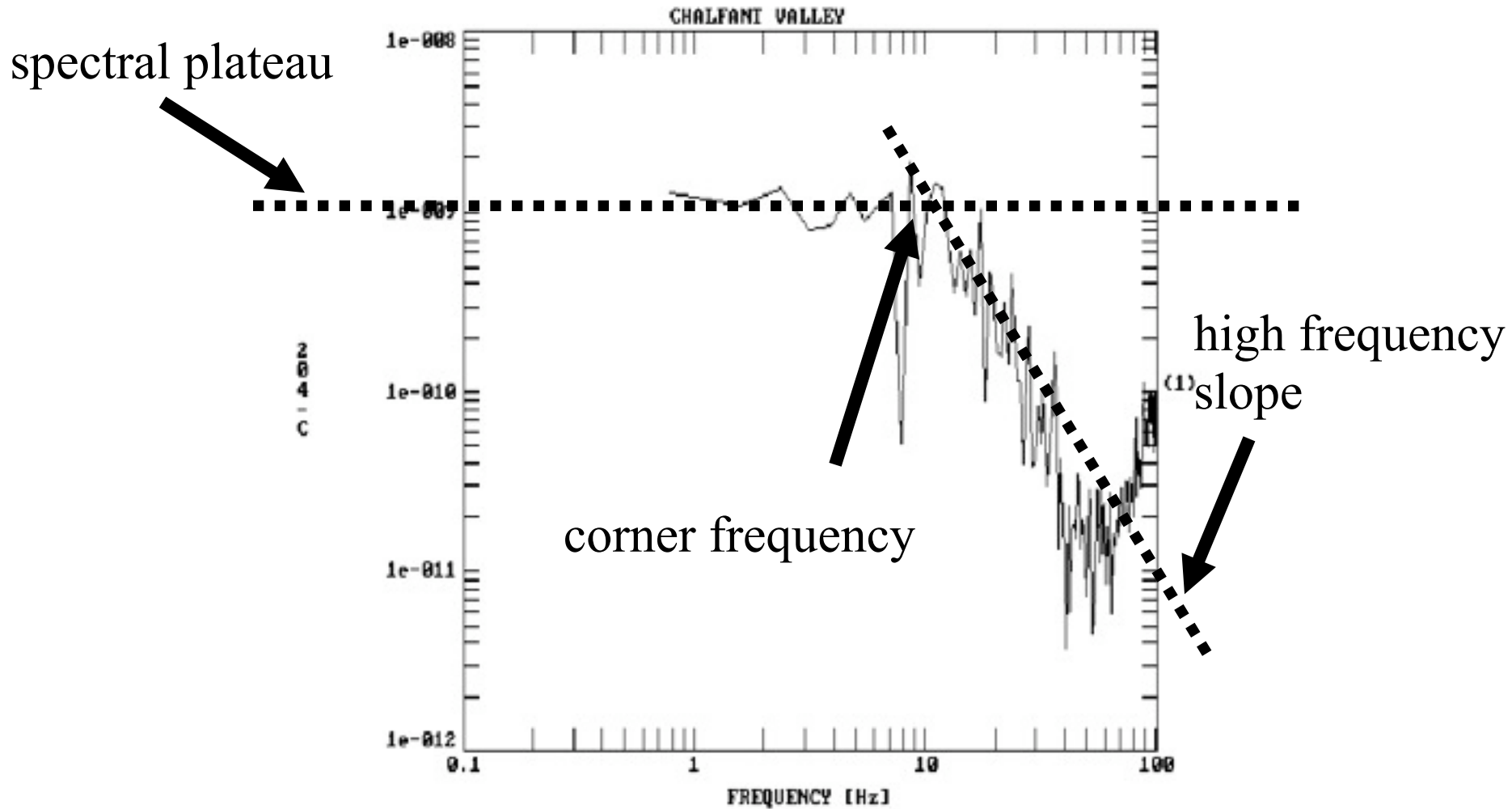CHALFANT VALLEY

corner frequency

high frequency slope

Fig. 1.8 Displacement spectrum for the P- wave portion