EDUCATION AND TRAINING ON INFRARED DIAGNOSIS

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Abstract:

Infrared Thermovision (IRT) is well established technique for contactless state diagnosis of a numbers technological machines and apparatus. On the base of the surface dynamic thermal map of the elaborated device one could provide Fault Detection and Diagnosis (FDD). As a result decision could be made for relevant actions according the current condition of the equipment-load decreasing, repairing before a predicted time or immediate stop for inspection. Important factors for correct thermovision data acquisition and their further interpretation for FDD are the possibilities of IRT tools software and professional knowledge and skills of the human as well.

In the presented paper a laboratory for Infrared Thermography based FDD is described designed via using new hybrid approach of modeling, monitoring and data processing in order to obtain computer based flexibility combined with real measurements.

The laboratory is based on integration of mathematical and physical models for simulation and physical mapping in laboratory conditions of temperature fields, arising on the elaborated devices surfaces. Computer modeling and simulation is realized in order to determine the 3D temperature field of the elaborated device. The main achievements of the authors is mapping of this simulation-based lattice on physical thermal plant, containing the same number of 100 finite elements. Each of these elements is autonomous and its temperature is tracking via individual control loop. The reference value of each control loop is determined from the corresponding finite element of the original approximate computer 10x10 lattice. The multivariable control system, containing 100 individual controllers, thermocouples and local heaters is fulfilled using power Programmable Logic Controller (PLC). A SCADA system is applied to manage full sensor, actuator and hand received continuous and discrete information. The interpretation of real measurements-preprocessing, clustering, data processing, fault detection, isolation and diagnosis is carried out in particular computer. Corresponding human-machine interface (interaction, 2D, 3D imaging) is developed.

The developed laboratory is multifunctional. In the aspect of Infrared Thermovision it gives the next main opportunities for education and training: (i) Theoretical fundament of IRT (ii) Real measurements with advanced IR tools. Measurement conditions are generated via physical modeling of real disturbances-temperature, speed and humidity of the ambient air, convective and radiant side heat flow, light effects, emissivity coefficient changes etc. (iii) IRT software using, monitoring data processing, visualization, (iv) Methods of Infrared Thermovision based Fault Detection and Diagnosis (FDD), (v) Application of FDD methods on the base of real measurements, (vi) Decision making on the base of FDD results.

Because of computer based modeling a variety of industrial plants are under consideration-metallurgical ladle, electrical arc furnace, reheating furnace. A lot of faults are modeled and FDD is accomplished using the acquired measurement data.

The equipment of the presented laboratory is expensive. Some of the components are unique. This makes the realization of distance education topical. A multimedia could transmit the

processes of simulation, measurement and FDD via Internet. The obtained thermovision and optic images could be broadcast to the student for exercise accomplishing.

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