UNDERSTANDING OF MULTISIGNIFICANT IMAGES: A DUAL PROCEDURE

D. Shapiro

Institute for computers technology and informatization
113114, 2 Kozhevnichesky per. 4\6, Moscow, Russia.

Abstract

In this paper the problem of formal interpretation of the multisignificant knowledge (Gestalt) is discussed, which is presented by various sensoric channels (video, audio, smell). This knowledge is needed in the dual processing, including both cerebral hemisphere mechanisms: the logical-combinatory and whole images operations. The applications of similar neurointelligence systems for concrete problems of informatization also is contained.

A Gestalt presentation

The multisignificant images are presented by the various sensorical channels and the bearers (printed text, sound text, picture, music play) of information. The dual polysensorical procedures (vision, tactile-movement) are studied by Edelman (1987), Reeke, Sporns, Edelman (1990). Roska (1989) investigates the dual procedure of learning of image by using the digital-analogy "cerebral" procedures. The adequate selection of factors and their combinations allow to facilitate and intensificate the understanding of meaning. The specifics of cerebral asymmetry in the problems of understanding and decision making was investigated by Shapiro, Rotenberg (1988, 1989). The meaning is presented by a concrete form metatext (meaning-text-meaning) (Chernigovskaya, Rotenberg, Shapiro, 1989). The realization of the problem of perception data about world (communication system and medium), their understanding and formation of adeqate result in verbal and operational forms (P-U-F) is based on the dual procedure. By analo-

gy with the "living systems" the logical-combinatory,probability algorithms(left hemisphere and the " whole scope and presentation" of multiconnections of image(right hemisphere) are used(Shapiro, 1991). The understanding is whole estimation of meaning, determination of passed data and formation of the standart and nonstandart association. The personal specifics of understanding is formed in the RH on base the implicite "interior etalon".This principle is used in the behavioral procedures for analysis of sound, visual and smell data. The Gestalt understanding is based on the right hemisphere cerebral principles(RHCP): the multiconnectioness and the "processing of low probability data" (Shapiro,Rotenberg,1988,1989).

A formal interpretation

The data about world are presented by input pattern

$$E = \left[\nabla_i (x_i, f(x_i)) \right]_t ,$$

where

x_i is an element of pattern($i = 1, \ldots, n$), $f_i(\cdot)$ is the interconnections of elements; ∇ is the operator, t is the time. The concrete "content of a pattern" is determined by condition of problem: the understanding of metaphors, understanding of intonational characteristics of speech,understanding of visual images(face),formation of doking of moleculare structures, identification smells etc. The way to understanding of multisignificant images is based on using of multiconnectioness, which has the characteristics of the right hemisphere (RHCP) and the concept "invariants",which show the problem-oriented specifics of multiconnectioness of concrete image. The RH strategy of Gestalt understanding may be realized in the" space of estimation of multiconnectionss" (SEM) indicated by Z, by means of global estimation of features. The procedure of "understanding of Gestalt" is based on the qualitative estimation of multiconnectioness and interpretation of result. The invariants are the base of the isomorphical investigation into concrete types of problems.

An invariant in the problem of understanding of metaphors is the degree likeness of features of element of various problem

regions.

If $X_i (i=1,\dots,n)$ for PR-I and $\mathcal{U}_K (K=1,\dots,K)$ for PR-II, then

$$q(x_i^j) \diamond q(\mathcal{U}_K^{\ell}),$$

where $\diamond$ is the operator (likeness, likeness with weakness, likeness with strengthening, antithesis), $q(\cdot)$ is the estimation (Fig.-1-).

The moleculare structure is characterized by features of surfase (countors) of the base molecule (I) and the local molecules (II, III), conditions for doking ("key-lock") which form the new object with new target properties (I-II, Ic-IIIb, II-Ic-IIIb). (Fig.-2-). The key and lock are determined by the characteristical features: the height (x_1^1) or the depth (x_2^1), the steepness of contours (x_1^2 or x_2^2) etc.

An invariant in the problem of doking of the moleculare structures is the degree of corresponding of charateristical features of various objects ($i=1,\dots,n, j=i,\dots,m, k=1,\dots,K, l=1,\dots,N_\ell$).

$$q(x_i^j) \diamond q(\mathcal{U}_K^{\ell}) \quad \text{for all } i,k \text{ of concrete objects,}$$

where $\diamond$ is the operator of corresponding (strong, light), $q(\ )$ is the estimation.

