



SOME RELEVANCE FIELDS OF SOFT COMPUTING METHODOLOGY

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Abstract

Soft computing (SC) is a combination of different type element, which aims to exploit tolerance for imprecision, uncertainty, approximate reasoning and partial truth to achieve robustness, tractability, and low cost solution. We can easily come to the conclusion that precision has a cost. Therefore, in order to solve real life problem with an acceptable cost we need to aim at a decision with only the necessary degree of precision. So SC provides chance to signify the ambiguity in human philosophy with real life uncertainty. This paper reviews some relevance fields of SC methodologies.

Keywords: Soft Computing, Hard computing, Hybrid Computing, Neural network, Fuzzy logic, Genetic algorithm

1. Introduction

In modern era, there are different techniques are used to solve real life problem like Hard computing (HC), Soft computing (SC) and Hybrid computing (HyC). HC methods are mainly based on mathematical approaches and therefore demand a high degree of precision and accuracy in their requirements. It is based on binary logic, crisp systems, numerical analysis and finite element analysis; it could establish itself long back, as conventional method for solving problems. It having features as: it works based on pure mathematics, it may yield precise solutions, it may be suitable for the problems, which are easy to model mathematically and whose stability is highly predictable. SC is an umbrella term for a collection of computing techniques. The term was first coined by Zadeh [1], who developed the concept of fuzzy logic (FL). It is not a concoction. Rather, it is a firm in which each of the components contributes a dissimilar methodology for addressing problem in its domain. In this viewpoint, the principal component methodologies in SC are complementary rather than competitive. These methods applied to real world problems frequently offer more robust, tractable and less costly solutions than those obtained by more conventional mathematical techniques [2]. These methods address different types of problems both in typology (control, data mining, forecasting, modeling, optimization, planning, reliability etc.) and in the areas of application (industrial production, logistics, energy, banking, food industry, medical industry, software engineering etc.). HyC is the combination of HC and SC which having their inherent advantages and disadvantages. Basically, it is used to get advantages of both techniques and reduce their individual's limitations for solving a problem more efficient and effective way.

In addition to the above introduction, this paper is organized as follows: in Section 2, ethics of hybrid computing is discussed. In Section 3, the methodologies of problem solving techniques are given. Section 4 is

related to application areas of soft computing. In Section 5, discusses about short description of soft computing in different areas. And finally in Section 6, the conclusion is made.

2. Ethics of hybrid computing

HyC is an integration technique which provides complementary reasoning and searching methods that allow us to combine domain knowledge and empirical data to develop flexible computing tools and solve complex problems. HC and SC techniques are fused together in following categories [3] as SC & HC (H1) : SC and HC are isolated, SC / HC (H2) : SC and HC are parallel connected, SC \ HC (H3) : SC with HC feedback, HC \ SC (H4) : HC with SC feedback, SC – HC (H5) : SC is cascaded with HC, HC – SC (H6) : HC is cascaded with SC, HC = SC (H7) : HC -designed SC, SC = HC (H8) : SC - designed HC, HC + SC (H9) : HC - augmented SC, SC + HC (H10) : SC -augmented HC, HC // SC (H11) : HC - assisted SC, SC // HC (H12) : SC - assisted HC. The degree of fusion of above two computing techniques varies very low to very high respectively. HyC methods have been applied to a large number of classification, prediction, and control problems.

3. The methodologies of problem solving techniques

The set of methodologies, $M = \{C_0, C_1, C_2, S_0, S_1, S_2, S_3, S_4, S_5, S_6, S_{11}, S_{12}, S_{111}, S_{121}, S_{21}, S_{22}, S_{31}, S_{32}, S_{33}, S_{34}, S_{41}, S_{42}, S_{43}, S_{44}, S_{51}, S_{52}, H_1, H_2, H_3, H_4, H_5, H_6, H_7, H_8, H_9, H_{10}, H_{11}, H_{12}\}$ is adopted as problem solving techniques which is shown in fig 1. where, C_0 = Precise model (PM), C_1 = Symbolic logic reasoning (SLR), C_2 = Traditional numerical modeling & search (TNMS), S_0 = Approximate models (AM), S_1 = Probabilistic models (PbM), S_2 = Fuzzy logic (FL), S_3 = Evolutionary computing (EC), S_4 = Neural network (NN), S_5 = Chaotic computing (CC), S_6 = Learning Theory, S_{11} = Bayesian belief nets (BBN), S_{12} = Dempster shafer theory (DST), S_{111} = Probability of fuzzy event (PFE), S_{121} = Belief of fuzzy event (BFE), S_{21} = FL controllers generated and tuned by ECs (FLEC), S_{22} = FL controllers tuned by NNs (FLNN), S_{31} = Evolution strategy (ES), S_{32} = Evolutionary programming (EP), S_{33} = Genetic algorithm (GA), S_{34} = Genetic programming (GP), S_{41} = Feed-forward neural network (FDNN), S_{42} = Radial basis function network (RBFN), S_{43} = Self-organizing map (SOM), S_{44} = Recurrent neural network (RNNs), S_{51} = Fuzzy logic + Chaos theory (FCh), S_{52} = Neural network + Chaos theory (NCh) and H_1 to H_{12} .

