CASE-BASED DIAGNOSIS AND INTERDISCIPLINARY EDUCATION

Emil Mihailov, University of Chemical Technology and Metallurgy, emil@uctm.edu
Mincho Hadjiski, University of Chemical Technology and Metallurgy, hadjiski@uctm.edu
Venko Petkov, University of Chemical Technology and Metallurgy, venko@uctm.edu

Key words: case-based reasoning, infrared thermography, intelligent diagnosis

Abstract:

It is broadly recognized from the top-managers that the success of many industrial plants in chemical, power, mining and silicate industry, metallurgy etc, strongly depends on the safe operation and low cost predictive maintenance of their machinery. Early diagnosis helps to avoid extensive damage to the machines and hence to reduce big losses from failing and repairing as well as from downtime which decrease productivity and economics. Thus diagnosis have to be obligatory an element in the engineering knowledge and skills.

Case-based diagnosis is one suitable instance to demonstrate the possibilities of the developed multifunctional and multitarget hybrid laboratory to show clearly the existing interdisciplinary relationships in a particular domain of knowledge based technical diagnosis. Case-based diagnosis is an application of Case-Based Reasoning, which is naturally connected with some area of mathematical logic, reasoning procedures, approximate reasoning, and similarity-based reasoning. These relationships are explained in easy understandable formal level. In the application layer the relationships are with such subjects as expert systems, pattern classification and fuzzy logic-based reasoning. Via comparison in the basic procedure the main relationships are presented and structured. A particular case-based diagnosis (CBD) is developed to estimate lining wearing in a hot metal metallurgical ladle using infrared thermography as a sensor information.

A mathematical model of unstationary heat exchange in the ladle is derived. A number of cases are considered with different geometry of the failed lining. Steady states are defined for each case and model-based case base is created. Using executive model of the developed stand the physical mapping of the model-based case base is fulfilling via infrared thermography measurements adding real environmental disturbances-temperature, humidity and speed of the ambient air, convective and radiant side heat flow, ladle surface emissitivity. As a result a case base of real measurements is created. The similarity measures and fuzzy logic based membership functions are defined. Particular new case for education is modeled and transferred into the thermal wall. Diagnosis procedure is carried out using case-based approach.

The developed multifunctional laboratory stand gives wide flexibility to make a variety of alternative variance of a foreside exercise: (i) To prove that man inspection is to slow according on-line diagnosis, (ii) steady-state diagnosis could be not precise enough in comparison with dynamic case-based diagnosis, (iii) inexact conclusions could be result of inexact premises, (iv) the features generation could be not straightforward depending on geometry of the damage.

The integration of computer simulation and physical modeling gives a possibility to learn important lessons about the relations between formal theory and practical reality.

Presenter:

Emil Mihailov, Associated Professor, PhD
University of Chemical Technology and Metallurgy,
8 St.Kliment Ohridski Blvd., 1756 Sofia, Bulgaria
E-mail: emil@uctm.edu, Tel. +35928163361