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ScienceDirect

Procedia Computer Science 102 (2016) 82 – 89

Procedia Computer Science

12th International Conference on Application of Fuzzy Systems and Soft Computing, ICAFS 2016, 29-30 August 2016, Vienna, Austria

Relativistic psychometrics in subjective scaling

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Abstract

The article announces the possibilities of semantic modeling in the development of feedback tools in social sciences. A new approach to the computational theory of perceptions (CTP) for analysis of mental object is proposed. The article demonstrates the implementation of relativistic psychometrics for the study of mental response (opinions, expectations and attitudes). The problem of image understanding and its significance is considered in combination of soft and hard computing. It is shown that the modeling of object (its coding and decoding in 'mental map') obeys the semiotic and mathematical logic. Computing with perceptions for the rules of mental representation proves their identity to the laws of conservation. The article demonstrates the versatility of the semiotic description of objects in Minkowski space. It also confirms by mathematical solution C. S. Peirce's metaphor, according to which the semiology of language is a truly universal algebra of relations.

Peer-review under responsibility of the Organizing Committee of ICAFS 2016

Keywords: mental representation; relativistic psychometrics; computational theory of perceptions; image understanding; significance; expert test system; psychosemiotics

1. Introduction

If computing with words[1] imitates the human way of thinking with linguistic information, so modeling with 'sign of words' imitates the human way of mental representation with semiotic information. Manipulation of visual perceptions is the brain's ability and manipulation of social perceptions is the mind's ability. But all mental games

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Peer-review under responsibility of the Organizing Committee of ICAFS 2016
doi:10.1016/j.procs.2016.09.373

controlled by the language games[2]. Because the language is a system of signs, the sign may be claimed as a dependent variable in all mental functions from emotion to cognition. 'Sinn und Bedeutung'[3] are functional of sing. We use relativistic computing[4] for meaning and quantum computing[4] for sense. It's the sign which provides encoding between the first and second signal systems. At the same time, the universal subject code[5,6] is responsible for categorization (semiotics of language), as the universal mental code is responsible for the conceptualization (semantics). This is how the formation of concepts, their signification and comprehension take place. All mental processes obey the principle of the sign. In this article we attempt to formalize the language of mental representation. We study semiotic process of thinking consistent with mental representation. We discuss a mathematical model of mental representation based on psychological and semiotic principles of perception and cognition. Why do people often see what is not there, and don't see what there is? The reasons for this trick are internal mental processes related to invariant sign operations in the scheme "sensation-perception-representation".

A transition of the sign from one system to another is no more than the encoding of its contents. Changing of the code modifies the interpretation of the object, not the object itself. The laws of its invariant transformations are constant. These are the 'conservation laws' of the object. They do not depend on the system of its representation and "work" in any of them. Their semiotics is universal and is of a meta-linguistic nature. These are universal constant ways of perceiving the world through objects and objects through words. In the study of mental response we are interested in semiotic focus to problem of 'object world'[7]. We proceed from the hypothesis that the semiotic process of mental representation is universal and may be performed in semantic-mathematic model. This model formalizes new method of subjective scaling and explains semiotic solution in 'progressing from perceptions to measurements'[8]. We suggest relativistic psychometric technology[9] and its software implementation. It is used in academic and applied research[10,11] as a test software module for expert systems (developer SNY-research Group[4]). The technology has been tested in education[12], sport, marketing, management, advertising, social politics. Universality of technology justified its research design for versatile application.

2. Semantic model of mental space

Let's specify the basic provisions of the measurement model 'through property'.

2.1. Intensity and rigidity in property space

Classical approach to measurement performs description of any object through its properties. In vector form any object Ω of mental space reflects into vector U in a property space:

$$\vec{U} = \{Q_1, Q_2, ..., Q_j, ..., Q_n\} \text{ , where coordinate } Q_j \text{ –the j-th property (j = 1, 2, .. n).} \quad (1)$$

Bur the subjective perception "with property" includes two different concepts: the intensity and the rigidity. To distinguish them we have to introduce two components for property: Vj, for the intensity of property, Uvj for rigidness of property and U_H for object rigidity. The space, in which such a representation is realized, will be called semantic mental space. The properties in this space are presented with plane (multidimensional), but not single vector (one-dimensional). The object coordinates are angular (not linear) and called "the semantic coordinates'.

By adding the object coordinates, the properties do not change, unlike the rigidity (object's mass).

Example of object definition: $\{V_1, V_2, U_H\}$, i.e. $\Omega = \Omega' \to \{V_1, V_2, U_H\}$,

Example of object's sum:

$$\Omega_\Sigma = \Omega + \Omega' \to \{V_1, V_2, 2 \cdot U_H\} \quad (2)$$

Vector representation of objects becomes impossible, because in vector addition coordinates of properties are to be summed. To return to vector representation, let us associate vector $\vec{U}_j$ to each j-th quality in a certain space. It is evident that this vector has a certain correlation to intensity of Vj property.