7. NOISE IN BIOLOGICAL SYSTEMS

Fluctuation phenomena very important not only in physics, but in other sciences, such as chemistry, biology and even human sciences

7.1. Noise in neuro-cardiology - Basic concepts

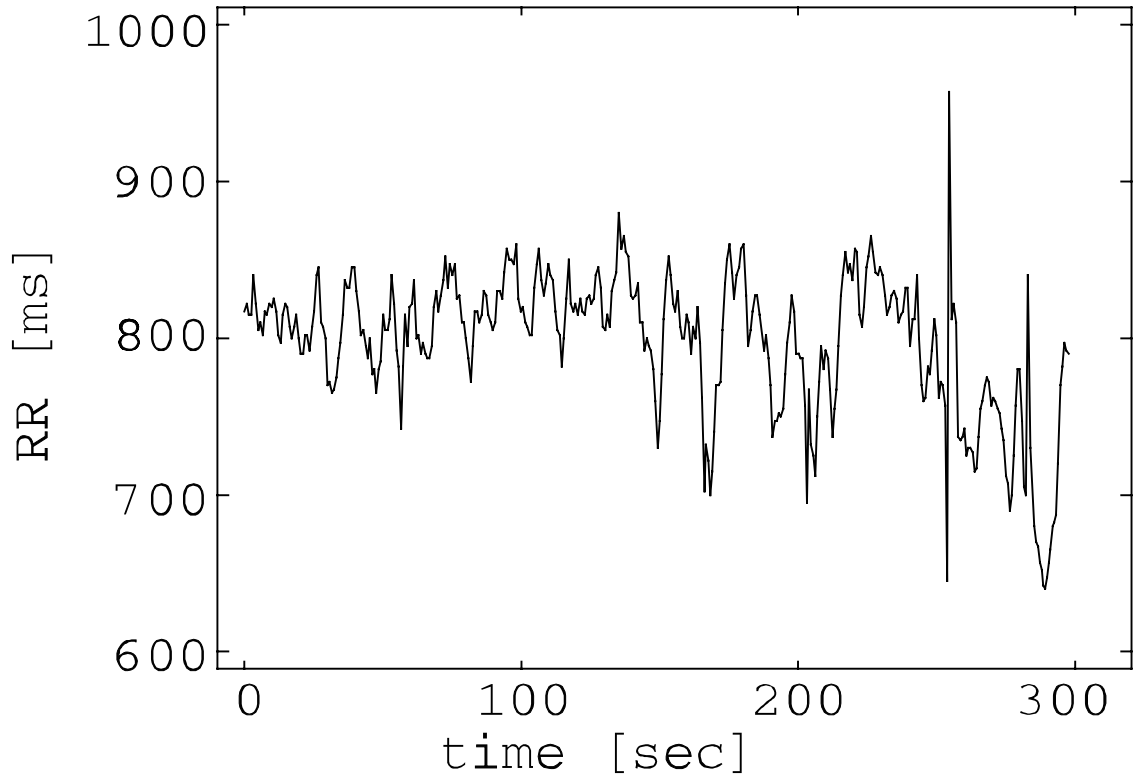
Autonomic nervous system controls:

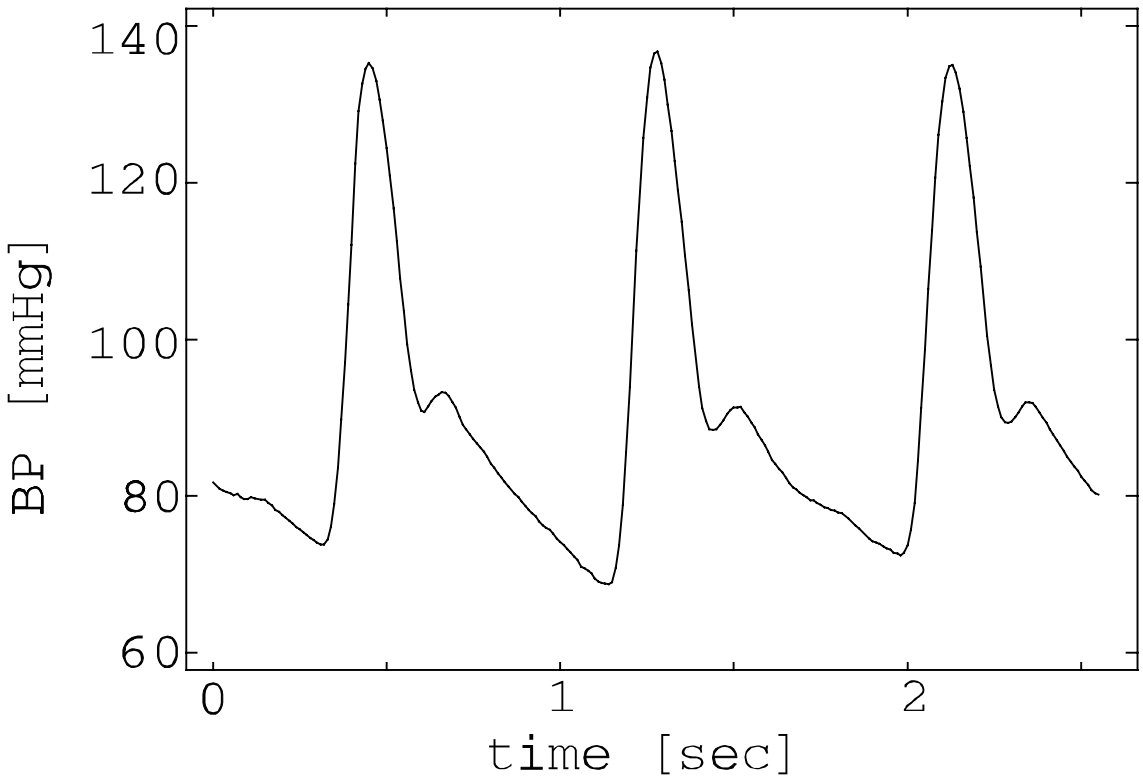
- arterial pressure, body temperature, cardiac muscle, ...

