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THE NEURAL SCHEME OF AN ELECTRONIC COMPOSER

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Abstrakt. *The neural scheme of structure, capable for creating voice series for influences on the object of control – human brain – has been offered.*

Key words: electronic composer, neural network, neural scheme, random process.

Introduction. The development of science leads us to a new challenge: artificial intelligence (AI) and neural network (NN) – inspired technology, that is capable of creating new virtual products, new virtual multitasking routines and even new virtual ways of thinking. One of such approaches means AI music composing, that is still a total fata morgana today.

Academician V. M. Glushkov more than forty years ago commenced the new ways to improving systems' characteristics based on AI programs [1]. But a lack of true followers shelved the great possibilities opened to late-bloomers. They [2 – 3] try to establish the fresh connections between the era of AI-beginners and modern fusion-styled scientific cooking of object-oriented programming www-blessed followers. Building a powerful shrewd conforming routine (based in our case on [4]) able for clever classical music composing should be a rich grant for any open-minded wisher in this area.

The neural scheme. Here we shall try to put our own brick to a wall of AI-supported programming classical music writing robot.

Fig. 1 shows a generalized view of the neural scheme. In this scheme the weight coefficients circuit hasn't been depicted yet. It's been opened up in fig. 2.

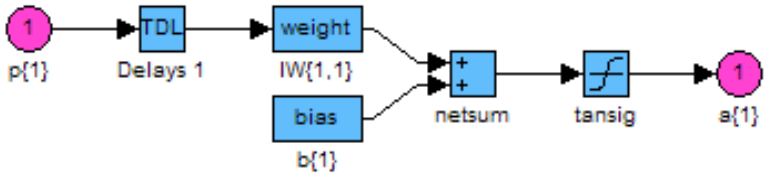

Fig. 1. The neural scheme

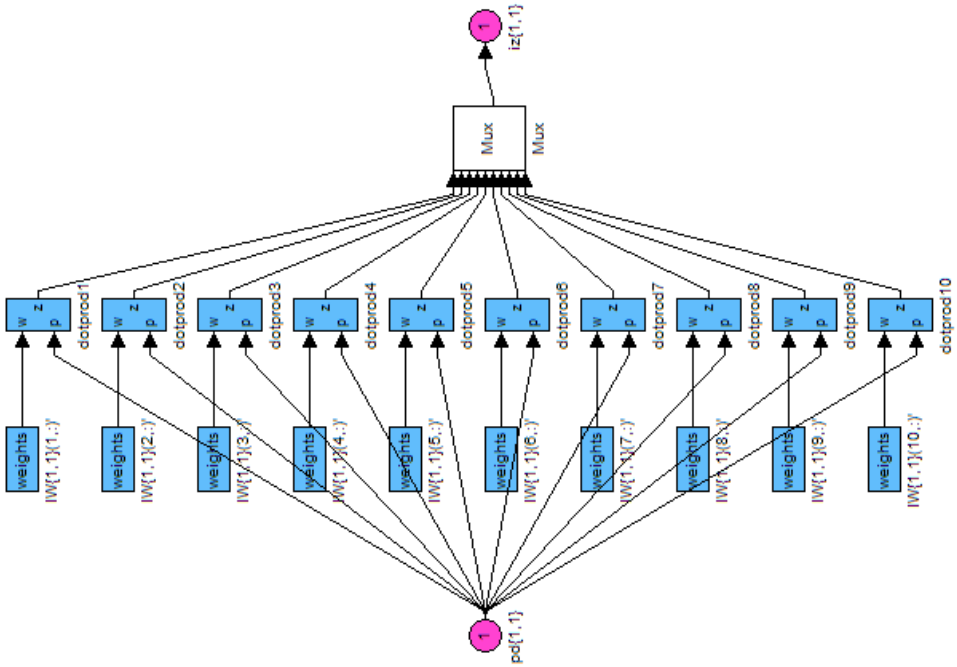

Fig. 2. The weight coefficients circuit

Here it has been revealed the inner philosophy of two random processes routing, of which the first being vector $p[i]$ (our initial signal, coming from the output of GCS – generator of control signals), when the second being $w[i]$ (vector of the weight coefficients.)

