An Analog Simulation of the Human Neural System

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Abstract

The object of this study was to create an elementary electronic circuit which can produce signals that are similar to those produced by intracellular and extra-cellular circuits, a hardware that works autonomously with no need of an external software because it self-creates it. In this paper I describe an artificial, and/or bionic, neural structure formed by the simulation of modular similar analog electronic elements for generating and/or re-establishing correct communication between components of a biological structure, in particular a nervous System. I present a series of data, which derive from a simulation of what becomes a very simple electronic and informational elementary circuit. This circuit is extrapolated from many other circuits which are supported by a universal model and, working together, give coherent answers and are able to help or replace a neuron or a group of neurons. The simulated structure includes a plurality of modular electronic devices interconnected together to form at least one pair of meshes and is able to generate analog electrical signals of various waveforms and various electric powers.

I have so realized an simulator System as a quasi-Boolean net, but functional only, because the omni-directional reaction to an operative, at a perturbation level action, gives origin to different functionalities in a similar structure, which exists in a non-digital way, or, it might be better to say, which lives in an analog quasi-digital way, with molecular code and decode factors, to which, at present, I approximate in an quasi-complete way. I have obtained an almost perfect correlation between those signals that are generated in nature and those that we have artificially produced. I have demonstrated that, to build a real and working artificial intelligence, or a detail of it, we must preliminarily plan an "opposite-engineering" System that, starting from the biological and not "vice/versa", can, in the meantime, define the *"how"*, hoping it becomes even the *"why"*. The fundamentals ideas that lead to the new electro-informatics model construction are examined either from a theoretical point of view (that is the basis for my researches and which describes the production and the direction bus of the informative signals) and from the point of view of the structure realization.

Keywords (in alphabetical order)

Automata; Chaos; Complexity; Cyborg; Models; Neurons; Robotics; Systems; Uncertainty.

Introduction

The object of this study is concerning the simulation of an elementary electronic circuit which can produce signals that are similar to the intracellular and extra-cellular.

I simulate a new type of neural transmission model that considers every single neuron as the receiver of $\boldsymbol{n}$ *signals* and as the generator (in answer) of $\boldsymbol{n^k}$ *signals* (with

n and **k** natural numbers), partly (½) in traditional Logic (with Bit) and partly (½) in Fuzzy Logic [with **Fit** (*F by Fuzzy*)][1] (see also *Fig.* ***12***).

The results, obtained in the course of several experiments of computerized circuit simulations, are comparable to those produced by neural circuits. Basing on these results I think that we can create bionic (artificial) cells which can functionally act like stem, glial, or other kinds of biologic cells (*Fig.s* ***1, 2, 3***).

