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# COMPARITIVE STUDY OF VARIOUS DIAGONISTIC TECHNIQUES IN ARTIFICIAL INTELLIGENCE

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## ABSTRACT

*This paper presents the problem solving approaches in Artificial Intelligence (AI) along with a review of the various diagnostic techniques used in industries . Various applications of AI techniques (expert systems, neural networks etc ) are well suited to cope with on-line diagnostic tasks for various applications in industries . Now a days AI techniques are being preferred over traditional practices. These systems and techniques can be integrated into each other with more traditional techniques . GA (Genetic algorithm ) is considered as the most recent product of the artificial intelligence techniques. A brief description of various AI techniques highlighting the merits and demerits of each other have been discussed.*

**KEYWORDS:** AI , Neural network , fuzzy logic , Genetic algorithm .

## I .INTRODUCTION

Intelligence helps in identifying the right piece of knowledge at the appropriate instances of decision making. A system capable of planning and executing the right task at the right time is generally called rational . Thus, Artificial Intelligence (AI) alternatively may be stated as a subject dealing with computational models that can think and act rationally. Induction machines are known as work horse of modern industries because of various technical and economical reasons., These machines face various stresses during operating conditions. These stresses might lead to some modes of failures. Hence the condition monitoring becomes necessary in order to avoid catastrophic failures . The diagnostic procedure, based on the voltage and current signals, can be organized in the following steps:1) choice of the failures to be considered;2) definition of cause-effect relationships;3) computation of the diagnostic indexes linked to the fault extent. Need of the hour and various developments in software applications has led to consideration of different diagnostic strategies by making extensive use of artificial intelligence (AI)-based techniques, including expert systems ,fuzzy systems, neural networks, and combined techniques .

## II.GENERAL PROBLEM SOLVING APPROACHES IN AI

Problems, for which straightforward mathematical / logical algorithms are not readily available and which can be solved by intuitive approach only, are called AI problems .To understand what exactly artificial intelligence is, we illustrate some common problems. Problems dealt with in artificial intelligence generally use a common term called 'state'. A state represents a status of the solution at a given step of the problem solving procedure. The solution of a problem, thus, is a collection of the problem states. The problem solving procedure applies an operator to a state to get the next state. Then it applies another operator to the resulting state to derive a new state. The process of applying an operator to a state and its subsequent transition to the next state, thus, is continued until the goal (desired) state is derived. Such a method of solving a problem is generally referred to as state space approach . The main trick in solving problems by the state-

space approach is to determine the set of operators and to use it at appropriate states of the problem .How to control the generation of states ? This, in fact, can be achieved by suitably designing some control strategies, which would filter a few states only from a large number of legal states that could be

generated from a given starting / intermediate state. Some of these well-known search algorithms are:

- Generate and Test
- Hill Climbing
- Heuristic Search
- Means and Ends analysis

a) Generate and Test Approach: This approach concerns the generation of the state-space from a known starting state (root) of the problem and continues expanding the reasoning space until the goal node or the terminal state is reached.. The basic strategy used in this search is only generation of states and their testing for goals but it does not allow filtering of states.

(b) Hill Climbing Approach: Under this approach, one has to first generate a starting state and measure the total cost for reaching the goal from the given starting state. We select randomly a new starting state and then continue the above search process. While proving

trigonometric identities , Hill Climbing, is used perhaps unknowingly.

(c) Heuristic Search: Classically heuristics means rule of thumb. In heuristic search, generally one or more heuristic functions are used to determine the better candidate states among a set of legal states that could be generated from a known state. However, the most difficult task in heuristic search problems is the selection of the heuristic functions.

(d) Means and Ends Analysis: This method of search attempts to reduce the gap between the current state and the goal state. One simple way to explore this method is to measure the distance between the current state and the goal, and then apply an operator to the current state, so that the distance between the resulting state and the goal is reduced. In many mathematical theorem- proving processes, Means and Ends Analysis is used.