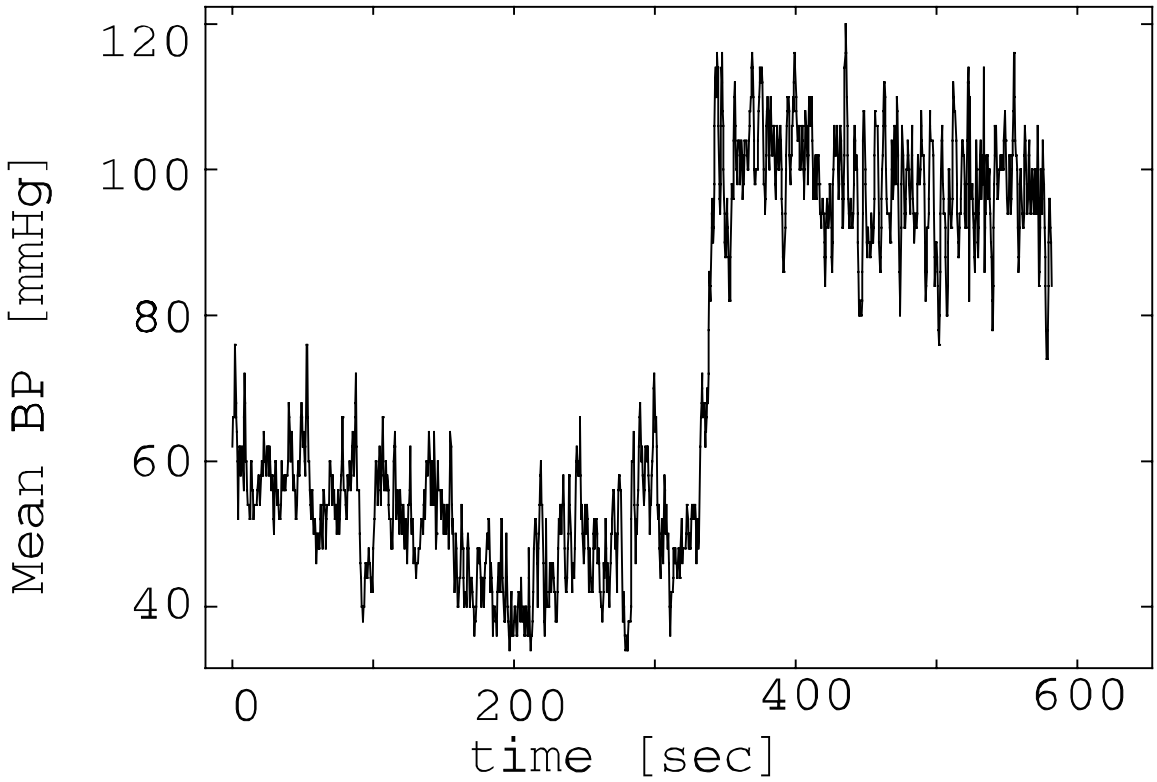
Measuring heart rate variability: detection of diseases

