Guest Editorial

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Biographical notes: Janez Grum is a Professor of Materials Science at the University of Ljubljana, Faculty of Mechanical Engineering. He is also the founder and editor-in-chief of a new journal *International Journal of Microstructure and Materials Properties – IJMMP* and has been editor of the *Journal News of Society for Nondestructive Testing*, Slovenian Society for Non-Destructive Testing, Ljubljana, Slovenia since 1994. He is editor of the six NDT Conference Proceedings, two ASM and Marcel Dekker book chapters and five books with several reprints. He has also published more than 100 refereed journals and more than 300 conference papers on heat treatment, laser materials processing and materials testing including non-destructive testing.

The papers collected in the present issue of the IJMPT were presented at the 8th International Conference on the 'Application of Contemporary Non-Destructive Testing in Engineering' organised by the Slovenian Society of Non-Destructive Testing. The Conference was organised with the financial assistance of the Slovenian Agency of Research.

The Conference took place in Portorož from 1–3 September, 2005. Portorož is a tourist resort lying at the East coast of the Northern Adriatic. It has a typical Mediterranean climate.

At the Conference 79 papers, 50 as oral lectures and 29 as posters, were presented. The scientific board of the Conference selected 27 papers for publication, of which 15 were for publication in the *International Journal of Microstructure and Materials Properties* (IJMMP) and 12 were for the *International Journal of Materials and Product Technology* (IJMPT). All the papers selected were strictly reviewed and selected on the recommendation of reviewers taking account of the subject matter of the two journals.

Material testing is a very important task in modern industrial production characterised by increasing computerisation. Non-destructive testing of materials and structures plays a very significant role in the production of various parts and structures as well as in their in-service testing. Very common applications of non-destructive testing are periodical control of aircraft and rolling stock as well as testing in nuclear power stations. Periodical checking is frequently specified by the manufacturer of the equipment. He will specify the testing method, devices and accessories to be used as well as the acceptance criteria.

Non-destructive testing is being increasingly applied to the maintenance of important systems operating without interruption and, as such, running major risks

since they are exposed to excessive material fatigue. Such high-risk systems include nuclear power plants and various means of communication, including aircraft and space ships. These systems have recently been increasingly subjected to a total control of their parts if they are to ensure their high quality. Although the high-risk systems are periodically controlled and maintained as needed, they are characterised by a systematic control of the indications obtained in testing of critical system elements.

Due to industrial requirements in the recent decade, numerous non-destructive material testing methods have intensely developed and have established themselves. The advancement of non-destructive testing methods has a primary impact on production automation, which is to ensure adequate product quality and no refuse. The process of production automation and the introduction of non-destructive material testing methods go hand in hand with the advancement of sensor technique, electronics, microprocessor techniques and computer engineering. In non-destructive testing with dedicated devices, the basic characteristics of the device used are important. They should enable the detection of various material properties and types of defects, their visualisation and registration as well as the classification of the signals captured and processed. A special place is occupied by computer-aided systems, which make it possible to store and process all the data on periodic checks, on the state and on the types of defects detected and this, in turn, makes it possible to know better the quality of part production and the state of the parts in operation.

It was the development of the technologies mentioned that contributed to the computer-aided product quality and material defect assessment. Non-destructive evaluation methods comprise numerous applications to production technologies, monitoring of production processes and, finally, to in-service inspection. Nowadays non-destructive testing (NDT) and non-destructive evaluation (NDE) are closely related since they make it possible to capture signals and indications from materials and structures and to process and store them. Thus, it is possible with every part or structure to check its history, which enables the prediction of its life. The methods concerned also permit statistical processing of the data obtained in non-destructive testing and non-destructive evaluation which, in turn, permits the evaluation of the production in terms of manufacturing process quality and the remaining life of a part or a system in in-service inspection.

Matz et al. presented a method for filtering ultrasonic signals based on the discrete wavelet transform. For classification of ultrasonic signals in A-scan they used a pattern recognition method called support vector machines. The study classified ultrasonic signals on various welded specimens with a fault echo and a back-wall echo.

Edalati et al. studied the ability of ultrasonic Lamb-wave testing for defect detection and sizing in a thin aluminium plate. Two ultrasonic Lamb-wave techniques, pulse-echo and emission, were applied to the interpretation of notch defects at various depths. The defect location and defect length were proposed to be determined in a manner similar to common ultrasonic testing methods. The distance-amplitude-correction curve was proposed for defect sizing, which gives some qualitative information about the defect depth. The pulse-echo method showed better sensitivity for defect detection and sizing.