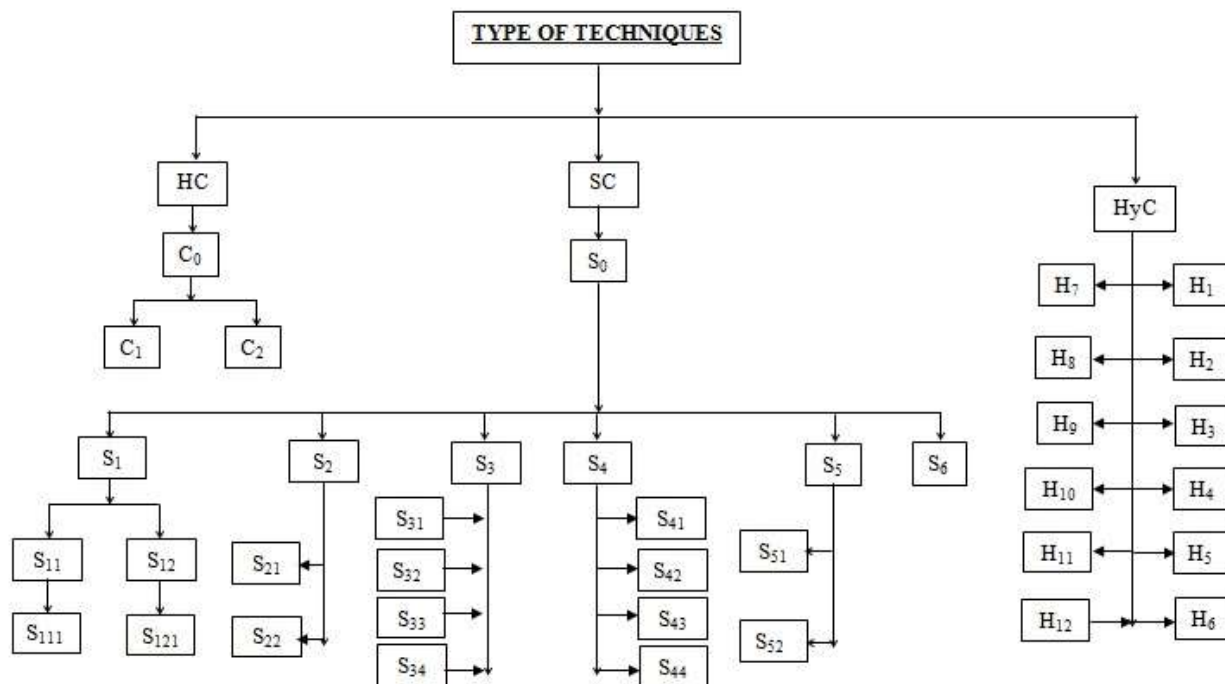


Fig 1

4. Application areas of soft computing

Soft computing techniques have become one of promising tools that can provide practice and reasonable solution. Soft computing techniques are used in different fields [4]. In modern era the application of SC technique increases rapidly in different areas as shown in the fig 2.



Fig 2

5. Short description of soft computing in different areas

| Sl. no. | Field of applications | Soft computing components | References |
|---------|----------------------------|---------------------------|------------------------------------|
| 1 | Aircraft and air traffic | NN, FL, EC | [5], [6] |
| 2 | Chemical process industry | FL, NN | [7], [8] |
| 3 | Communication networks | FL, NN, EC | [9], [10], [11], [12] |
| 4 | Control and Monitoring | EC, FL, NN | [13], [14], [15], [16],[17],[18] |
| 5 | Cooling and Heating | FL, NN, EC | [19], [20], [21], [22], [23], [24] |
| 6 | Data communications | FL, NN | [25], [26] |
| 7 | Data Security | ANN, FL | [27] |
| 8 | Fault diagnosis | FL, NN | [28], [29] |
| 9 | Food preparation | FL, NN, EC | [30], [31] |
| 10 | Induction Motor Drives | FL, NN | [32], [33] |
| 11 | Inverters and Converters | FL, NN | [34], [35] |
| 12 | Manufacturing Technologies | FL, NN | [36], [37] |

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|----|----------------------------------|-------------|------------------------------|
| 13 | Medical industry | FL, NN, GA | [38] |
| 14 | Mobile Robots | FL, NN | [39] |
| 15 | Multi-Agent Robots | EC, FL | [40] |
| 16 | Multi-objective optimization | GA | [41] |
| 17 | Network Optimization | GA | [42] |
| 18 | Planning | FL, NN, EC | [43], [44], [45], [46] |
| 19 | Power Control | EC | [47] |
| 20 | Radio Planning | ANN | [48] |
| 21 | Rainfall forecasting | FL, NN | [49] |
| 22 | Reliability optimization | FL, NN, GA | [50] |
| 23 | Resource Allocation | ANN | [51] |
| 24 | Satellite Imaging | ANN, FL, EA | [52] |
| 25 | Scheduling | ANN | [53] |
| 26 | Software quality | FL, NN | [54] |
| 27 | Software reliability | FL, NN, GA | [55], [56], [57], [58], [59] |
| 28 | Spacecraft | NN, FL, | [60], [61] |
| 29 | Steel Process Industry | FL, NN | [62] |
| 30 | Stock market forecasting | FL, NN | [63] |
| 31 | Switched Reluctance Motor Drives | FL | [64] |
| 32 | Time series forecasting | NN | [65] |
| 33 | Textile | FL, GA, NN | [66] |
| 34 | Wireless sensor network | FL | [67], [68] |

6. Conclusion

The application of SC increases day by day rapidly in many areas and it has become a major area of educational and industrial research. Other new methodologies like chaos computing, learning theory and immune networks are added to expand this area. These new methodologies of SC help to design new product. SC methodologies plays vital role for finding the solution of real life problems very efficiently and effectively.

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