7.2. Measurments of quantities

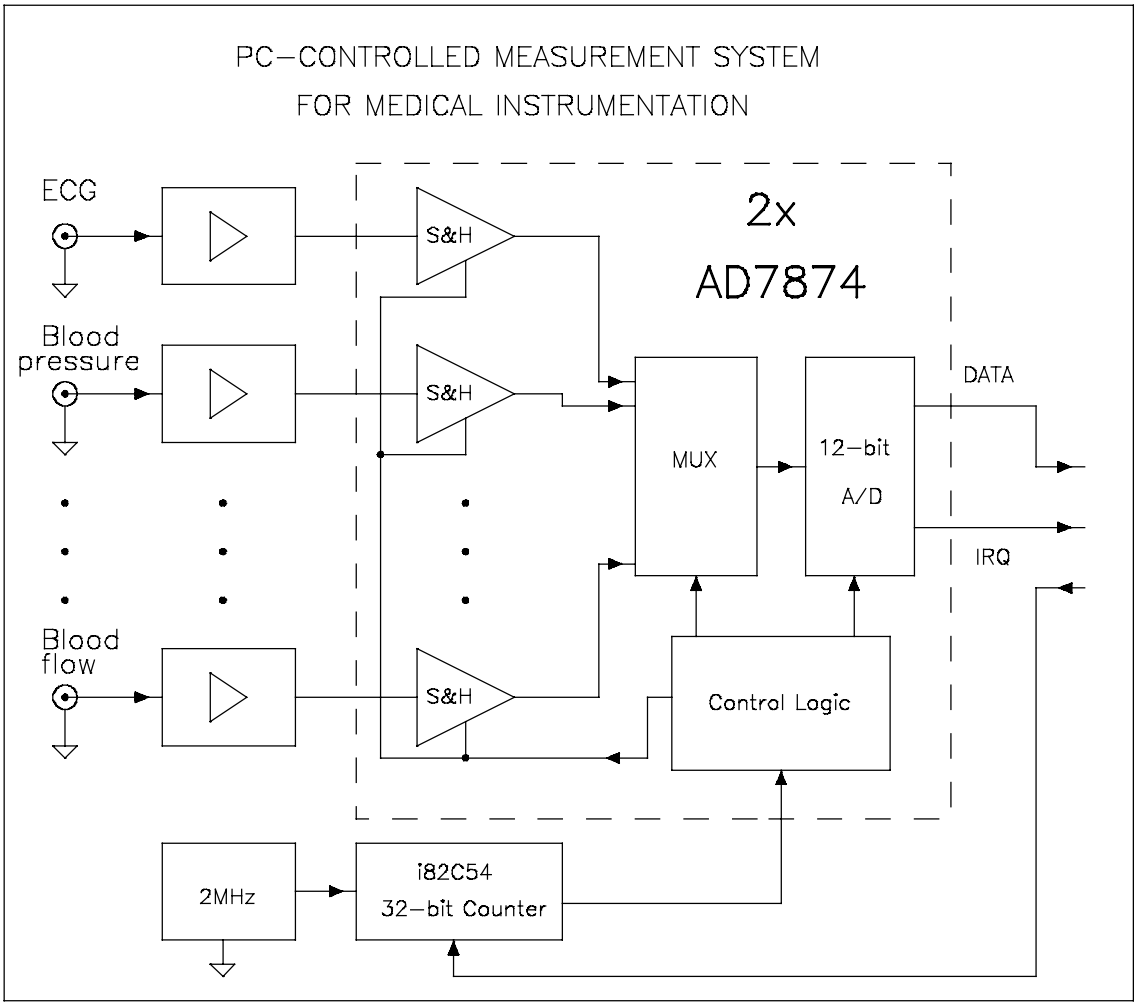
- ECG
- Blood pressure
- Blood flow
- etc.



