Digital signals/Time domain

- **total energy**, **average power** and **root mean square**

$$E = \sum_{i=1}^{N} x_i^2, \quad P = \frac{1}{N} \sum_{i=1}^{N} x_i^2 \quad \text{and} \quad RMS = \sqrt{\frac{1}{N} \sum_{i=1}^{N} x_i^2}$$

```
>> E = sum( xi .* xi ); % total energy
>> P = mean( xi .* xi ); % average power
>> RMS = sqrt( mean( xi .* xi ) ); % root mean square
```

- **decibel full scale**, different for **power-** and **magnitude-like** quantities, e. g.

$$P_{\text{dB}} = 10 \log_{10}(P) \quad \text{and} \quad RMS_{\text{dB}} = 20 \log_{10}(RMS)$$

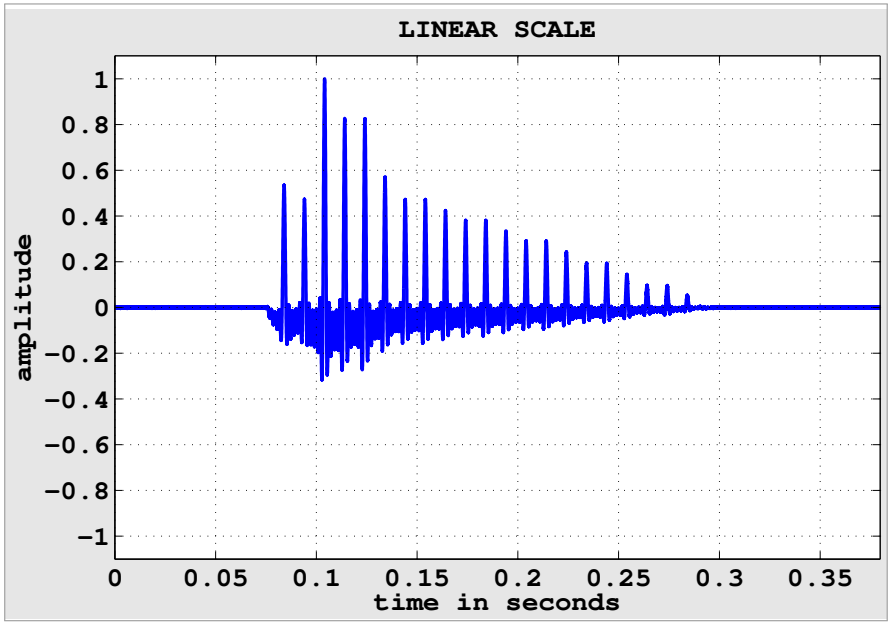
```
>> PdB = 10 * log10( P ); % power-like
>> RMSdB = 20 * log10( RMS ); % magnitude-like
```

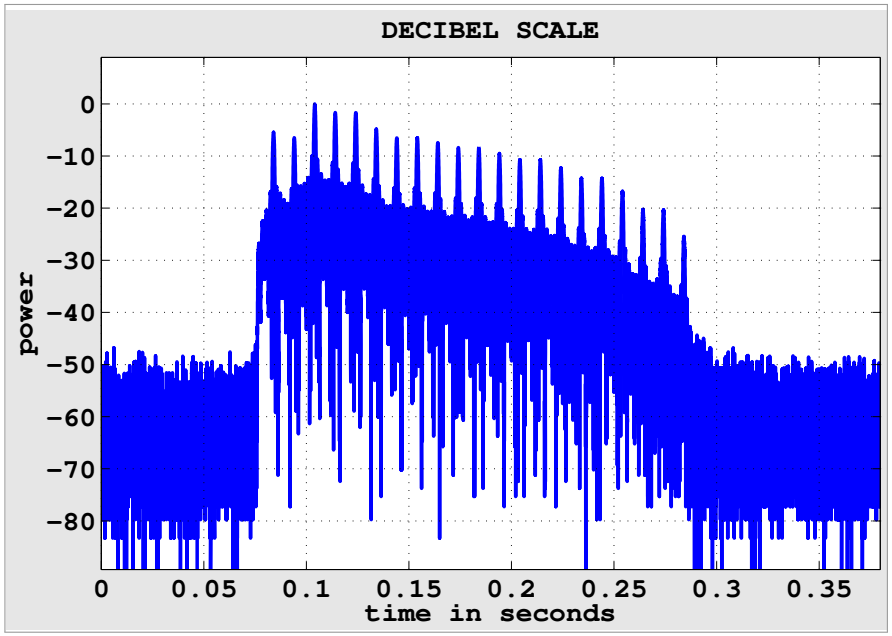
- **zero-crossings rate**

```
>> fZ = sum( abs( diff( xi >= 0 ) ) ) / N * fS;
```

Time domain

- **example:** `matlab/decibel.m` (`matlab/sound.wav`)





- **exercise:**
  - compare **linear** and **logarithmic scales**
  - explain **negative decibel values** (e. g. —3 dB power, —6 dB magnitude)
  - specify the power of silence in decibels