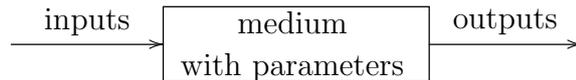


Inverse problems

General topic for bachelor and master theses

Often physical models consist of following components: inputs, medium parameters and outputs:



In case all inputs and medium parameters are known and outputs are to be determined, we have a *direct problem*. But in case some of the inputs or medium parameters is unknown and we reconstruct it by means of measurements of outputs, we have an *inverse problem*.

Classical inverse problems occur in medical and industrial tomography, where locations, sizes etc. of inhomogeneities of bodies are determined by means of measurements on surfaces of the bodies.

Inverse problems occur also in determination of physical parameters of materials. For instance, let a body with an initial temperature T_0 placed to an environment with a temperature T_e . The quantities T_0 and T_e are inputs. The temperature T of the body starts to change in time. The history of temperature depends on inputs and properties of a material (parameters), e.g. conductivity, heat capacity, memory of the material etc. Measured temperature at some positive moment contains information about properties of the material and can be used in reconstruction of the parameters.

In mechanical excitation of a nonlinear material, specific shape-preserving waves, so called solitons arise. Characteristics of solitons (amplitudes, velocities etc.) contain information about material parameters. Measuring these characteristics, the parameters can be determined.

Solution of inverse problems is useful in estimation of relevance of a physical model, too. In case solutions of the inverse problem corresponding to different data approximately coincide, the model is relevant, otherwise not.

The specific topic of the thesis depends on a level of the study (bachelor or master) and preferences of a student. It is possible to choose either a theoretical or a numerical approach.

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