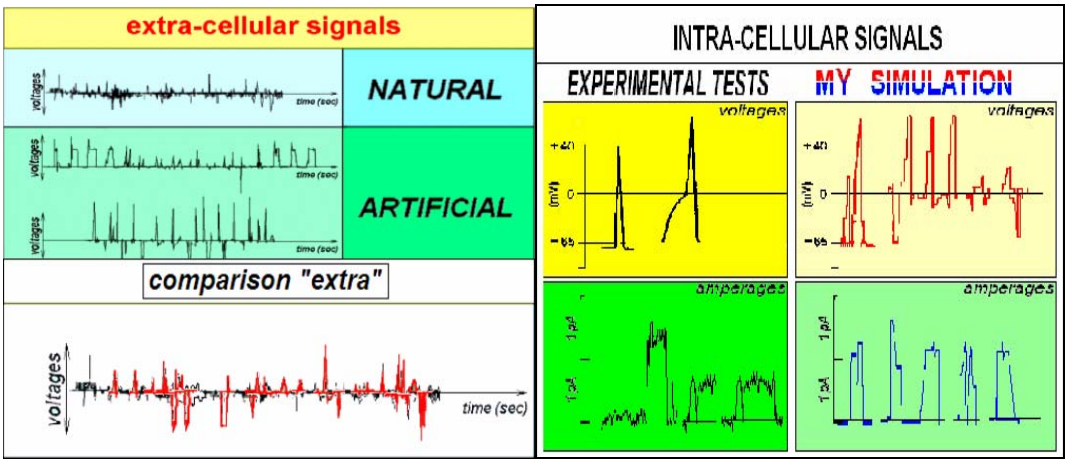


Fig. ***1***

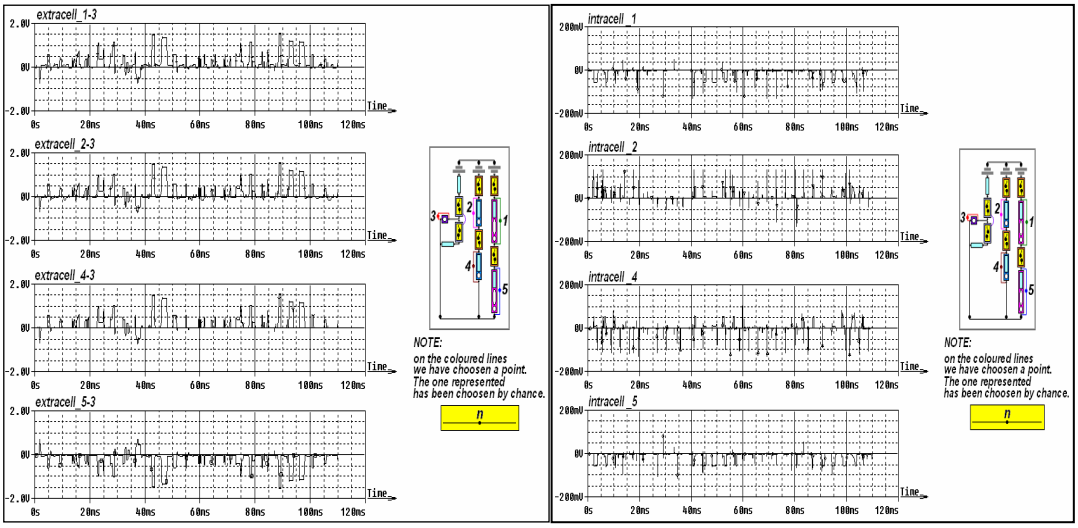
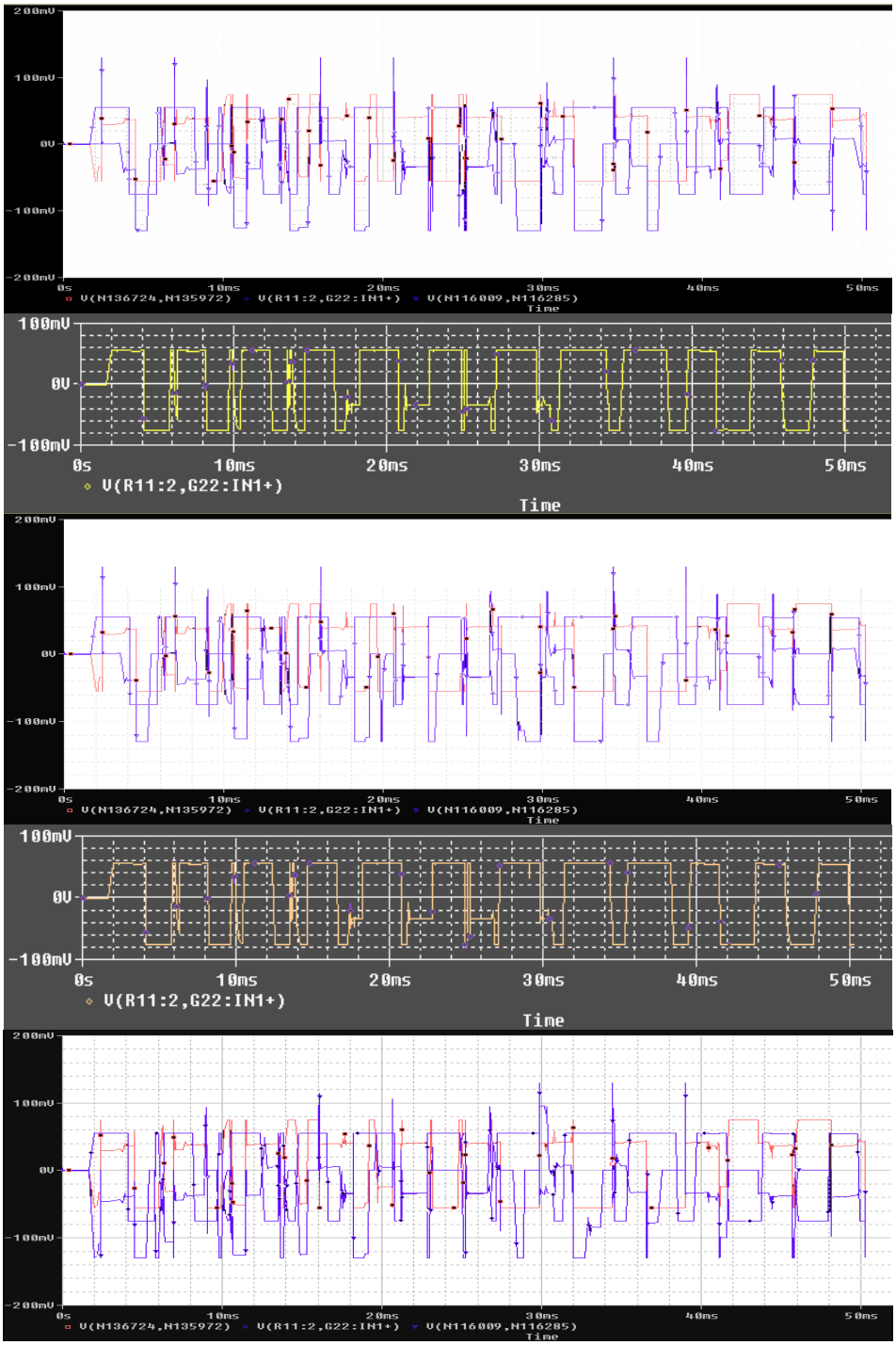
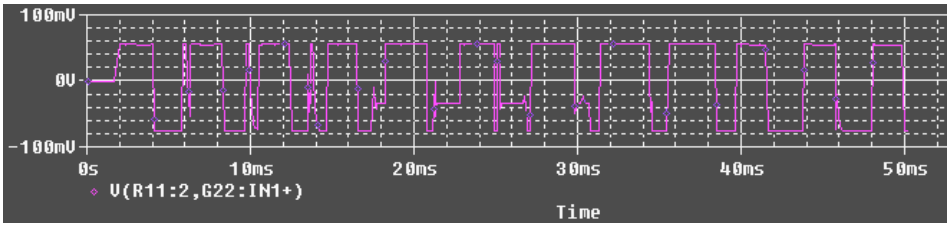