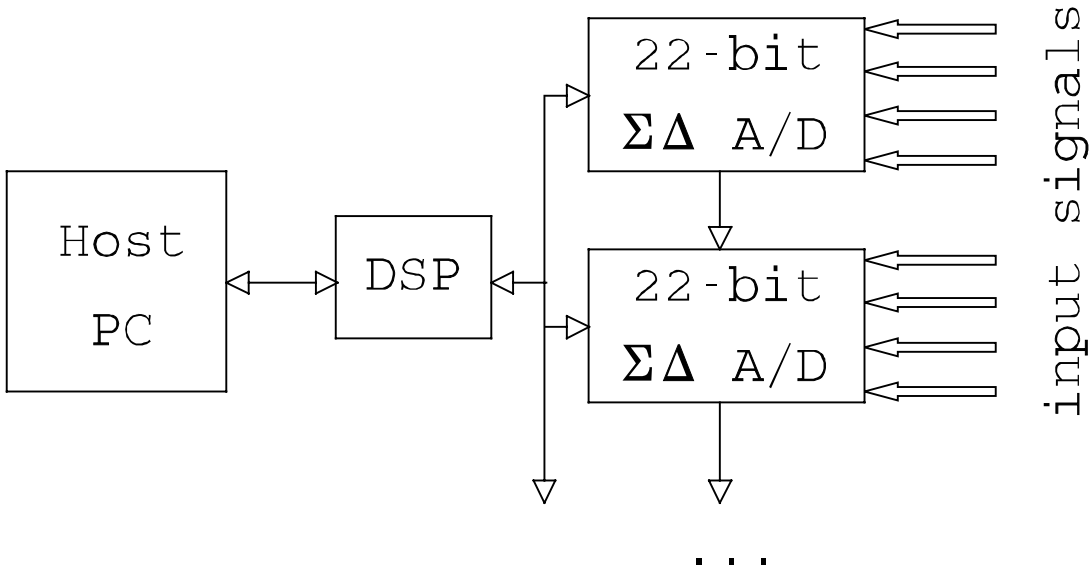

140
120
100
80
60
BP [mmHg]
0
1
2
time [sec]


120
100
80
60
40
Mean BP [mmHg]
0
200
400
600
time [sec]

Computer controlled measurement system example:



Next generation measurement system example:



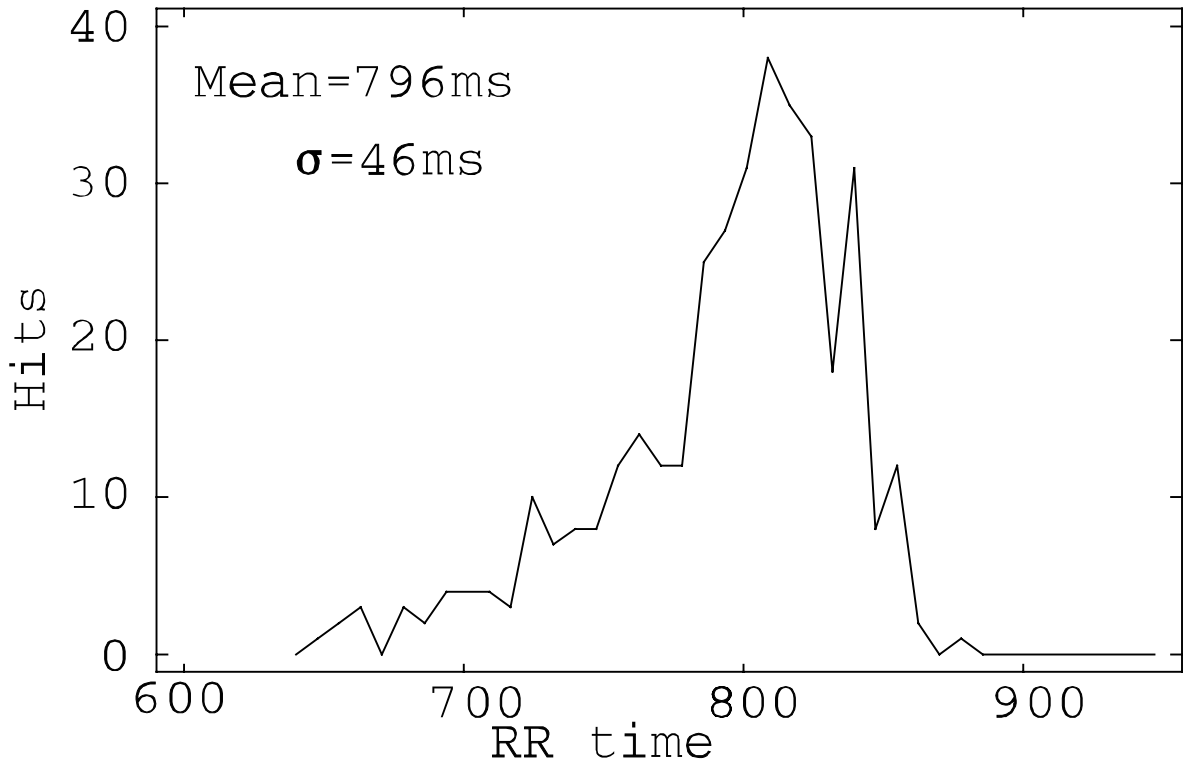
Advantages:

- flexibile DSP based architecture
- very high resolution
- internal digital filtering (noise reduction)

