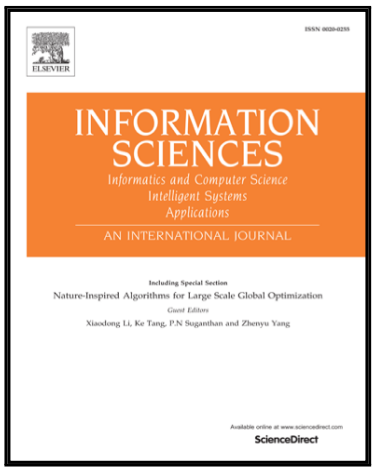

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Grouping granular structures in human granulation intelligence

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Abstract

Human granulation intelligence means that people can observe and analyze the same problem from various granulation points of view, which generally acknowledge an essential feature of human intelligence. Each granulation view can generate a granular structure through dividing a cognitive target into some meaningful information granules. This means that a large number of granular structures can be generated from the cognitive target. However, people can group these granular structures and select some representative ones for problem solving. This leads to an interesting research topic: how to efficiently and effectively group a family of granular structures. To address this issue, we first introduce a granular structure distance to measure the difference between two granular structures within a unified knowledge representation. Then, we propose a framework for grouping granular structures, called GGS algorithm, which is used to efficiently partition them. Moreover, two indices denoted as *DIS* and *APD* are also designed for evaluating the performance of a grouping result of granular structures. Finally, experiments carried out for nine data sets show that the GGS algorithm comes as a sound solution from perspectives of its convergence, effectiveness and scalability. In this way we have proposed and experimented with the general framework for discovering the structure inherent in granular structures, which can be afterwards used to simulate intelligent behavior of human's abilities of granular structure selection.

Key words: Granular computing; Granulation intelligence; Granular structure; Knowledge representation; Granular structure distance

1. Introduction

Artificial Intelligence refers to ability of a machine to perform tasks through work like a person, and the purpose of its research is to let this machine work like person. It can be roughly divided into two aspects from the viewpoint of cognition level. One focuses on understanding and simulating the mechanism of perception including vision, touch, smell, hearing, and so on. The other concerns on understanding and simulating the advanced cognitive mechanism, such as human learning, reasoning, decision and solving ability for complex problems.

As one of human advanced cognitive mechanisms, granular computing (GrC) is becoming a timely and innovative topic in artificial intelligence, information processing, data mining and knowledge discovery. Granular computing, as a special term, is coined by Zadeh and Lin [19, 20, 21, 61]. In 1979, Zadeh firstly argued that fuzzy information granulation plays a fundamental role in human reasoning. Three basic issues in granular computing are information granulation, organization and causation. As it was pointed out in [59]-[62], information granulation involves decomposition of whole into parts; the organization involves integration of parts into whole; and the causation involves association of causes with effects. In 1985, Hobbs [12] introduced a concept of granularity to characterize granulation degree used by an observer. In 1992, Zhang and Zhang [63] pointed out that people can observe and analyze the same problem from various granulation viewpoints, which is a generally acknowledged feature of human intelligence. In 1998, Yager

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