Fig. ***2***


200mV
100mV
0V
-100mV
-200mV
0s
10ms
20ms
30ms
40ms
50ms
V(N136724,N135972)
V(R11:2,G22:IN1+)
V(N116009,N116285)
Time



In each of the tree images, the upper part shows the whole signal produced, the lower part the behaviour of one of the components. The six images (two by two) are at an increasing Hz. (see the detail in Fig. ***6*** *and the connected note)*

Fig. ***3***

I so obtain a fusion between Neurosciences and Robotics that lead to ***C****yber****N****euro****P****hysiology*[2] and from this to *Bio****n****ethics*[3].

With an extremely simplified description of a single form-circuit of a single circuit model, I configure the theoretic bases which are, at the moment, the most completely possibly configured.

With this form-circuit I analogly simulate single parts of a neural system mainly in function of two conjectures that consent me to show how the signals distribution inside the brain and along the distributive canals (in and/or out) of a human body works:

1. first conjecture: the myelinic sheath, with its nodes, pumps and canals, get constant the energetic balance due to external stresses, transforming the neuron (considered as a flux tube) from a dissipative temporarily system (an so temporarily informative) to a non temporarily dissipative (and so non temporarily informative);
2. second conjecture: the single neurons nucleus recognizes the nature and the intensity of the internal and/or external informative stresses, and acts as a screening for the of the same stresses addressing along the following paths.

At the beginning of my researches I had several different points to verify:

1. if it is possible that a trajectory is transformed in a distribution function;
2. if the operator, necessarily to introduce in this case, is the analogous complex of an Hamiltonian;
3. in which cases the thermodynamic equilibrium laws remain invariant and on the contrary in which one they are "varying";
4. which are this variance parameters;
5. after how much time we are in a position to estimate eventual differences;
6. if the physical usual simbology for the binary notations introduction can be abandoned;
7. if these notations would be valid for Biochemistry translated on the pure biological plan, in which also the rules of the uncertainty are valid;
8. if we can work in analogy with the symbolic Logic positions, transforming

the physical laws in a kind of tables of truth which include the indetermination;

9. if a traditional Logic is coherent with the (either symmetrical or above all antimetric, as in the case of life) truth;
10. if a scientific demonstration proves the physical truth.

With the simulations I give a plain or at least partial answer to some of these points. The *human* System is an autopoietic highly complex System and it concretizes only one of the potentialities offered by the different relations.

Probably it partially activates them serially, i.e. modifying itself temporarily in parallel. It is a System whose study needs three epistemological connotations: an absolute time doesn't exist, an absolute space doesn't exist nor an absolute centre which can be the *source* (that irradiates) or the *sink* (that absorbs).

A System in which everything is interconnected, interrelated, depending from (i.e. perturbed), and influential (perturbing) on. A System rich in several different complex and chaotic subsystems. It is the System of life that continuously *moves towards* and *into* the chaos just to order it.

