Chapter 12
Human Centricity and Perception–Based Perspective and Their Centrality to the Agenda of Granular Computing

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ABSTRACT

In spite of their striking diversity, numerous tasks and architectures of intelligent systems such as those permeating multivariable data analysis, decision-making processes along with their underlying models, recommender systems and others exhibit two evident commonalities. They promote (a) human centricity and (b) vigorously engage perceptions (rather than plain numeric entities) in the realization of the systems and their further usage. Information granules play a pivotal role in such settings. Granular Computing delivers a cohesive framework supporting a formation of information granules and facilitating their processing. The author exploits two essential concepts of Granular Computing. The first one deals with the construction of information granules. The second one helps endow constructs of intelligent systems with a much needed conceptual and modeling flexibility. The study elaborates in detail on the three representative studies. In the first study being focused on the Analytic Hierarchy Process (AHP) used in decision-making, the author shows how an optimal allocation of granularity helps improve the quality of the solution and facilitate collaborative activities in models of group decision-making. The second study is concerned with a granular interpretation of temporal data where the role of information granularity is profoundly visible when effectively supporting human centric description of relationships existing in data. The third study concerns a formation of granular logic descriptors on a basis of a family of logic descriptors.

1. INTRODUCTION

Let us consider a system (process) for which constructed is a family of models. The system can be perceived from different points of view, observed over some time periods and analyzed at different levels of detail. Subsequently, the resulting models are built with various objectives in mind. They offer some particular, albeit useful views at the system. We are interested in forming a *holistic* model of the system by taking advantage of the individual sources of knowledge – models, which have been constructed so far. When doing this, we are obviously aware that the sources of knowledge exhibit diversity and hence this diversity has to be taken into consideration and carefully quantified. No matter what the local models may look like, it is legitimate to anticipate that the global model (say, the one formed at the higher level of hierarchy) is more general, abstract. Another point of interest is to engage the sources of knowledge in intensive and carefully orchestrated procedures of knowledge reconciliation and consensus building. Granularity of information (Bargiela & Pedrycz, 2003, 2005, 2008, 2009; Bezdek, 1981; Pedrycz & Rai, 2008; Pedrycz & Hirota, 2008; Zadeh, 1997, 1999) becomes of paramount importance, both from the conceptual as well as algorithmic perspective, in the realization of granular fuzzy models. Subsequently, processing realized at the level of information granules gives rise to the discipline of Granular Computing (Bargiela & Pedrycz, 2003). We envision here a vast suite of formal approaches of fuzzy sets (Zadeh, 1997) rough sets (Pawlak, 1991, 1985; Pawlak & Skowron, 2007), shadowed sets (Pedrycz, 1998, 1999, 2005), probabilistic sets (Hirota, 1981; Hirota & Pedrycz, 1984) and alike. Along with the conceptual setups, we also encounter a great deal of interesting and relevant ideas supporting processing of information granules. For instance, in the realm of rough sets we can refer to Pawlak (1991). From the algorithmic perspective, fuzzy clustering (Bezdek, 1981), rough clustering, and clustering are regarded as fundamental development frameworks in which information granules are constructed.

The objective of this study is to introduce two conceptual and algorithmic underpinnings of Granular Computing overarching the entire domain, namely a principle of justifiable granularity and an optimal allocation of information granularity (Section 2 and 3). In Section 4, we focus on the role of second principle in the AHP models of decision-making including their group alternatives. Granular time series are investigated in Section 5; here we demonstrate a pivotal role of the principle of justifiable granularity. The ensuing optimization problems are formulated. In Section 6, we discuss an idea of granular logic and discuss how it emerges as a result of a global view at a collection of local logic descriptors. Conclusions of the study are covered in Section 7.

2. THE PRINCIPLE OF JUSTIFIABLE GRANULARITY

Here we are concerned with the formation of a single information granule Ω based on some experimental evidence being a set of a single-dimensional (scalar) numeric data, $\mathbf{D} = \{x_1, x_2, \ldots, x_N\}$. The information granule itself could be expressed in a certain formal framework of Granular Computing. The principle of justifiable granularity (Pedrycz & Gomide, 2007) is concerned with a formation of a meaningful information granule based on available experimental evidence. In its formation, such a construct has to adhere to the two intuitively compelling requirements:

1. The numeric evidence accumulated within the bounds of Ω has to be as *high* as possible. By doing so, we anticipate that the existence of the information granule is well motivated (justified) as being reflective of the existing experimental data.

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