Fig. 3 gives the practical realization algorithm for 7-notes-chord parallel processing. Here "x" stands for multiplier, "$\sum$" for adder and "►" arrow sign for a transfer function.

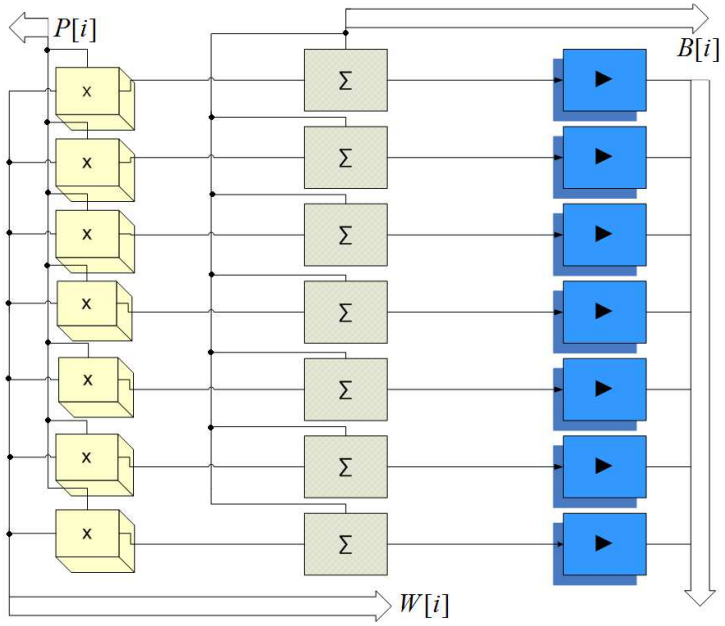

Fig. 3. Neural network architecture for 7-notes parallel processing (7-notes chord)

$P[i]$ stands for input vector, $W[i]$ – for weight coefficients vector and $B[i]$ for bias vector if used any.

On the other hand, fig.4 represents the possibility of use the 7-neuron NN as one complex 7-input neuron in a matrix scheme, combined of such neurons. The number of neurons Ni, j in it should be defined from practical needs for musical information being processed.

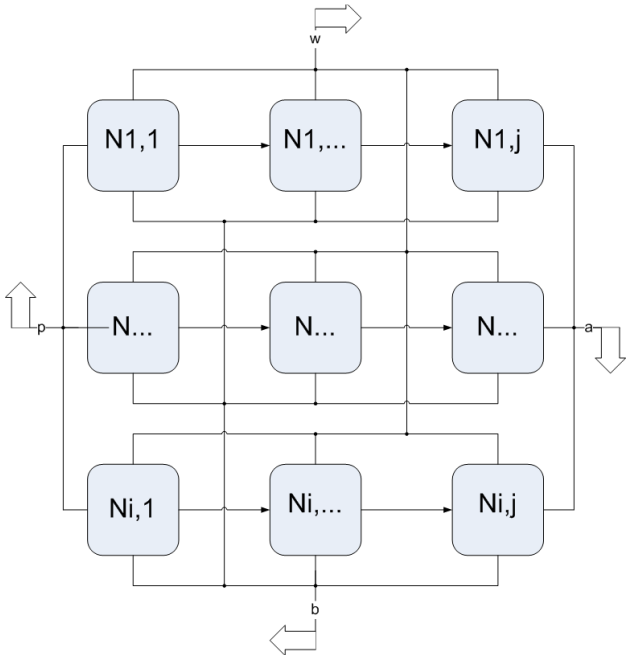

Fig. 4. A "complex" neuron consisting of a number of initial 7-neuroned NN

The music composed can be correlated to a number of initial musical sources, giving, for example a fusion of Bach, Mozart and Eugeny Stankovich or autocorrelated resulting in "shifted" melodies, tempos, harmonies.

Or, the process of music composing can be seen from the point of independent *N* algorithms realizations leading to “mixing up” their musical text under a certain governing routine applying specific weights and biases and in such a way organizing “collective work” of virtual composers 1, 2, …, *N*.

Of course, fig. 4 can be deemed as a complex neuron, too. One can then use a NN combined form those neurons, and so on.