The future consists of probabilities and only the present choice carry out a specific one and the scenario is purely dynamic. In this myriad of opportunities and solutions, Chaos is no more that a dynamic equilibriums sequences summation. When a System lacks of balance, tends to get a new configuration at a different energetic values. We can notice this in self-regulating "biological" Systems. An organism is a self-regulating System.

It has a feed-back control System al least of the second order. In my researches I assume the human body has a geometric structure with the same morphology of the universe. And other[4].

The communicative biological signals move inside it essentially like the photons outside. We know for example that the intersynaptic exchange occurs through matter, energy and information.

My neurons set neither can create matter nor can receive or transmit it, and so it by-passes this type of exchange, it is planned for immediate informations and energy clutching just before the source of the transmitter-neuron and for giving informations just after the reception-sink of the receiver-neuron.

Biologically the neuron, whose axon works in an analogous way to the a Collider's LINAC (*Fig.* ***4***),

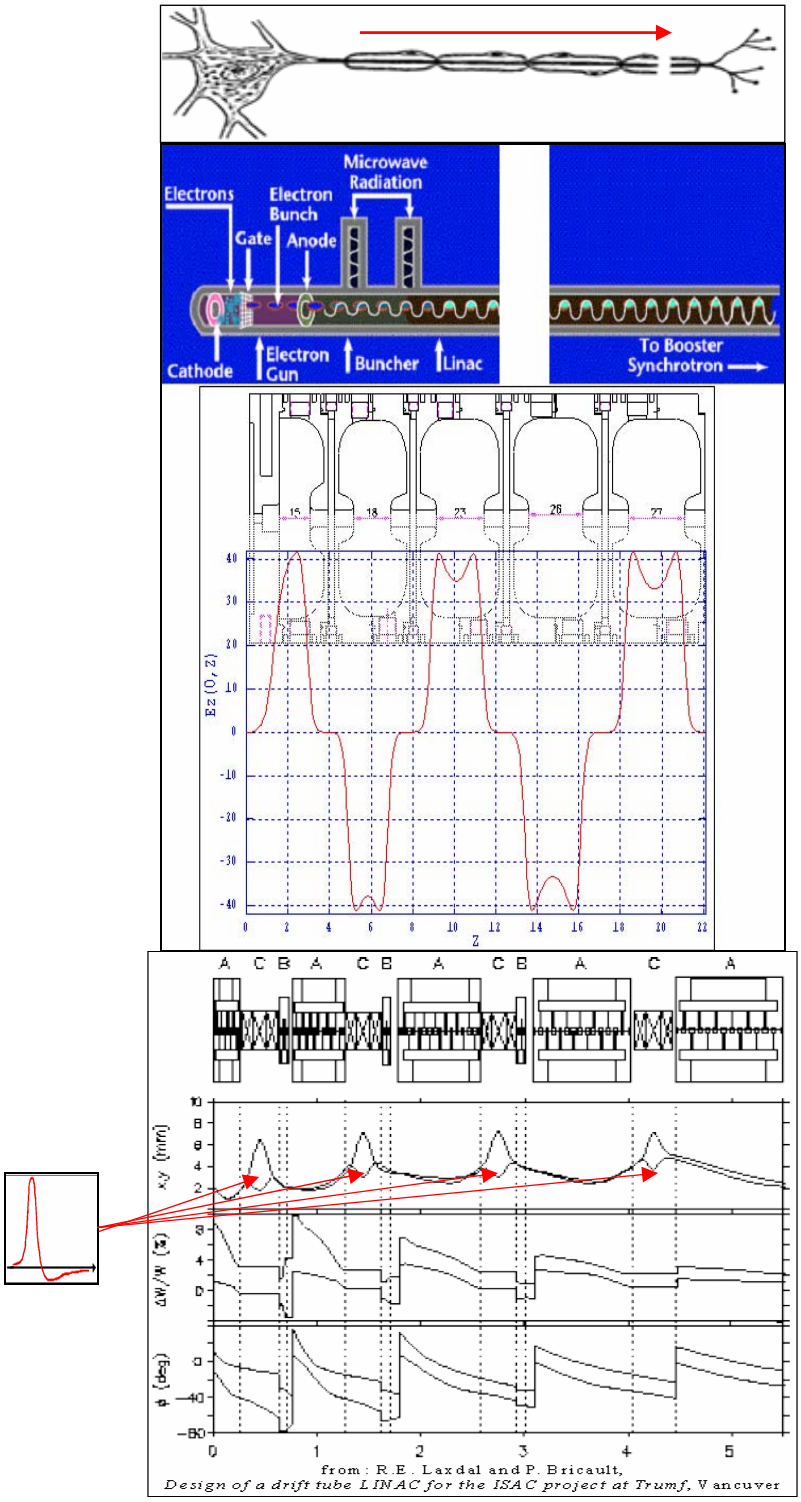


*Fig. **4***

is characterized by an enormous surface in order to facilitate the exchanges.