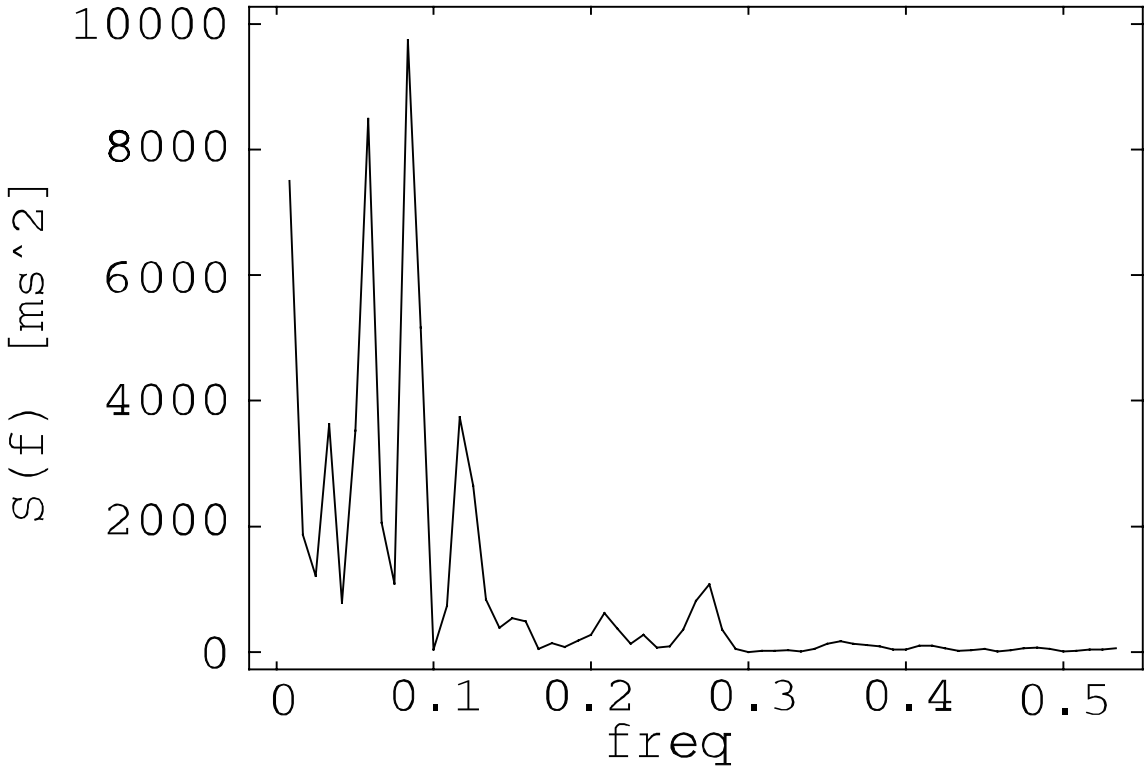
7.3. Methods of analysis

7.3.1. Statistical quantities (mean, RMS, p(x))

Example: heart rate fluctuations



7.3.2. Spectral analysis



7.3.3. Time dependent spectral analysis

- Short-time windowed (2 minutes) FFT analysis
- Especially for investigatin loosing of consciousness of unknown origin

