The intellectual processor on basis of 2-nd order objects in restoration of images

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ABSTRACT

This paper deals with the problem of intellectual restoration of images. It is suggested to represent various objects and stages as objects of the first and second orders. Representation of dominant object as second order object reveals its new properties, that is an opportunity to control its own parameters. Complex representation of dominant object as second-class object of the first and second types allows to eliminate defects of its own image, as well as defects of image of subordinated object.

Keywords: artificial intelligence, restoration of images, neural networks.

1. DEFINITION OF FIRST ORDER OBJECTS

All objects of environment are divided into certain orders. The 1-st order object $\boldsymbol{x}_n^1$ represents some heterogeneity due to which it stands out against general homogeneous background. The 1-st order object can be submitted as set of two and more 1-st order objects. It is true and converse statement: the 1-st order object can be a part of other, larger 1-st order object. Thus, 1-st order object can be any object or group of objects, for example, a triangular prism, a ball, the TV, a desktop support, a domestic interior, a wood landscape, a still -life, etc. Hence, the dominant and subordinated objects, and also a stage consisting of them, are 1-st order objects: $\boldsymbol{x}_1^1, \boldsymbol{x}_2^1, \boldsymbol{x}_\Sigma^1 = \{\boldsymbol{x}_1^1, \boldsymbol{x}_2^1\}$. Then, 1-st order objects formally can differ in complexity from each other (i.e. power of set of all possible states): $|\boldsymbol{x}_\Sigma^1| > |\boldsymbol{x}_1^1| > |\boldsymbol{x}_2^1|$.

2. DEFINITION OF CONTROL OPERATORS OF DOMINANT OBJECT SUBMITTED AS SECOND ORDER OBJECT

Second order object $\boldsymbol{x}_n^2$ is a result of transformation of 1-st order object. Are known two versions of 2-nd order object:

- 1-st type: object $\boldsymbol{x}_n^{2.1}$ (figure 1.a);
- 2-nd type: object $\boldsymbol{x}_n^{2.2}$ (figure 1.b).

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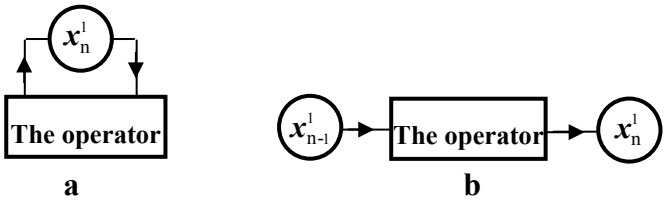

Figure 1. Second order objects of: a – 1-st type $x^{2.1}_n$; b – 2-nd type $x^{2.2}_n$.

Operator I of 2-nd order object is the processor, which changes 1-st order output object on basis of information received from 1-st order input object. The operator I shows dependence of new state of object on its old one. The 2-nd order object of 1-st type $x^{2.1}_n$, is considered as:

$$x^1_n = I(x^1_n). \tag{1}$$

Solution of this expression is a set of certain states of object $x^1_n : x^1_{n1}, x^1_{n2}, ..., x^1_{nq}$, where $q = |x^1_n|$ – complexity of object $x^1_n = (x_1, x_2, ..., x_K)$, determined as $|x^1_n| = |x_1| \cdot |x_2| \cdot ... \cdot |x_K|$, where $|x_k|$ – number of states of parameter x_k. The single object x^1_n, capable to control its states may be considered relatively as "the dominant object". Hence, it is possible to assert, that 2-nd order object of 1-st type $x^{2.1}_1$ has some given to him fundamental property $x_{I_{1,1}}$, which allow to change its own parameters by means of operator $I_{1,1}$:

$$x^1_1 = I_{1,1}(x^1_1). \tag{2}$$

Graphic interpretation of 2-nd order object of 1-st type is submitted on figure 2.

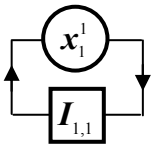

Figure 2. Dominant object as 2-nd order object of 1-st type $x^{2.1}_1$.

The control operator $I_{1,1}$ is also used for decision of other problems, such as problem of restoration of image. Then, dominant 2-nd order object of 1-st type $x^{2.1}_1$ is characterized as follows: $x^{2.1}_1 = [(x_{11}, x_{12}, ..., x_{1R}, x_{I_{1,1}}), I_{1,1}]$.

The dominant object $x^{2.1}_1$ can have a set of different states $x^{2.1}_{11}, x^{2.1}_{12}, ..., x^{2.1}_{1q}$. And, for external observer, states of dominant 2-nd order object of 1-st type $x^{2.1}_{11}, x^{2.1}_{12}, ..., x^{2.1}_{1q}$. are represented as states of 1-st order object $x^1_{11}, x^1_{12}, ..., x^1_{1q}$. Dominant object represented as 2-nd order object of 1-st type, can have only several certain states, but not all possible, while number of possible states of dominant object represented as 1-st order one is equal to maximum. And, value of parameters of multivariate variable of 1-st order object doesn't depend on each other, that greatly differs from 2-nd order object of 1-st type. Therefore, without loss of information, 2-nd order object of 1-st type $x^{2.1}_1$ can be replaced by 1-st order object x^1_1.

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