Davidenko studied principles of the elementary non-wave theory of field of ultrasonic transducers used for pulse-amplitude defectometry (FNFT). Graphical

representation of the energy field with its structure and boundaries is presented in the form of an amplitude-distance-defect diagram (ADD) and that of the geometric field is presented in the form of a defect-distance-amplitude diagram (DDA). The direct problem of ultrasonic testing, solved usually using ADD-diagrams, is generally work in energy field defectoscopy and the inverse problem for the solution is called work in geometric field defectometry.

Nowadays, there is a growing need for infrastructure renewal worldwide. Highways pavements, bridges, parking garages and other exposed structures are becoming functionally obsolete or deteriorating while governments struggle to produce the funds to catch up. It has become clear in the recent decade that these infrastructure rehabilitation challenges demand new technologies, mainly devices for assessing infrastructure deterioration. Non-destructive structural evaluation of pavements is an important part of the pavement management process, particularly at the project level. Mattos et al. discuss the measurements of pavement surface deflection generally used for this purpose. The flexmeter device for pavements (FDP) measures the deflection basins of a relatively light magnitude load applied on the pavement surface. FDP is a device used for assessing the pavement behaviour, which measures the tangent to basins deflection produced by a load applied on the pavement surface. The measured results from the flexmeter device of pavements are compared with the Benkelman Beam.

Savin et al. propose the use of a new type of the inner eddy current transducer with a rotating magnetic field, which has the capability to detect the discontinuities of pressure tubes. This method is very promising for the determination and characterisation of blisters cracking.

Gerasimov et al. proposed parameters for the identification of surface cracks signals based on features of the Fourier spectrum and wavelet spectrogram of eddy current sensor. Simulation data revealed that both methods have good ability for identification of short and shallow surface cracks.

Grimberg et al. proposed a method for eddy current non-destructive examination of carbon fibres from carbon epoxy composites, an eddy current micro sensor with orthogonal coils was developed and the data obtained were processed using the holographic technique. With a small modification of lift-off the successive layers of fibres can be visualised.

Potočnik et al. proposed a method for nondestructive fault detection based on the evaluation of acoustic features known as psychoacoustic modelling of human auditory perception. Various mechanical defects of rotary machines can be reflected in altered acoustic signatures. The proposed approach is illustrated by a case study that shows the quality of produced compressors. The results show that the major faults that occur in a production can be reliably detected.

Sukhorukov presents a new instrument developed by INTRON with a set of eddy current probes installed at the belt under a test surface. The instrument provides storage, displays data on a steel cord condition in-situ and gives information about rope breaks, corrosion, splice damages and their locations.

The paper titled 'Indentation shape parameters as indicators of spot weld quality' by Bračun et al. presents a laser-based method for three-dimensional measurements of the shape of electrode indentation, where image processing algorithms are employed. The method is based on illumination of the indentation with structured

light and detection of the image of the illuminated indentation by means of a digital camera. Shape parameters to serve as indicators of spot quality are also discussed.

Brudar presented a study of the magnetic field around two separated magnetising coils where the arrangement of coils is not standard. The author gives basic algorithms used with the method of finite differences.

Grum et al. described the system designed to capture sound emission during the quenching process on two different specimens in a few different quenching agents. Analysing acoustic emission signals can give useful information and confirm differences between different quenching conditions, thus can lead to new approaches to the monitoring of the hardening processes.

The present overview offers the reader numerous scientific results obtained in the field of non-destructive testing and evaluation and provides him with numerous references of the researchers treating the problems concerned in a comprehensive way. It also gives him a good insight into the present state of research in the field, widens his knowledge of the issues and is, as such, very suitable as a study aid to undergraduate students and even more so to postgraduate students.

Special thanks are due to the authors contributing their papers to this special issue of the IJMPT. They are a result of the very critical work of reviewers and the authors. It can be said that the papers satisfy high standards of quality.

Our great thanks are due also to our co-workers, Mr Franc Ravnik BSc and Ms Nevenka Majerle, who took care of the coordination among the reviewers and the authors and prepared the papers for publication.

We sincerely hope that the papers presented on non-destructive testing and evaluation will be a valuable source of information to researchers in various scientific fields and users in the field of materials and production.