Artificially this can be realized only increasing the number of probes in reception or in transmission, articulating their mutual relationships and the most possible facilitating the coding. I planned Cards that completely simulate the different types of circuit (from the divergent to the convergent, from the recurrent to the parallel). They can also be connected with other similar Cards, forming regular polygonal groupings (from **3** till **8** sides) which can be linearly, planarly and spatially combined.

There is a remarkable coincidence with the real situation if we consider the paths that link the nervous centres.

We can't yet transform the different neuron-states (which are still increasing and the more and more specific) in psycho-states.

That is why we aren't able to generating, as an example, the conscience. I have only obtained the possibility to create an inter-connectible hardware with similar elements, *that works without any software introduced from the outside but that is self-controlling and self organizing.* In this paper, the physical objects, like the biological ones, are substituted in the simulation with other physical (specifically artificial) devices.

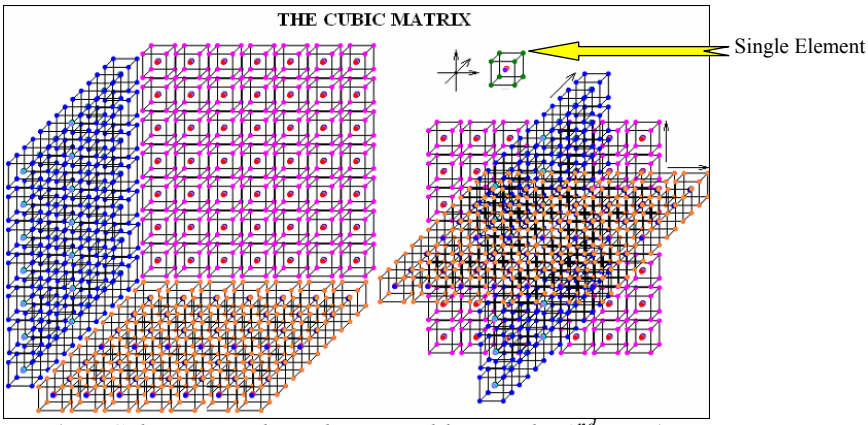
In order to structure the device simulation I have initially verified that the bionic approach couldn't be only digital just because nothing exists of similar or analogous in nature[5], and I choosed the analog approach in order to obtain a similar-biological device that could be the most possible compatible with what exists in nature: a biomedical analog-digital device communicating with the existent.

The first problem was to find a transmission model that was adaptable to my approach.

The Hopfield model, that is efficient in the digital part, needs modifications and adaptations for a chip with more pertinent biological characteristics (and therefore exclusively analog or similar-analog) which can communicate with the physical part.

So I had to modify this model, having to consider the inertia in transmission and in receiving.

In order to simulate a human intelligence I had also to structure a new Math, permitting to resolve Systems of Systems of equations. I called it "Cubic Matrix Algebra" and it is a fundamental tool for the realization and the functioning of the circuits I simulated (*Fig.* ***5***).



(see Cyberneurophysiology – Bibliography 2nd Part)

Fig. ***5*** (see also *Figs.* ***6, 13***)

