

# QUALITY PRE-ASSESSMENT IN STEEL INDUSTRY USING DATA BASED ESTIMATORS

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**Abstract:** In this paper we present a comprehensive framework enabling data based quality pre-assessment for the quality of metallurgical products, and report on the main experiences gained in cooperation with an industrial partner. The proposed approach is based on a sequential structure including data pre-processing to obtain a well-conditioned problem as well as nonlinear modelling approaches to determine dependencies. As we document here, this approach works correctly for approximately 90% of the cases, but hints are given on which essential modifications (associated with the problem setup) should be taken to re-formulate the problem in order to increase its performance.  
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## 1. INTRODUCTION

Quality assessment is a standard and central issue in industrial processes and is usually performed on the basis of an inspection of the final product, either by a human operator or in a computed assisted way (see e.g. in (Piuri *et al.*, 2005) and references therein). The latter approach includes usually an automatic inspection and/or classification method, very often based on pattern recognition tools, as described e.g. for steel in (Wiltchi *et al.*, 2000). A much more appealing possibility, however, consists in performing an indirect assessment, *i.e.* without visual inspection of the final product. These methods can include intermediate process data and are therefore not necessarily predictive in a strict sense, but offers the essential advantage of allowing to understand the relationships between process quantities and quality. To this end, different approaches can be used, in particular a classical issue is the choice or combination of model based (as in (Furtmüller *et al.*, 2006)) vs. data based approaches.

This paper partially summarizes a case study for an industrial partner in the field of metallurgical process engineering, within which purely data based approaches were used to predict the quality of steel products, where the results of the human inspection were used as comparison, partly as training and

partly as validation data. Essentially, the experience can be summarized in a few points which will be detailed further below:

- (a) It is indeed possible to implement an automatic quality assessment scheme which reproduces rather well the results of the human inspection of the final product.
- (b) The specific choice of the modelling algorithms, as long as nonlinear modelling methods are used, is not the critical issue.
- (c) The binary decision on the quality by the human operator is the crisp expression of a continuous value, and therefore is the wrong quantity on which to train the algorithms.
- (d) Even though very many data are recorded on typical steel (and other) industrial plants, they might not contain the necessary information.

The paper is structured as follows: First we present the basic structure used with its variants, then we summarize some important results. Finally we discuss how these experiences support the conclusions stated above. Due to confidentiality agreements, no attempt is made to provide a full description or an unambiguous characterization of the data, but this does not affect at any extent the insight gained in the process.