1.14.21. HYBRID DIGITAL IMAGE CORRELATION/THERMOVISION METHOD FOR MONITORING AND MEASUREMENTS OF DISPLACEMENT AND DEFECTS IN CIVIL ENGINEERING STRUCTURES

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Techniques used for measurement of displacement/strain and defect detections in civil engineering are based on a variety of physical phenomena, among which mechanical, optical, electrical and ultrasound methods prevail. Each of these methods has its unique properties, which predestine it for different types of measurements or/and structural health monitoring. In the case of complex structures and structures exposed to a variety of environmental conditions the information gained from a combination of methods provides the best results. Therefore within the project MONIT [1] the variety of complementary methods and tools has been developed including a set of optical sensors (fig. 1). In the presentation we will briefly describe a distributed intelligent system for civil engineering structures on-line measurement, remote monitoring, and data archiving in which a set of optical, full-field displacement sensors are connected to a controlling server.

In the second part of the paper we will focus on a novel concept of hybrid digital image correlation/thermovison method in which these two techniques are applied for simultaneous monitoring of a chosen object (selected field of view) in order to extend the content of information captured. Digital image correlation (DIC) method using two camera setup [2] (3D DIC) provides the maps of displacements in three directions (u, v, w) if the structure is exposed to loading (mechanical or thermal within elastic or elasto-plastic range). The thermovision camera (we use the camera working in the range 8 – 14 μm and thermal sensitivity <0,08°C) delivers the actual maps of temperature distribution at the monitored surface.

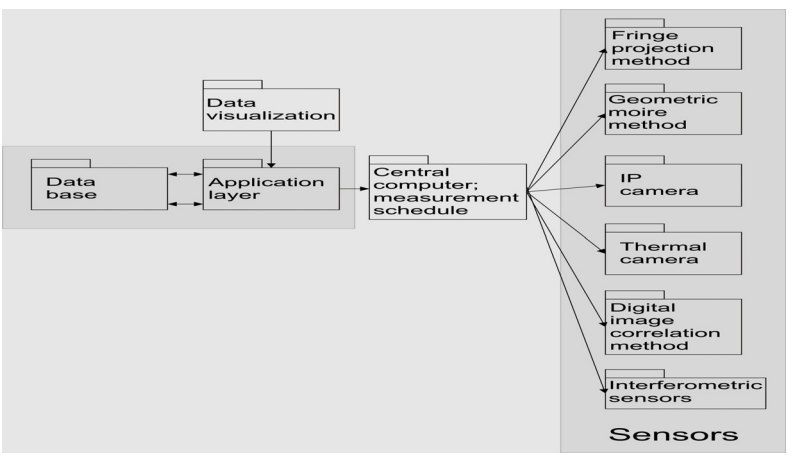

Fig.1. The scheme of monitoring/measurement system based on a set of optical sensors

These two information can be combined in different ways depending on the a'priori knowledge of the internal structure and loading conditions. The defect detection and the health of the structure assessment is based on FEM analysis which takes into account experimental data from both systems. This technique is specifically intended to be used for structures in which the internal integrity of the material can be visualized by temperature distribution, which includes bridges (see fig. 2), big concrete structures of different civil engineering applications, composite structures (the layers of different materials incl. heat insulation).
The photo represents the overlayed images of an bridge structure seen from the bottom and its colour-coded temperature distribution.

Finally the examples of application of the described method and its implementation in the full monitoring system are presented.

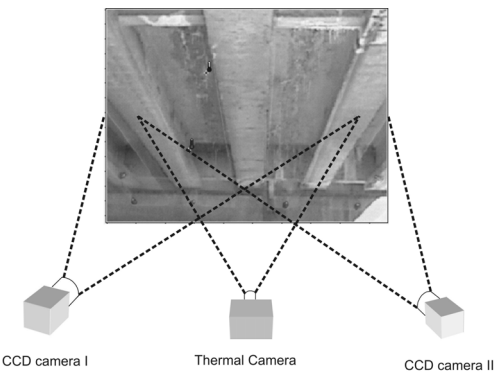

Fig. 2. The scheme of experimental system using the hybrid DIC/thermovision methods

References:

1. **http://www.monit.pw.edu.pl.**
2. **Kujawińska M.** at al. "Remote on-line monitoring and measuring system for civil engineering structures" Proc. SPIE. – 2009. – V. 7389. – P. 738904-1-10,
3. **Orteu J-J.** "3-D computer vision in experimental mechanics". 2009. – V. 47. – P 282 – 291.