Measurement Techniques of Processes

1. Measurement planning

- Through an example introduce the main concepts of measurement planning. (Variables and parameters; indirect quantities; dependent/independent variables; controlled/extraneous parameters; handling of extraneous parameters)
- Give an overview of uncertainty analysis. (uncertainty of direct variables; random/systematic error; uncertainty of indirect variables; error propagation)

2. Data acquisition

- Explain the procedure of quantitization. (define the problem; discretization of time and voltage; discussion of quantitization error through an example)

3. Signal processing

- Derive the expression of the average and root-mean-square value of a signal. Define the definitions of correlation, auto-correlation and cross-correlation. Give examples for possible applications.
- Fourier series and Fourier transformation. (orthogonal projection, coefficients of continuous signals, coefficients of complex formalism, coefficient of discrete signals, properties of spectra)

4. System behaviour

- Response of a first order system for step and harmonic input function. (equation; parameters; homogeneous solution; non-homogeneous solution for step function; error function; determination of time constant; non-homogeneous solution for harmonic function; amplification and phase diagram)
- Response of a second order system for step and harmonic input function. (equation; parameters; homogeneous solution; non-homogeneous solution for step function; optimal damping rate; rise and settling time; ringing frequency; non-homogeneous solution for harmonic function; amplification diagram; phase linearity)

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