of the instrument corrected displacement record of station 204 (top trace in Fig. 1.7).
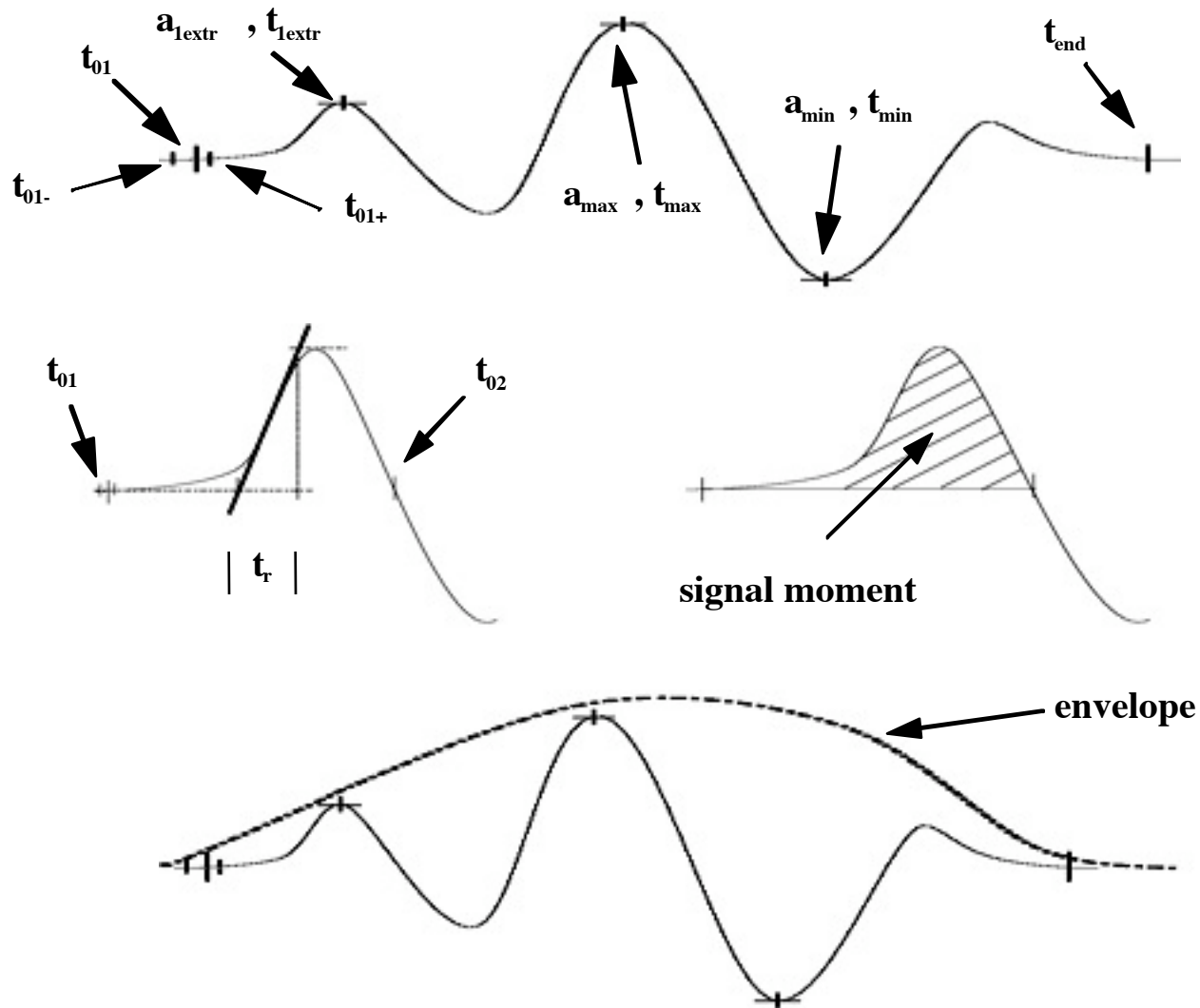
Signal parameters

