ADVANCED DIAGNOSIS EDUCATION IN MULTIFUNCTIONAL LABORATORY

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Abstract:

The problems of Fault Detection and Diagnosis (FDD) attain increasingly significance in last two decades. The theoretical aspects gain a number of new approaches following the achievements in control theory, artificial intelligence, decision making. Nowadays FDD theory is well established multidisciplinary area covering broad application fields as engineering, economics, communication, IT, Internet, medicine. Application of FDD in industry is traditionally well accepted, but recently it received more and more popularity in process industry, power industry, automotive industry etc, because it contributes to reach more safety, cost effective maintenance, reduced unplanned breakdowns.

Contemporary FDD science, engineering and management are concentrated in three main directions (i) threshold based, (ii) control theory based and (iii) Artificial Intelligence based approaches.

The created multifunctional laboratory with hybridization of computer-based and physical-based modeling approaches satisfies all prerequisites to organize training and education on advanced FDD in different level, volume, purpose, organization.

The educational curricula of advanced FDD consider full enough lists of topics, which are consensually accepted into the FDD community. In the direction of threshold based FDD it involves consideration of different types of thresholds: condition-based, risk-based, multi-laired, dynamic, adaptive. Model based FDD covers the topics like residual generation, robust residual generation, residual evaluation, fault detection, fault isolation, fault diagnosis. The area of Artificial Intelligence-based FDD contains the next main subjects: classifiers based diagnosis (Bayes, Artificial Neural Networks, Fuzzy Logic), rule-based diagnosis, case-based diagnosis, Support Vector Machine-based.

Proposed multifunctional laboratory in the case of education in technical diagnosis allows a big flexibility in different aspects: (i) computer models could face all requirements for particular industry orientation (heat exchangers, reactors, civil construction), complexity, mathematical description, (ii) different level of consideration depending on the course specification (industry oriented, BSc, MSc), (iii) volume of the course could be optional. The main peculiarity of the laboratory is the possibility to fulfill FDD processing in two ways – (i) using synthetic simulation data and (ii) on the base of real measurements. Depending on the target group a different balance between two alternatives are possible.

Multifunctional laboratory enables to learn the possibilities of different theoretical or heuristic methods to overcome the influence of simulated or real environmental disturbances (air temperature, and speed, radiant heat flow, border furnace characteristics etc.). Again two way of realization of external disturbances are available-synthetic generated via separate computer model or physical model-based environmental influence. In a more advanced courses on intelligent FDD integration of a separate approaches is available - for instance neuro-fuzzy classifiers, model-based threshold diagnosis, probabilistic – rule based diagnosis.

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