### III.PARENT DISCIPLINE AND APPLICATION AREAS OF AI

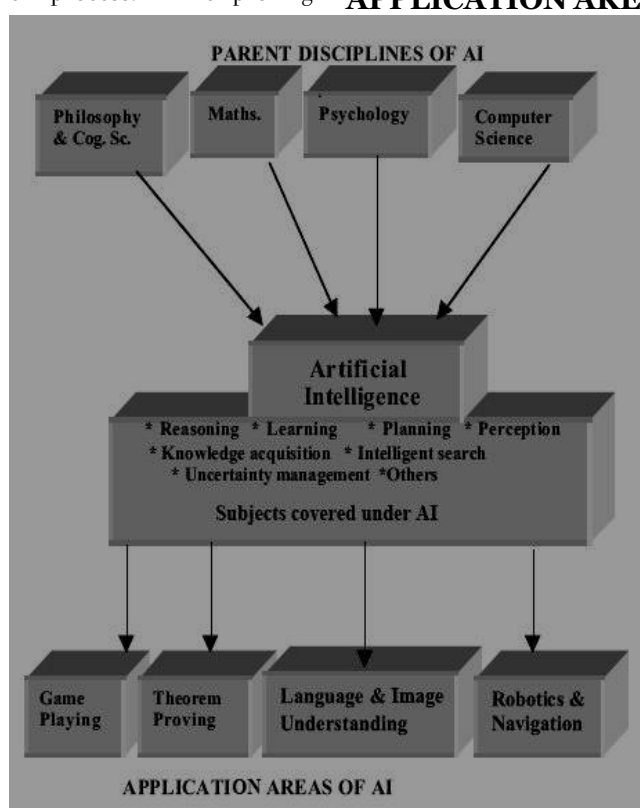


Fig: 1

The subject of artificial intelligence spans a wide horizon. It deals with the various kinds of knowledge representation schemes, different techniques of intelligent search, various methods for resolving uncertainty of data and knowledge, different schemes for automated machine learning and many others. Among the application areas of AI, we have Expert systems, Game-playing, and Theorem-proving, natural language processing, Image recognition, Robotics and many others. The subject of artificial intelligence has been enriched with a wide discipline of knowledge from Philosophy, Psychology, and cognitive Science, Computer Science, Mathematics and

Engineering. Thus, in fig. 1, they have been referred to as the parent disciplines of AI. At-a-glance look at fig.1 also reveals the subject area of AI and its application areas.

### IV. VARIOUS DIAGONSTIC TECHNIQUES IN AI

#### (1) Expert system:-

The basic elements of an expert system are the production rules to model the knowledge base, the objects to model the data, and the inference engine to process, by various inference mechanisms, the rules. This structure allows one to move from traditional data

processing to knowledge-based processing .Production rules can activate complex operations or introduce

heuristic reasoning, simply handling typical thresholds of particular faults.

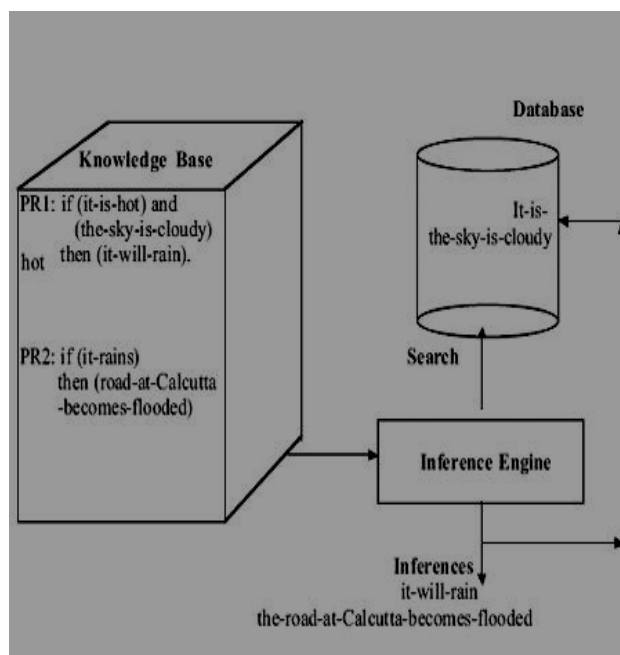


Fig 2 : Illustration of an Expert system

**(2)Fuzzy logic** can be applied to replace the crisp rules of an expert system with linguistic rules when the investigated problem is too complex to be analyzed by quantitative techniques and a hypothesis cannot be declared true in exact terms .The essential part of fuzzy logic is a set of linguistic rules applied to linguistic variables characterized by appropriate membership functions. An algorithm can convert the linguistic strategy based on expert knowledge into a fuzzy inference. Then, it is possible to improve an expert system by inserting the fuzzy logic concepts that use fuzzy rules and fuzzy inferences. The linguistic rules are more suitable than the crisp ones to describe the inexact nature of real machines, but the shapes and number of membership functions must be initially selected using a large database of experimental data or simulated data.

**(3)Neural networks (NN):-**

NN are parallel distributed information processing units with different connection structures and processing mechanisms, are particularly suitable to link the different variables of a physical system where the relationship between the independent and the dependent variables are not easily quantifiable .The first NN structures used in the diagnostics are of the multilayer preceptor type (MLP), trained using the back propagation algorithm. The input vectors are selected variables derived from the transducer signals; for every input vector , the output vector is given, defined according to the machine condition. During the learning process, the NN weights are adapted in order to produce the desired output vectors. This process is the so-called supervised learning process (SLP).

**(4)Genetic Algorithm:-**

GA is a stochastic optimization procedure inspired by natural evolution. It can yield the global optimum solution in a complex multi-model search space without requiring specific knowledge about the problem to be solved. A genetic or evolutionary algorithm operates on a group or population of chromosomes at a time, iteratively applying genetically based operators such as crossover and mutation to produce fittest populations containing better solution chromosomes .