Fig. 1.9 Commonly determined signal parameters such as onset times and amplitudes, rise time, signal moment or envelope parameters.
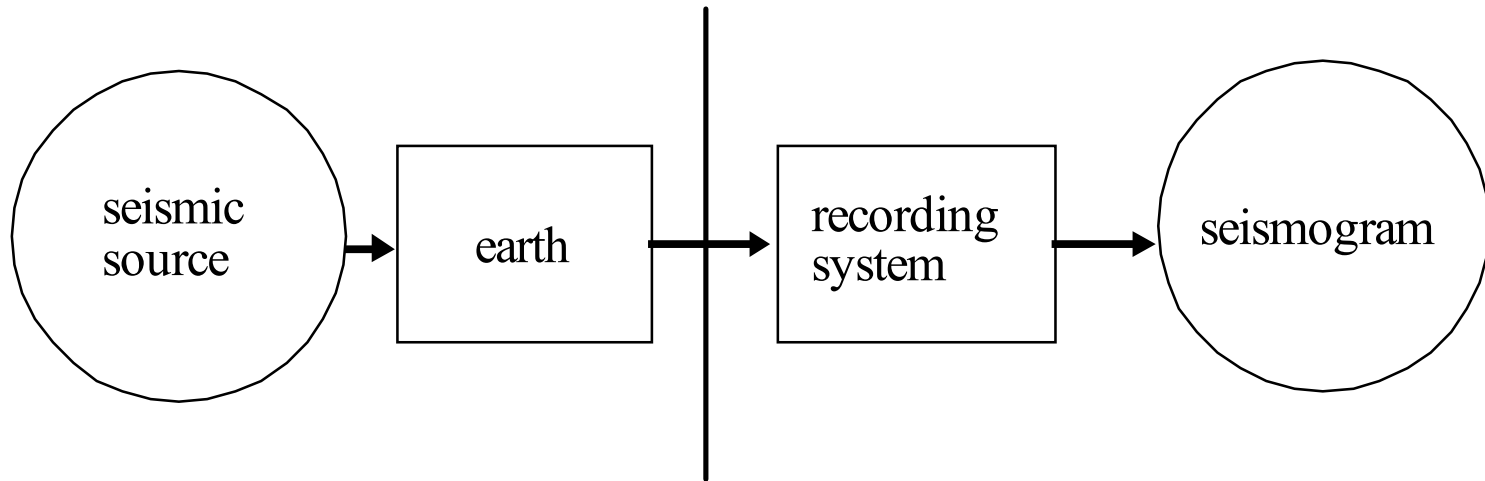
Motivation II

Seismogram

Fig. 1.11 System diagram of a seismogram

Seismogram

seismic source → earth → recording system → seismogram
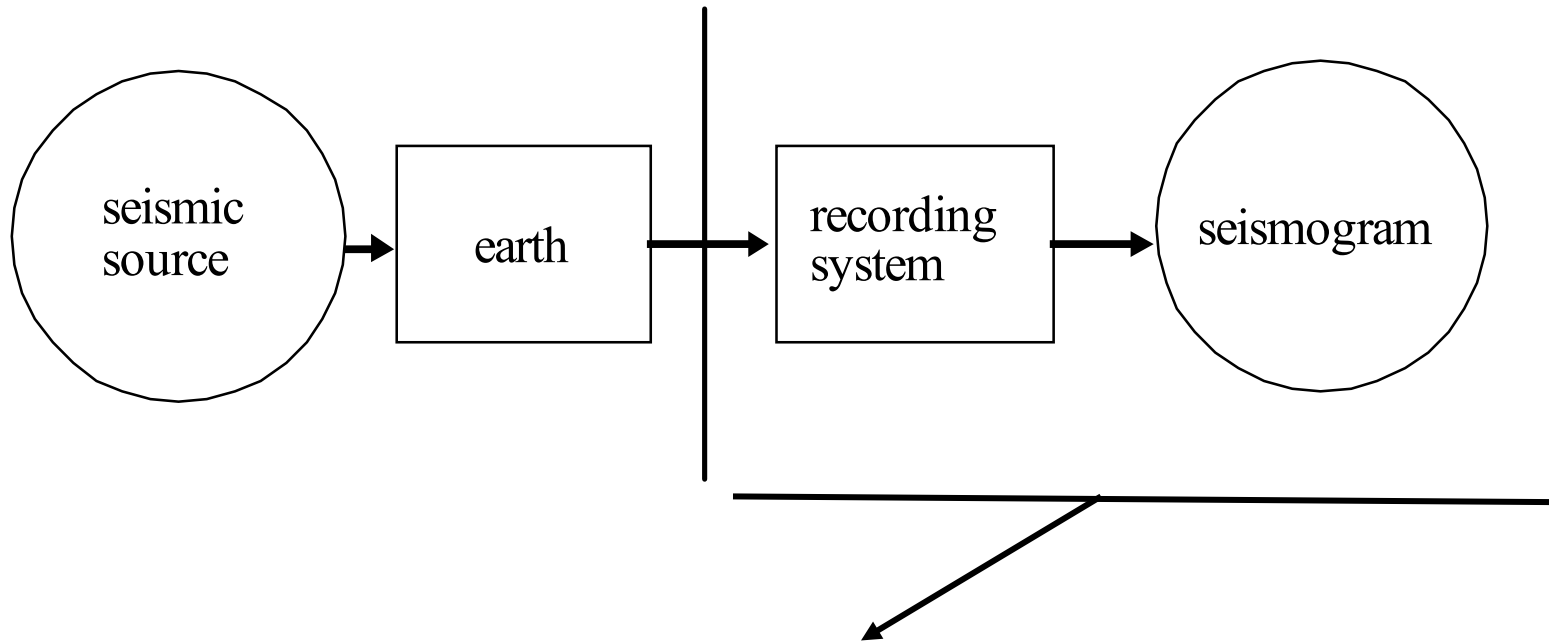
This part is covered by SEED

