INTEGRATED DATA ANALYSIS: NON-PARAMETRIC PROFILE GRADIENT ESTIMATION

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Abstract

The estimation of distributions and distribution gradients from pointwise measurements of profiles is frequently hampered by measurement errors and lack of information. A combination of measured profile data from heterogeneous experiments is suitable to provide a more reliable data base to decrease the estimation uncertainty by complementary measurements. The Integrated Data Analysis (IDA) concept allows to combine data from different experiments to obtain improved results [1]. Persisting missing information is usually regularized by applying parametric interpolation schemes to fit profiles and derive gradients at the expense of flexibility. The lack of flexibility affects in particular the estimation of profile gradients. The estimation of profile gradient uncertainties is usually not considered. The goal is to reconstruct profiles only from the significant information in the measured data and avoid noise fitting without restricting profiles using parametric functions.

A flexible non-parametric distribution estimation is achieved by using exponential splines. Exponential splines adaptively allow for flexibility in regions where profile data provide detailed information as well as smoothness (cubic splines as limiting case) elsewhere. Regularization parameters as well as number of knots and knot positions are marginalized in the framework of Bayesian probability theory. The resulting posterior probability distribution allows to estimate profiles, profile gradients and their uncertainties in a natural way. An application of exponential splines will be shown on temperature and density profile gradient estimation from an integrated data set measured with different experiments for transport modeling at Wendelstein 7-AS and ASDEX Upgrade.

References:

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