Damped Oscillations

The energy of a non-ideal oscillator continually decreases because of damping effects. The resulting decrease of amplitude can be described by an envelope function, whose shape depends on the underlying type of damping.

Goals:

You collect data for a typical example of a damped oscillator by means of a computer assisted experiment or a video analysis of the motion.

You test a hypothesis about the damping envelope, discuss its scope of application and relevant parameters.

Experiments:

- Oscillating rod damped by water resistance
- Mass on a spring damped by air resistance
- Mass on a spring damped by kinetic friction
- Pohl's pendulum with eddy current damping
- Oscillating test tube in water damped by water resistance
- LCR oscillator

Procedure:

A Study the experimental setup and make yourself familiar with measuring (devices, parameters you can vary, etc.). Make a realistic plan for the lab session.

B Find a favourable combination of the variable parameters and collect a first series of data. Before you continue convince yourself that the data is reasonable.

C Systematically vary two of the parameters relevant for the damping and collect the corresponding data series.

D Save the files containing your data and/or videos on your network drive.

Analysis:

1. Investigate if the period is constant for a given set of parameters and how it depends on the parameters of your system.
2. Using an favourable data series determine the amplitude for a reasonable number of times. Test the hypothesis for the shape of the envelope by plotting the data in a way that should yield a straight line. Determine the parameters of the envelope function from a fit to the data.
3. Write down a formal expression for the damped oscillation and give numerical values for all parameters. Overlay the graph of this function with the corresponding data points.
4. Investigate how the parameters affect the time constant of damping. The effect of one parameter should be presented in a quantitative way.

Requirements:

If you do not write a report on this experiment, work at least on steps 1 (only qualitative discussion of parameters) and 2 of the analysis.

For a report the complete interpretation is required. In the theory part you should explain the dependency on the relevant parameters for both the oscillation period and the time constant of damping.

Hand in your report or interpretation and the lab journal by Friday, 3 December 2010.