Work's Hypotheses (that are simplified for this paper) and Conditions

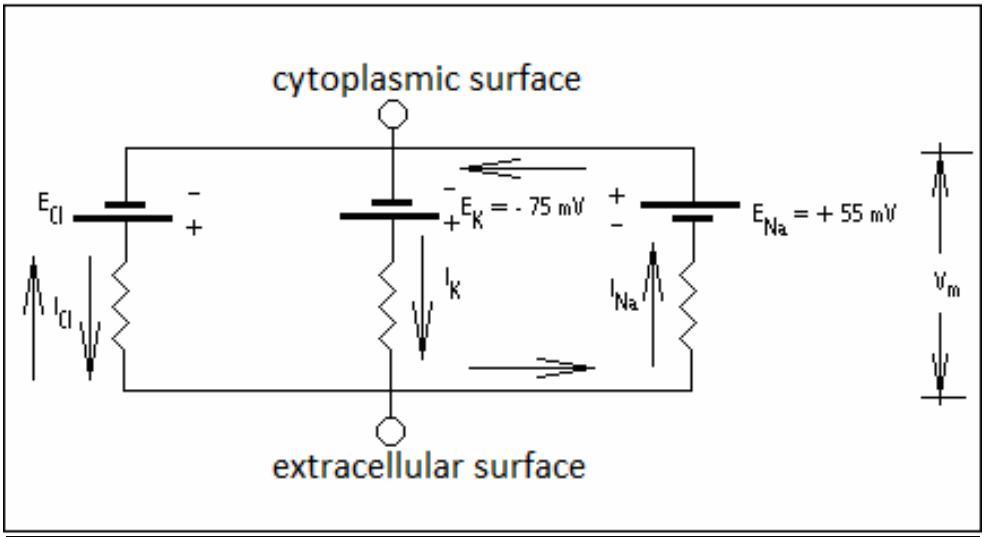
From the point of view of the structure, the fundamental ideas that lead to this new electro-informatics model are:

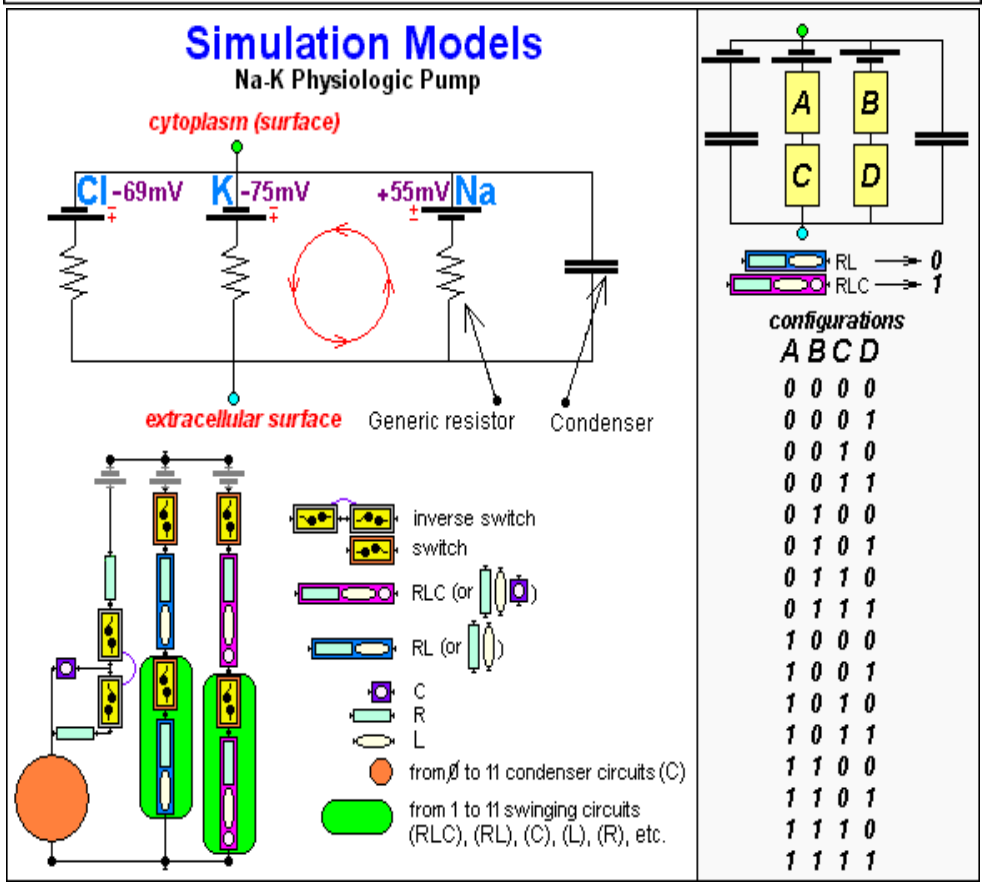
1. the artificial neural structure is composed by interconnected modular parts;
2. the neural System can be represented by a composite graph in which the *paths* are constituted by neurons and the *nodes* are constituted by the contact synaptic points among the same neurons, or by astrocities (as intermediate);
    - The graph will have as many arcs as the reticule elements (atoms).
    - The $\mathbf{p_1,...,p_n}$ arcs will form a circuit (that will be defined dependent) if, and only if, the $\mathbf{p_1,...,p_n}$ atoms in the reticule will be correspond to the same element;
    - The trees which are extractible from the graph corresponding to the three-dimensional reticule L, will have all the x_{ji} side if, in the geometry corresponding to L, whatever points base, which generate it, will contain $\mathbf{x_{ji}}$
    - The trees, extractible from the graph, correspond to the matroid bases: a tree will have the arcs $\mathbf{x_{1(ij)},...,x_{p(ij)}}$ if $\mathbf{x_{1(ij)},...,x_{p(ij)}}$ are one of the sub-sets of the graph arcs that result to be chiefly independent.
3. the algebraic structures associated to the neural sub-sets are Non-Abelian Groups.
4. each interconnected modular part is composed of clusters of oscillators with variable resistance, inductance and capacities characteristics, settled among them in under-sets, ordered with permutation, disposition, and combination criteria;
5. each interconnected modular part is formed by a variable number of sets of plates of which there is just one with central link characteristics and at least another one working in non-Aristotelian Logic and/or at least another one working in Aristotelian Logic;