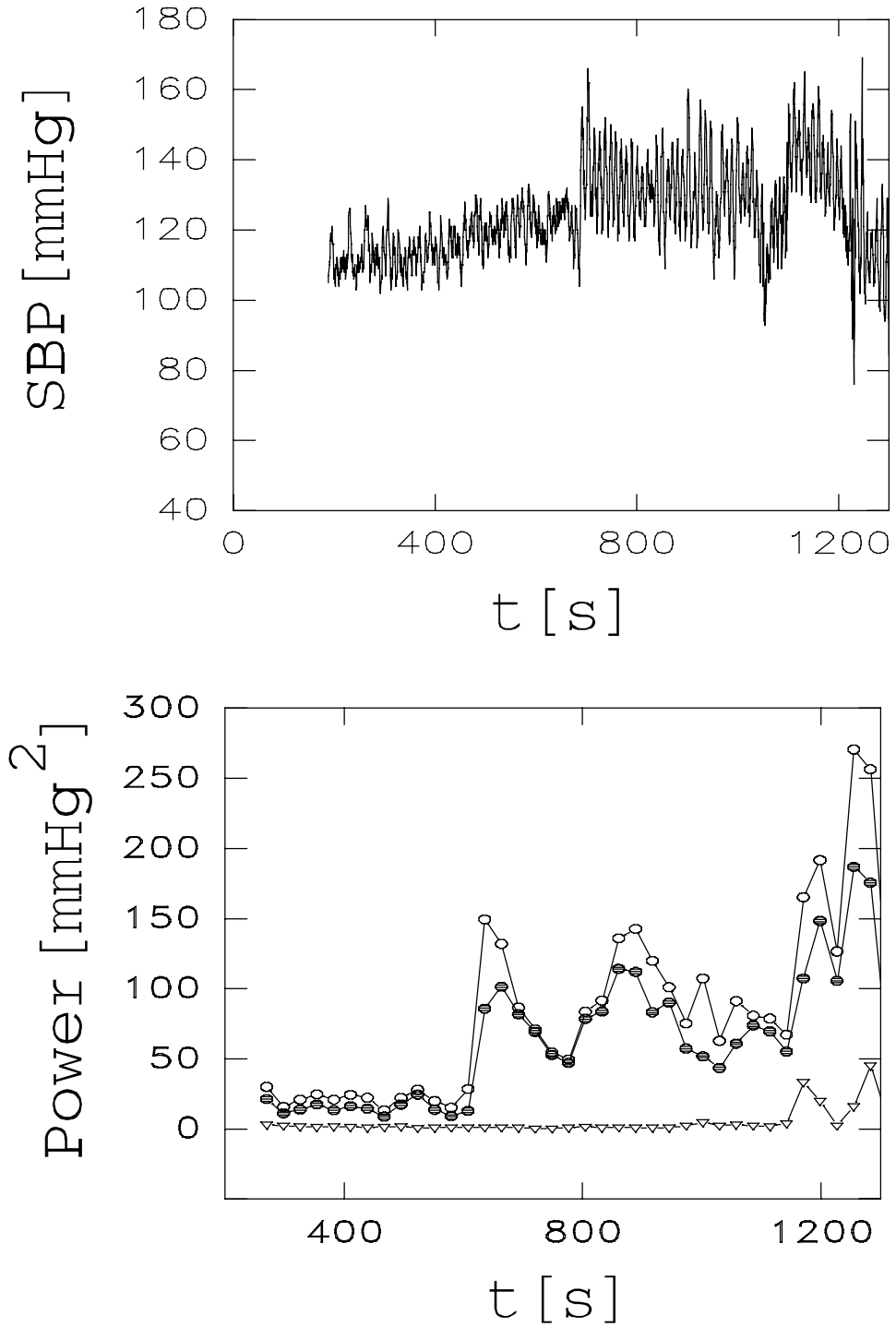
Time dependence of integrated parameters:

Total : 0.01-0.50 Hz

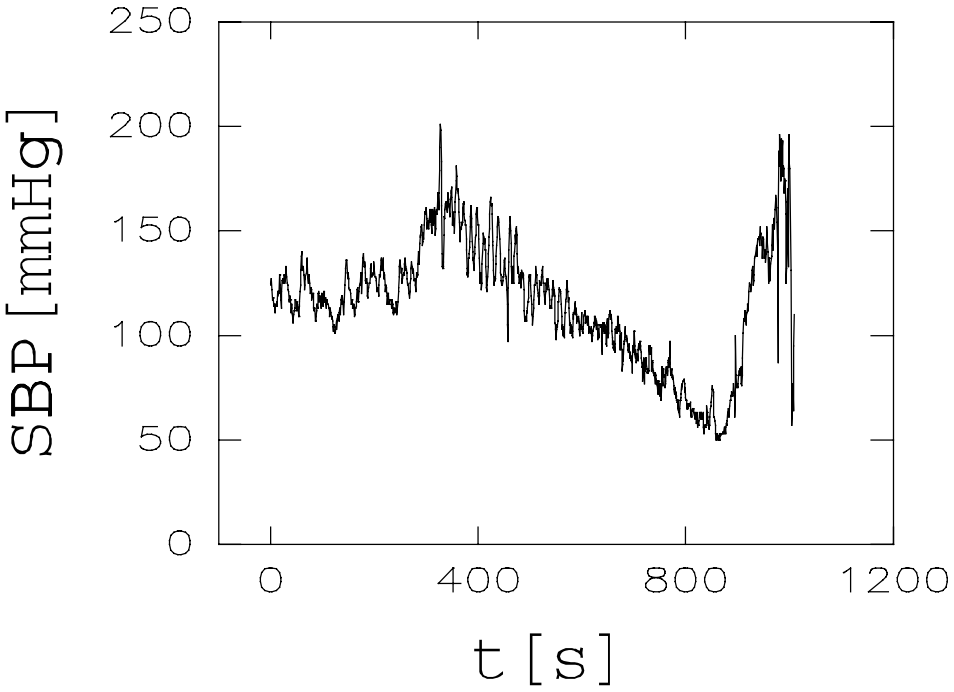
LF : 0.01-0.15 Hz

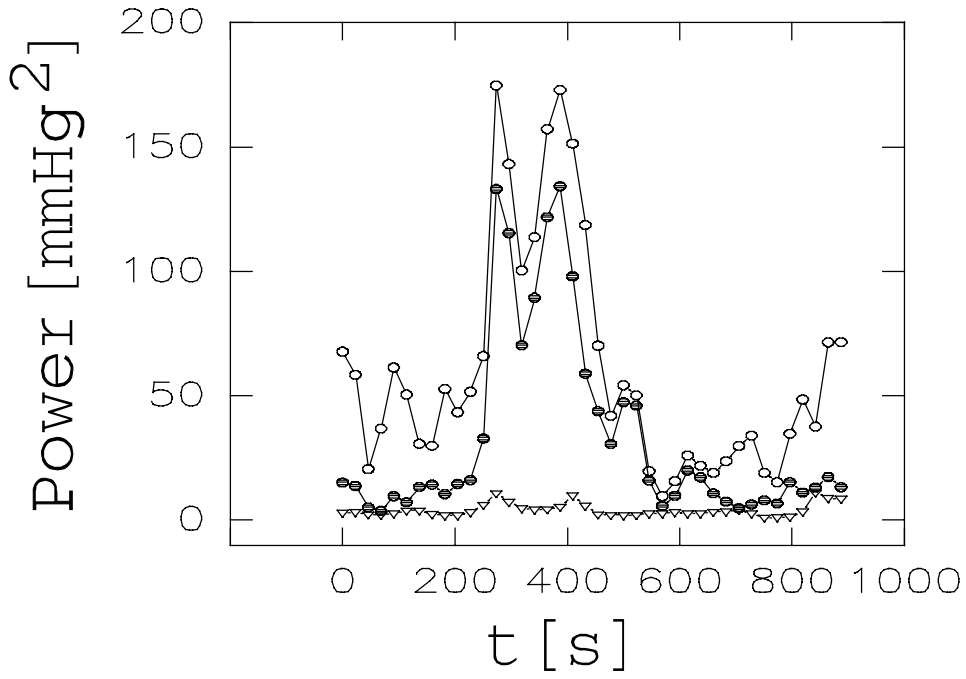
HF : 0.15-0.50 Hz

Tilt test (0-70) result: healthy control

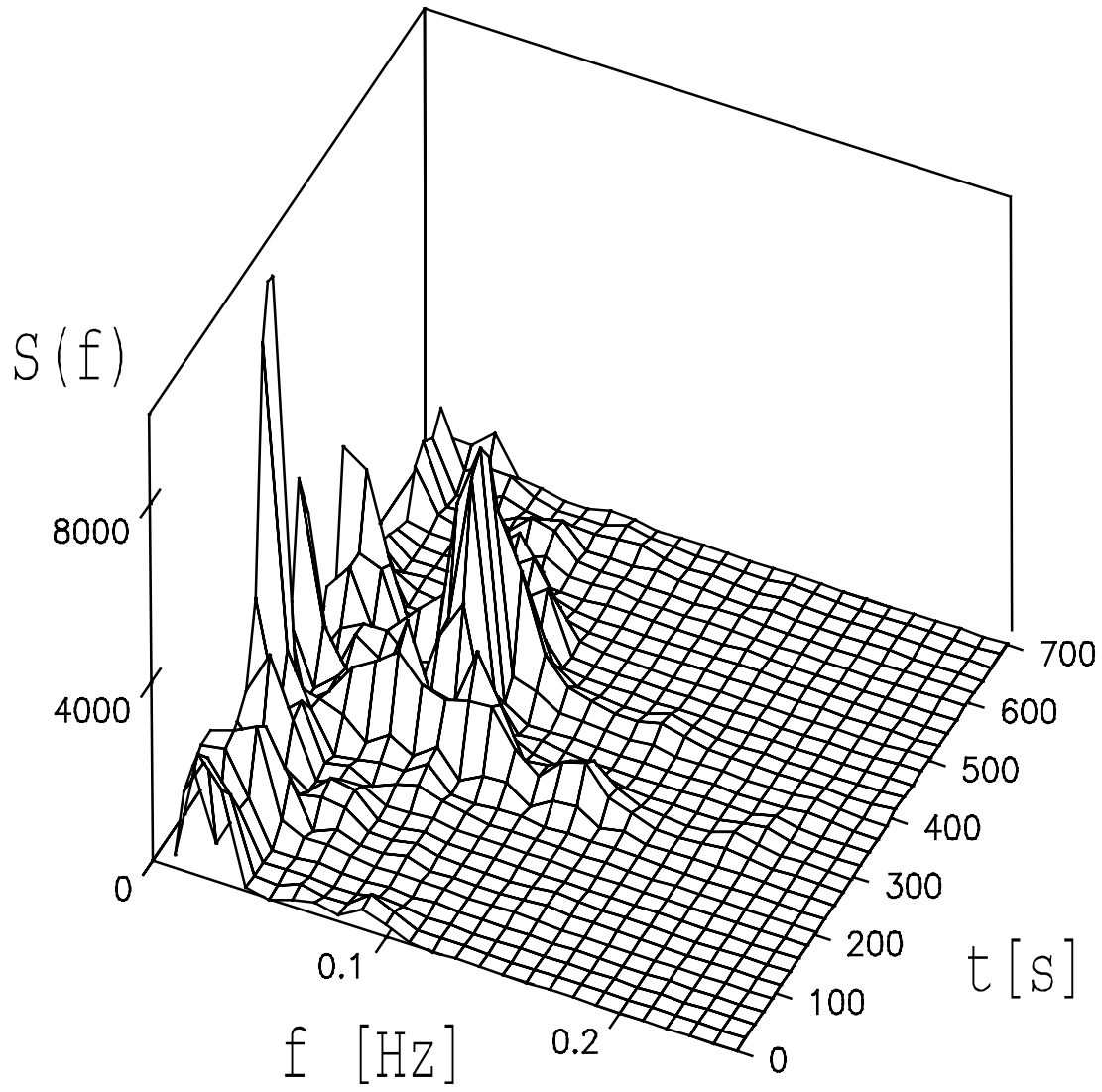


Tilt test (0-70) result: subject with disease