An invariant in the problem of understanding of intonations of speech are the tone, timbre and rhytm.

In the procedure of the "face understanding" the characteristical features of elements are the nose, ears, eyes, mouth, forehead, wrinkles (x_i^j). The estimations of these features $y_i^j = q(x_i^j)$ are the sets of qualitative terms (big, little, ...,). In the problem of understanding of elements of the "hysteresis of perception" the invariants are the complexity, the asymmetry and the harmony (Shapiro, 1991).

The input pattern in the problems of detecting of smell x_i $(i=1,\dots,n)$ from mixture by means of totality of sensing elements $\Pi_K (k=1,\dots,N_K)$ is presented. These sensing elements possess different and unstable selectivity for different elements of mixture. Let $x_i^K, \dots, x_{i+\zeta}^K$ be signals prosessed by k sensor, $S_i^K, \dots, S_{i+\zeta}^K$ be corresponding values of selectivity (in general $S_i^K \neq S_{i+\zeta}^K$), β_i^K is output signal of the k sensor for the i input (selectivity S_i^K). Then at time t set of outputs for the input pattern E_t is determined by matrices B, found by scanning of the LH. During transient process a temporal superposition of values of B and

elements can be estimated according to multielemental qualitative scales: q_{β} (never, randomly, enough frequently, frequently, always). The membership of values of estimations to concrete element of scale (q^{ϑ}_{φ}) allows to determine the "zone of risks" $<\varphi>$: <min,...,max>. The structure of these zones and interconnections of estimations y^{k}_{i} presents the dynamics of evolution of input pattern and the combination of selectivity of sensor $E_t \rightarrow \bar{B}_t \rightarrow M_t(y^{k}_{i}/\beta)$. (Fig.-3-). The community of sensing elements outputs (by Freeman, 1987, Minor and Vasileyva, 1987) may be presented as a picture. An invariants in this case are the degree of complexity degree of asymmetry and degree of heterogeneity. The invariants are determined by means of parametrs of the "graph of estimatios"

$G=[D(q), L(q)]$, (where D is a set of vertices, L is a set of a edges). $z_{\gamma}=g_{\gamma}(Nd)$, (Nd is a number of active vertices). These estimation of invariants are realised by means of qualitative scales and parallel operations form $q_{\gamma}: z_{\gamma} \rightarrow y_{\gamma}$ (γ= c,a,h). The global estimation of image is Y=(Yc,Ya,Yh). The degree of correspondence the concrete realization with the "interior etalon image" is determined by means of the membership surface, $R_{\mu}M(R) = \bar{\Pi}(Yc, Ya, Yh)$, where R is an image, μ is membership function, $\bar{\Pi}$ is a membership surface which is realized by means of the fuzzy operational logical reasoning and suppositions (Shapiro, 1992a).

Principles of realization of neural networks

The " RH procedures " are realised by means of the model "Chorus" which is based on the principle of the heterogeneous excitable tissue (Shapiro, 1992). It allows to use two aspects: structural-spatial and functional. The spatial presentation of a medium (strip, half-ring, spiral and their combinations) consist of a set of streamlined heterogeneous elements Cr and local groups Δ C. Minimal distance between of elements into group is 1. In the functional aspect the individual and local groups features of elements are determined and their influence on the dynamics characteristics of medium. The sample individual characteristics are: $\bar{Z}_1$ - frequency interval of exciment; $\bar{Z}_2$ - intensity of excitment; $\bar{Z}_3$ - speed of changing of the intensity of sounding;

$\bar{Z}_{\gamma}$ - the degree of belonging of the concrete element to the local group. Every local group is characterized at moment t by $\Delta_t \bar{z} = \odot(\bar{z}_{\alpha})$, where is the operator, which characterizes the structure of interconnections in local group ("one's neighbour on the left, right"; the diverse rays etc).The qualitative scales are used for processing of the multisignificant images q_{ℓ} : $\bar{Z}_{\ell} \rightarrow Y_{\ell}$ $\ell = 1 \ldots, n$. The general features of interconnections of global groups are determined by means of the geometrical (distance between regions) and physical (degree of parallelism with weakness or intensification, interconnections of tones, degree of contradictoriness etc).These interconnections have definite or sporadic nature (Tsetlin,1963). The estimation of general features is determined by $(Y_{G}, Y_{PH}, \Delta Y, T)$, where: $Y(\cdot)$ is estimation of geometrical, physical and structural features which are determined by means of qualitative scales. T is the time of functions.The dimensionality and structure of concrete model realization are determined by the requirements of a concrete problem.