Sampling

Decimation

Seismometer

Amplifier

AAA filter

DAA filter

Analog LTI system

Digital LTI system

Tuesday, September 1, 2009
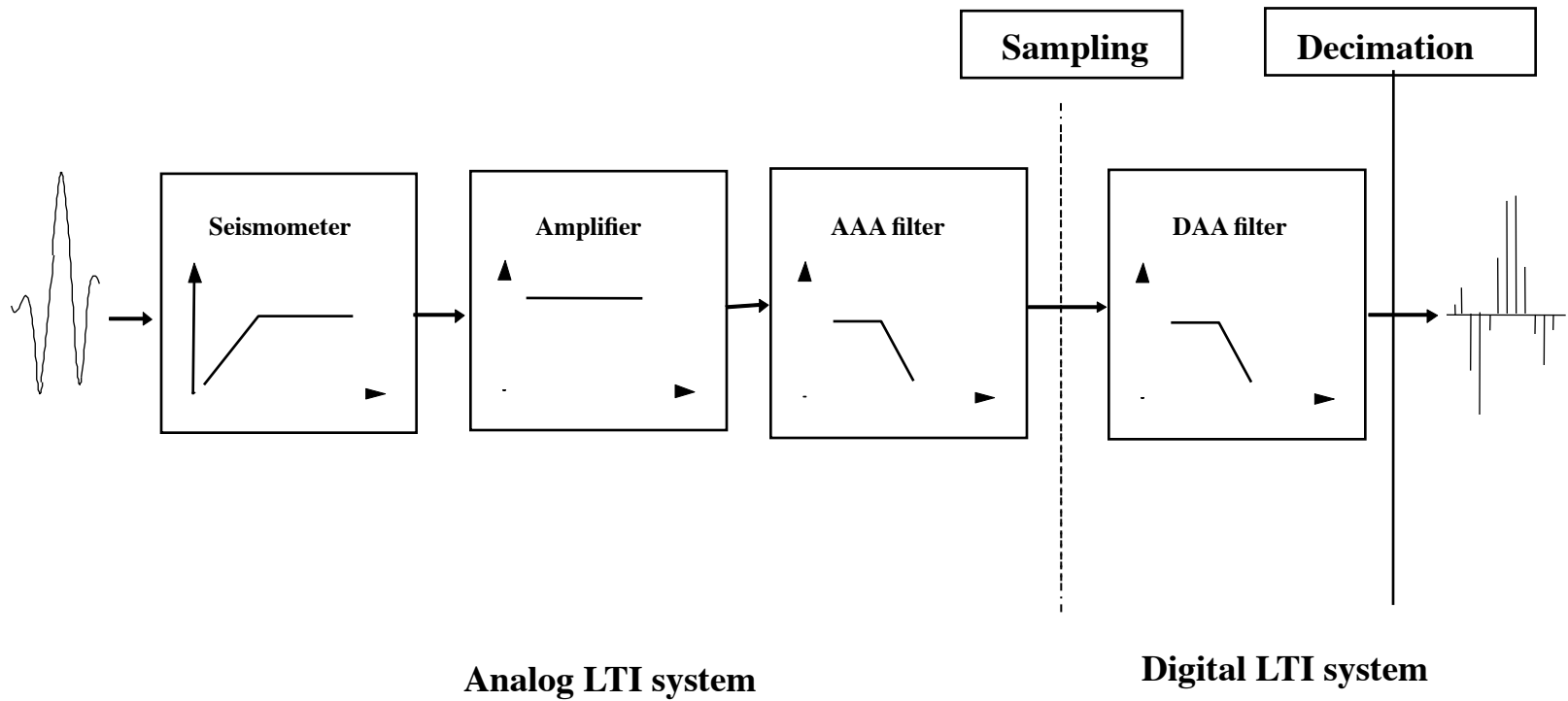
```
#          << IRIS SEED Reader, Release 4.4 >>
#
#          ======== CHANNEL RESPONSE DATA ========
B050F03    Station:    RJOB
B050F16    Network:    BW
B052F03    Location:   ??
B052F04    Channel:    EHZ
B052F22    Start date: 2007,199
B052F23    End date:   No Ending Time
#          =========================================
#          +          +---------------------------------------+          +
#          +          | Response (Poles & Zeros),  RJOB ch EHZ |          +
#          +          +---------------------------------------+          +
#
B053F03    Transfer function type:          A [Laplace Transform (Rad/sec)]
B053F04    Stage sequence number:           1
B053F05    Response in units lookup:         M/S - Velocity in Meters per Second
B053F06    Response out units lookup:        V - Volts
B053F07    A0 normalization factor:         6.0077E+07
B053F08    Normalization frequency:          1