**(5) Support Vector Machine:-**

SVMs are the methods for creating functions from a set of labeled training data. The function can be a classification function (the output is binary: is the input in a category) or the function can be a general regression function. For classification, SVMs operate by finding a hyper surface in the space of possible inputs, which will attempt to split the positive examples from the negative examples.

**V. AI BASED STATOR FAULT DIAGNOSTICS**

Recently AI techniques are being preferred over traditional protective relays for fault diagnostics to manage data acquisition and processing in order to increase the diagnostic effectiveness. The main steps of an AI based diagnostic procedure are ‘signature extraction’, ‘fault identification’ and ‘fault severity evaluation’ The faults of an induction machine supplied by sinusoidal voltages are linked with the harmonic content of the stator current, i.e. each fault is associated with the presence of specific harmonic components.

## VI. APPLICATION DRAWBACKS

The above described features of the AI techniques should correspond to wide industrial applications, but plant operators look at these tools with a certain degree of suspicion, due to their complexity and their cost. A commercial application proposed by Siemens uses AI techniques, but it is limited to the recognition of fault presence and not to a true diagnosis. The system is presented as a "protection system," and it is a manager of thresholds fixed from experience and not from faulted machine models.

To implement a complete diagnostic system for industrial applications, it is fundamental to:

- 1) Employ minimum configuration intelligence;
- 2) Develop a knowledge base transferable from machine to machine.

With regard to the first point, in connection to the structure of a diagnostic system, the best idea appears to be a global neural solution in which a first-level unsupervised NN clusters the inputs and classifies the fault mode. Several second-level supervised NN's, all of which are dedicated to a specific fault, are available to evaluate the degree of the fault. Regarding the diagnostic system components, i.e., the NN's, the minimum configuration intelligence can be obtained by improving the NN architecture. For example, this can be achieved by using adaptive activation functions which move apart of the knowledge from connection weights to the neurons, obtaining for the solution of the same problem, structures with a smaller number of neurons. The most efficient learning technique of the NN devoted to a particular fault could be obtained utilizing simulated data derived from faulted machine models, experimentally tested, because this technique could be transferable from machine to machine. Models able to simulate the faulty machine behavior utilizing a limited number of machine parameters are particularly suitable to this aim. The detection of the most important parameters, which influence the faulty machine behavior, should allow defining new input variables, a combination of the electric variables and these parameters, which are not dependent on a specific machine. The NN learned by the inputs will present outputs, in per-unit values or in percentage values, with general validity.

## VII. COMPARISON OF VARIOUS AI TECHNIQUES

ANN modeling techniques for fault diagnosis sometimes does not give satisfying results. The noise present in the signals and usage of feature set that do not, describe the signals accurately and local convergence of gradient based learning are some of the most probable reasons for the 'not so good' results. The concept of feature selection and genetic training are used to improve the classification accuracy and to reduce the computational time. A simple GA is used to select best set of feature set from the available set of features. A multi layer feed forward ANN can be trained with GA as a global search technique to overcome the local convergence problem. A drawback

of GA is that it has no concept of an optimal solution," or any way to test whether a solution is optimal. Both the ANNs and SVMs learn from experimental data, and are universal approximations in the sense that they can approximate any function to any desired degree of accuracy. After learning ANNs and SVMs these, are given with the same mathematical model and they can be presented

graphically with the same so-called ANN'S graph. They differ

by the learning methods.

## VIII. ORGANIZATIONS AND PUBLICATIONS CONCERNED WITH AI

The American Association for Artificial Intelligence (AAAI), the European Coordinating Committee for Artificial Intelligence (ECCAI) and the Society for Artificial Intelligence and Simulation of Behavior (AISB) are scientific societies concerned with AI research. The Association for Computing Machinery (ACM) has a special interest group on artificial intelligence SIGART. The International Joint Conference on AI (IJCAI) is the main international conference. The AAAI runs a US National Conference on AI. Electronic Transactions on Artificial Intelligence, Artificial Intelligence, and Journal of Artificial Intelligence Research, and IEEE Transactions on Pattern Analysis and Machine Intelligence are four of the main journals publishing AI research papers

## CONCLUSION

It covers the application of expert systems, fuzzy logic, artificial neural networks and combined techniques as *fuzzy* neural networks. The advantages of using artificial intelligence are shown. Some aspects related to the application of minimum prior knowledge are also discussed. Although at present there are only limited number of practical implementations, it is believed that in the future these techniques will have a significant role in problem diagnosis in industries, fuzzy-neural diagnostic systems will become extensively used. As such AI has various applications and advantages but it has limited sensory input. Compared to a biological mind, an artificial mind is only capable of taking in a small amount of information. This is because of the need for individual input devices. The most important input that humans take in is the condition of the bodies. What is going on within the bodies, can help maintain and do work much more efficiently than an artificial mind. It can be said that Artificial intelligence is the "science of making machines do things that would require intelligence if done by men." Apart from some disadvantages that it has, it is clear that during their development stage, mathematical models may still be required.

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