Choice of transfer functions, used in NN, can significantly impact the quality of musical text being produced by the virtual composer. Besides, transfer functions can “breathe” under a control of special routine, molding their response. Interesting results gives using a transfer function based on fractional derivatives equation solution [5].

A general matrix equation connecting input (**P**), weights (**W**) and output (**A**) is showed below. It works for any NN-structure possible (it’s given without taking into account biases vector **B**).

$$\begin{vmatrix} w_{1,1} & w_{1,\dots} & w_{1,i} \\ w\dots & w\dots & w\dots \\ w_{1,j} & w_{\dots,j} & w_{i,j} \end{vmatrix} \bullet \begin{vmatrix} P_1 \\ P\dots \\ P_j \end{vmatrix} = \begin{vmatrix} A_1 \\ A\dots \\ A_{i,j} \end{vmatrix}$$

Finally, fig. 5 represents the inner structure of original AI&NN-based application “AQUARIUS” ©:

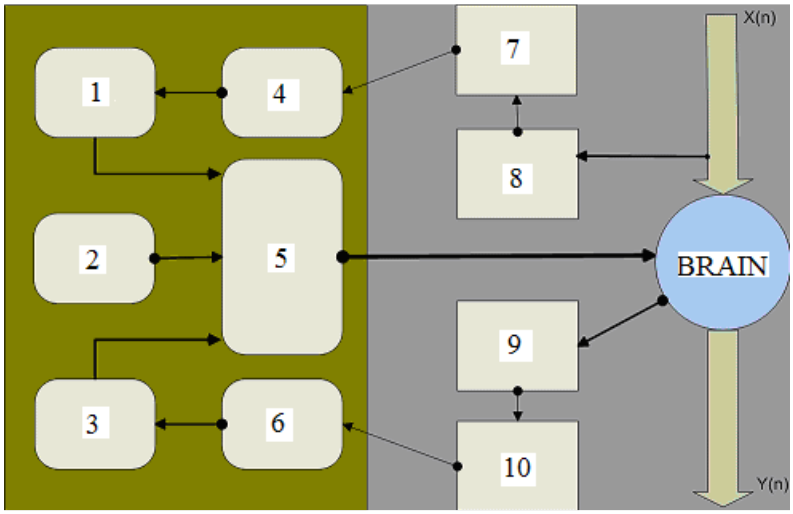

Fig. 5. Structural scheme of „*AQUARIUS*” ©

Here:

1) The block of operating actions BOA (the subblock of a translation operator, the subblock of transfer function).

2) The sensor of a medium condition (SMC). The given block is the recipient and the analyzer of an entering signal which generally can be both digital, and analogue.

3) The sensor of an object condition (SOC studies the influence by ACS on object of control – a brain of the patient.

4) Digital-to-analogue converter (DAC) it is necessary for transformation of analogue initial signals into the digital ones. In case of a digital initial signal this block is a subject to elimination.

5) The module of estimation of the object condition (MEOC) treats the digital signal received from SOC and supplements a database of the object condition.

6) The module of estimation of the medium condition (MEMC) treats the digital signal received from SOM and supplements a database of a medium condition.

7,8) The database of medium condition (DMC) and a database of the object condition (DOC) are necessary for regulation of BOA signal.

9) The database of control algorithms (DCA) stores a population of translation operators which is used by BOA at synthesis of audio series.

10) Control object (CO) in our case is the brain of a person using the software developed.

Conclusion. The neural scheme of an electronic composer has been given in this paper. This neural scheme should be translated into a PC program or subroutine, that will help to develop virtual music creating software [6]. It is a feedforward NN that can be realized both in one- or multilayered versions. The number of hidden layers depends on a musical task given. A lack of feedbacks and target vectors leads to a very quick "on-line" processing mode, that allows to compose large musical texts in the twinkling of an eye. This helpful instrument can significantly reduce monotonous, routine, drudgery work when creating musical texts of a steady emotive temper.

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О. В. Вишнівський

Нейронна схема електронного композитора

Запропоновано нейронну схему структури, яка здатна синтезувати звуковий ряд для впливів на об'єкт управління – головний мозок людини.

А. В. Вишневский

Нейронная схема электронного композитора

Предложена нейронная схема структуры, способной синтезировать звуковой ряд для влияний на объект управления – головной мозг человека.