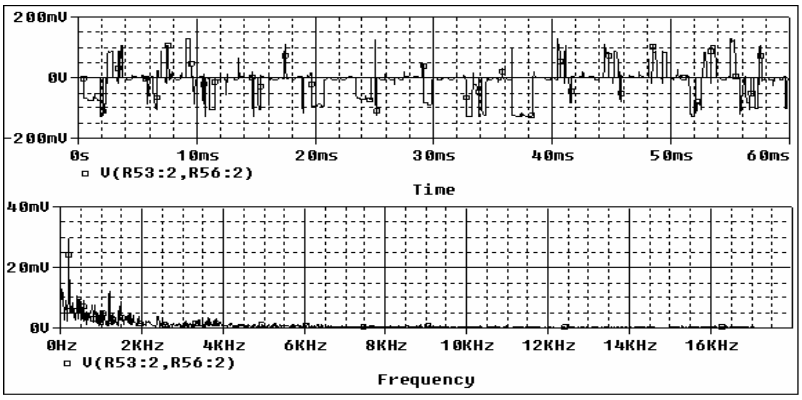
6. every plate is composed of an optimized number of oscillators (with appendages) which transmit with several different wave forms;
7. each oscillator works in a field of intensity current, of potential difference, of wave form (sin., trian., squa.), of frequency (with an approximation to the third decimal), of intensity and of (continuous or discontinuous) signal typology, in a receiving conditions dependent way;
8. each oscillator behaves as an autonomous component of a neural simulation net that is assumed as a dynamic interface either towards a natural neuron or a single set, and/or several natural neuron sets, and establishes reciprocity and reversibility relationships in resonance;
9. each, working at a quantic level, oscillator transmits informative bits in function of the quanta' numbers (the informative energy of **1 bit** *is equivalent to energy* of **2 quanta**). The natural neurotransmitters are artificially replaced by the associated generic energetic forms. As in the natural model, in the artificial one the through a chaotic nutation cone information transfer is selectively absorbed by receptors which have the same frequency of the various understratums transmitters: the transferring and the receiving take place in iso-frequency; that is it exists just an only receiving point towards which the neurotransmitter, emitted by the transmitter, will be directed;
10. any artificial neuron acts, in its completeness, *simultaneously* interpreting both the cerebral lobes influences (a kind of a quantic non-locality);
11. the bottom noise determines the inertia to the answer and masks the synchronicity. Every oscillators combination, or permutation or disposition outflows, are disguised as radiation, information in iso-frequency: the emission takes place in a similar-digital form on an analog carrying wave;
12. for every plate the feed-back is studied and simulated also by a virtual *"Petri's Nets"* and the serial and the parallel ones are simulated also by a virtual *"Markov's Chain"*; we know that we are dealing with exclusively analog signals which respect their being digital only for the fact that they are present or absent. In order to respect this pseudo-digitalism, switches are plugged inside the artificial circuits; they give the emission cadence restoring or changing the immediately preceding conditions: in such a way they contribute to the formation of several serial and/or parallel kinds of feed-backs, emphasizing or decreasing the number of virtual "Petri's Nets" and of virtual "Markov's chains", which have origin: and this happens with repeatable Logical sequences;
13. the natural neurotransmitters are artificially replaced by the associated generic energy forms.
14. for each plate the oscillators set is structured in a **Na-K** pump (and **Cl**) simulation;

I now describe the simulation of a model of a circuit that emulates the Na-K (Sodium-Potassium) pump which derives from a new model of neural transmission which is based on the essential difference between telecommunication and bio-

communication: i.e. telecommunication is rigid and aseptic and bio-communication has also [bio]inertia, either in transmission and in reception. (*Fig.* ***6***)