This way was realised in the system "Image ", which presents the "block-functional" structure. In the block "Preprocessor" the characteristical features of the concrete type of elements are detected. The "LH-blocks" realizes in the correspondence with the specifics concrete tasks and functions : scanning, superposition, discovery of elements and its features,and also their estimations. The "RH-functions" are realised by means of the macroblocs "Formation of invariants"and"Global estimation".The collective decision-making is formated in the macroblock "Interpretation".

Applications

The system "IMAGE" is applicated to the personal(PIP) and a regional problems of informatization (RIP). The PIP includes the following aspects:the recieving of business information and forming of reaction in corresponding forms;the "computers secretary" which understands the intonational characteristics of speech; the intellection sensoric prosthetics; the systems of iridodia-

gnosis;the systems of analysis of genetic and molecular(doking) structures;the computers systems for the art editors and directors(producer);the simulation of psyhophisical and behavioral phenomena;the systems of image knowledge learning(for humanities and natural sciences).The RIP includes the following aspects: the image knowledge learning with socio-cultural and traditional specifics of regions(peoples of Nord);the identification of characteristics of complex medium and their elements for using in regional ecological conditions- the features of smell composition and color; the remote systems of medical monitoring for the complex regional conditions etc.

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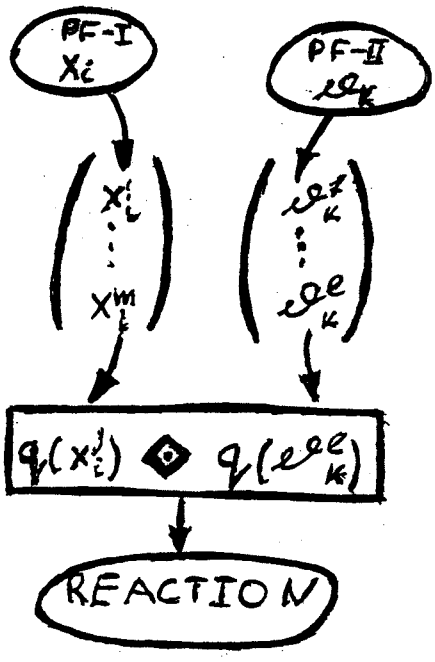

Fig. 1 The formation of metaphors

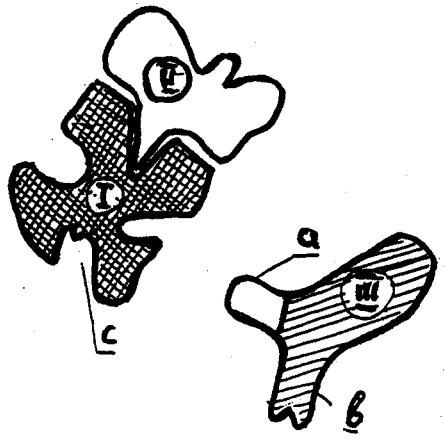

Fig. 2 The formation of moleculare structures.
I- The base molecule.
II,III- The local molecules
a- The "false kay".
b- The "Operating kay".
C- The lock.

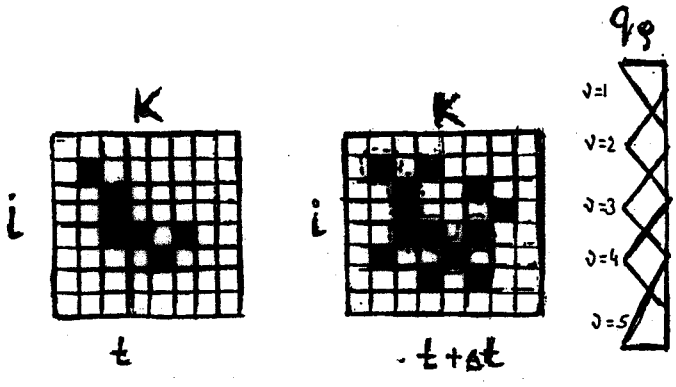

Fig.-3- Temporal superposition of signal's values