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Identification of Material Parameters: How to Control the Impact of Measurement Errors

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There is a number of advanced phenomenological plasticity models which accurately describe an anisotropic mechanical response on the macroscopic level. Typically, the corresponding hardening parameters cannot be measured directly and have to be identified by solving an inverse problem. We set the main focus on the stability of identification procedures with respect to errors contained in the experimental data (cf. [1]). A mechanics-based metric is introduced in the space of material parameters in order to estimate the impact of the measurement errors. The advantages of this new metric over the conventional Euclidean distance are discussed. Two applications of the metric are considered regarding the parameter identification for a model with combined isotropic and kinematic hardening from [2]. The first example involves the definition of optimal weighting coefficients which appear in the least-square error functional. It is shown that in some cases a non-diagonal weighting matrix provides much more stable identification results. The second example is related to the parameter identification basing on heterogeneous non-monotonic torsion tests. Different identification strategies are considered involving various sample cross-sections and loading paths. A simple procedure is presented which allows us to assess the dependence of the identified material parameters on the measurement errors, thus giving a clue to the best identification strategy.

[1] T. Harth, S. Schwan, J. Lehn and F.G. Kollmann, IJP, 20, 1403-1440 (2004).
[2] A.V. Shutov, R. Kreißig, Comp. Meth. Appl. Mech. Engrng., 197, 2015-2029 (2008).