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Introductory notes for the Acta IMEKO Special Issue on

"Technical Diagnostics : New Perspectives in Measurements, Tools and Techniques for Industrial Applications"

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The concept of *Quality* has undergone important transformations over time. In a first assumption, sometimes passed in many industrial contexts, the term "product quality" was essentially associated with "compliance". Nowadays, the term "conformity to specifications" is widely used but this has to be considered only as an aspect in the measurement of the quality level. In fact, referring to the ISO Standard 9001 - *Quality management systems*, the term Quality corresponds with the degree to which a set of characteristics of an object fulfils requirements. Concerning characteristics, such Standard proposes a classification in physical (e.g. mechanical, electrical, etc.), temporal (e.g. reliability, availability, etc.), and so on. It is interesting to observe that also the concept of product changed over time. Now, it is usual to assume the product as the result of a manufacturing process in which a series of activities transforms raw materials, technologies and resources into the output – that is the product. So, it is mandatory to implement different activities concerning monitoring, as well as to collect and analyse appropriate data with the aim to demonstrate the suitability and the achievement of a desired quality levels. The analysis of data provides information about conformity to product requirements but also related to characteristics and trends of processes and products, including opportunities for preventive actions. This last aspect – the preventive action – depends also on the ability to monitor both the functionality of the product and the capability of the process to fulfil requirements.

In this scenario IMEKO TC 10 aims to represent a reference point for scientists and researchers. It can be regarded as a forum for exchanging knowledge and sharing ideas concerning methods, principles, instruments and tools, standards and industrial applications on Technical Diagnostics as well as their diffusion across the scientific community.

In this issue two main aspects are considered as a result of different research activities presented in the Workshop. First, the impact of technical diagnostics on the product performances is considered. For this topic different points of view and proposals in the field of fault diagnosis are presented by the authors. B. Aubert et al. deal in [1] with an Extended Kalman Filter based fault detection in Permanent Magnet Synchronous Generators. Being such equipment used often in high technology contexts, it is fundamental to guarantee high performances in terms of reliability and safety. Authors propose a method for inter-turn short-circuit detection based on the identification of the short-circuited turns ratio in a faulty PMSG model expressed in Park frame. Several tests are also implemented in order to demonstrate robustness and sensitivity of the approach. In the field of testing for electronic devices an interesting contribution is proposed by D. Załęski and R. Zielonko in [2]. The paper concerns the testing of analog circuits and blocks in mixed-signal Electronic Embedded Systems (EESs) by means of the Built-in Self-Test (BIST) technique. In particular, two testing functions are performed:

functional testing and fault diagnosis on the level of localization of a faulty element. Such proposal can be applied in a wide range of EESs. In this first topic of the Workshop also the work presented by M. Lazzaroni et al. [3] can be located. Authors proposed a thermal characterization of a power converter demonstrator used in particularly critical environments where the presence of radiation and magnetic fields are possible. In addition to the previous applications, it is important to underline how Technical diagnostics can be considered also to check the operating conditions and the functionality of components (above mechanicals), machines and plants. This is the case of the research presented by G. Dinardo in [4] about measurements of vibration affecting rotating components of machines. Authors propose a novel configuration of a Laser Doppler Vibrometer (LDV). The instrument was set up for the estimation of the out of plane vibrations of moving (rotating) objects, in order to give a better characterization of the self-tracking technique employed with the use of a 1D single point LDV. On the subject of measurements of vibration, but with different aims, is the paper of I. Bodini et al. [5]. The research concerns a monitoring activity for on-board vibration in public transport. This can be considered an example of how technical diagnostics can be implemented as support for the evaluation of quality of service. A set of experimental tests has been performed by the Authors to define a vibrational comfort index and to collect a large dataset that allows statistically significant comparisons between different infrastructures and their characterization. The proposed technique can also be useful for diagnostics purposes, such as vehicle comparison and road maintenance state monitoring. As said above, the vast area of technical diagnostics covers also different topics as, for instance, the manufacturing environment. M. Scagliarini proposes in [6] a method for assessing multivariate measurement systems. This article describes an approach that, using the data routinely available from the regular activity of the instrument, offers the possibility of assessing multivariate measurement systems without the necessity of performing a multivariate gauge study. The practical application of this research is of interest considering that, often, critical decisions about process and product quality depend on the quality of the measurement systems. The paper [7] of M.N. Durakbaşa et al. presents, instead, a particular study on process parameters like cutting speed, feed rate, depth of cut, tool geometry, and different coatings. The goal is to indicate the effects on surface roughness of the machined product on the basis of two and three-dimensional precise measurements. Taguchi and Regression methods are proposed as methodological approaches in order to predict average surface roughness values against edge radius wear.

In conclusion, the papers presented in the *12th IMEKO TC10 Workshop on New Perspectives in Measurements, Tools and Techniques for Industrial Applications*, and briefly described here, confirm the vast research area and different interests of scientists in technical diagnostic.

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