B053F09    Number of zeroes:                2
B053F14    Number of poles:                 5
#          Complex zeroes:
#           i  real       imag       real_error    imag_error
B053F10-13   0 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00
B053F10-13   1 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00
#          Complex poles:
#           i  real       imag       real_error    imag_error
B053F15-18   0 -3.700400E-02 3.701600E-02 0.000000E+00 0.000000E+00
B053F15-18   1 -3.700400E-02 -3.701600E-02 0.000000E+00 0.000000E+00
B053F15-18   2 -2.513300E+02 0.000000E+00 0.000000E+00 0.000000E+00
B053F15-18   3 -1.310400E+02 -4.672900E+02 0.000000E+00 0.000000E+00
B053F15-18   4 -1.310400E+02 4.672900E+02 0.000000E+00 0.000000E+00
```

Seismometer
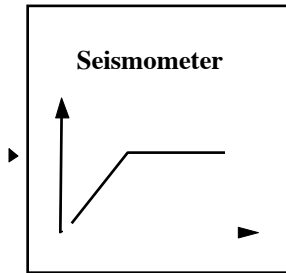
Definition

- Filters or systems are, in the most general sense, devices (in the physical world) or algorithms (in the mathematical world) which act on some input signal to produce a - possibly different - output signal.
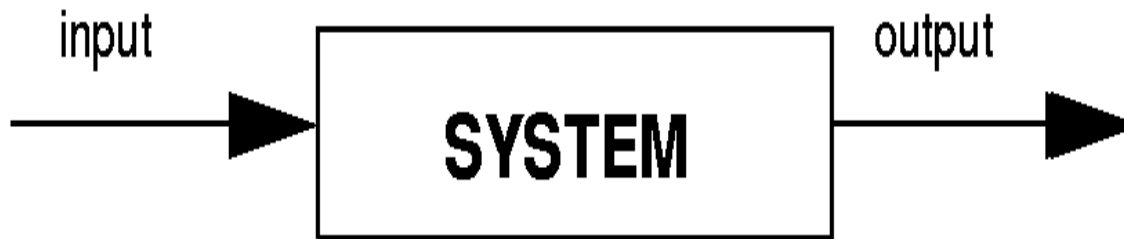
Block diagram

Fig. 1.10 Block diagram of a system