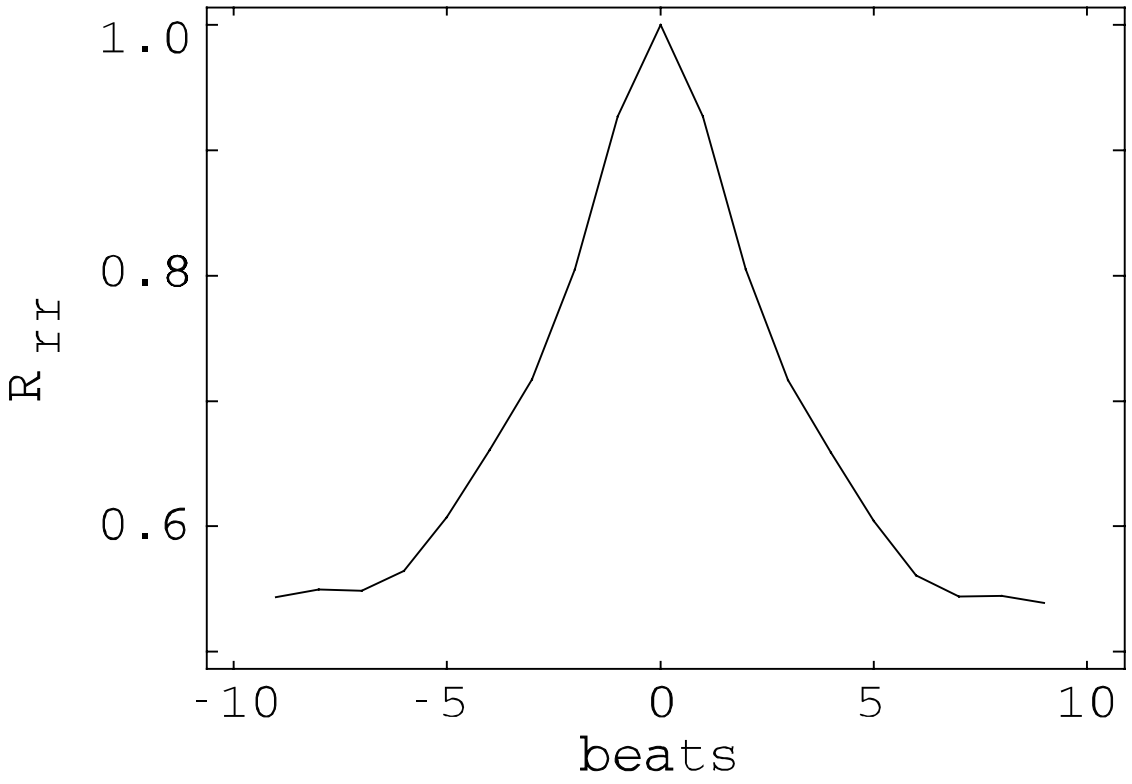
Power spectrum time dependence for systolic blood pressure (subject with disease)



7.3.4. Correlation analysis

Examples:

Autocorrelation of heart rate



Cross correlation between heart rate and blood pressure