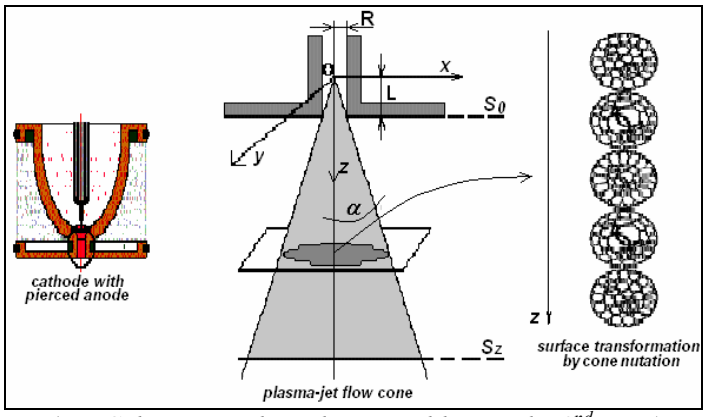




The Pump and results of the first experiment

Fig. ***6***[6]

I consider also the hypothesis that whatever neuron behaves in analogous and not identical way in reception and in transmission, it is subdivided into decomposable more and more specialized parts and, moreover, it transmits and receives with lags only on iso-frequency trajectories, in *cones* of flux or fluid, which have the characteristics of an ionized gas. (*Fig.* ***7***)



(see Cyberneurophysiology – Bibliography 2nd Part)

Fig. ***7*** (see also *Fig.* ***11***)

I also believe that in any bionic synapse, messengers *in* and *from* any possible direction, can be transmitted and received, and also that a specific kind of messenger is accepted by only one particular kind of receptor, or forwarded only by a particular kind of transmitter. Specifically, the receptor will have to utilize the same frequency of the transmitter. To emulate this structure, I am convinced that:

1. lags are done by inductance;
2. switches give transient conditions and produce opening and closing extra-currents, creating or interrupting the electric flux either in the mash simulating the **Na-K** pump and in the branch simulating the **Cl** (Chlorine) one;

3. charge and discharge condensers (in the **Cl** branch) determine the threshold signals;
4. signals, that are only analog, have to be compounded and modulated, to create a steples caring wave.

It is functional to use a switched input oscillator, that here becomes the cybernetic equivalent of the tout court Logic, but changing it from an a-temporal to a temporal Logic. It can so effect the transition and connections between objects (in this case: neurotransmitters), constructing, for example, the directions for the interconnections among elements which become interdependent.

I have considered coherent the possibility to simulate at least three types of circuit elements that, taken together as a Systemic set, can give us **36** possibilities (some are repeated) for the construction of **27** different **Na-K** pumps. Each of these **27** different combinations of electronic base components can be considered as an **ATPase** mechanism simulation.

I simulated, projected, and partially realized a final base-structure (from **80** to **960** Cards in **27** different configurations, with different combinations, in double **7**-values Logic and everyone of them subdivided into **40** strata), that, if only partially active, with a field of imposed suitable frequencies (with ad-hoc analog and non-digital devices that aren't here described), conveniently combined and permutated among them in its whole, can give at least over $\mathbf{10^{45}}^{(\text{minimum})}$ interconnections, at various frequencies and wave-forms.

All these interconnections, modulated, half in Aristotelian Logic, half in Fuzzy Logic, simulate the left and right lobes of the brain.

For one single complete element of this structure, I have obtained the theoretical simulation of at least over $\mathbf{10^{52}}^{(\text{minimum})}$ messengers, with **m**olecular **w**eight **u**nits (**m.w.u.**) between $\mathbf{10^2}$ and $\mathbf{10^3}$, which give at least over $\mathbf{10^{57}}^{(\text{minimum})}$ informative signals.

For the structure I make use of a three values Logic that, for an eventual further formation of tissues of bionic elements, will increase al least to seven. This seems to be an ideal situation for a correct planning, because, if it is impossible to create bio-logic messengers, they can anyhow be replaced by their energy forms, which are transmitted or received through microprobes.

Moreover, considering the automatic energy transfer, I can deduce that it is possible to by-pass, exalt or eliminate the activation or inhibitory mechanisms, such as the monoamine oxidase (MAO).

I have so made an emulator System as a quasi-Boolean net, but functional only, because the *omni-directional* reaction to an operative, at a perturbation level, action, gives origin to different functionalities in a similar structure, which exists in a non-digital way, or, it might be better to say, which lives in an analog quasi-digital way, with molecular code and decode factors, to which, at present, I approximate in a non quite complete way.

Basing on theorical calculus, each oscillator, in series of stratums, originates energy and frequency forms for the neurotransmitter simulation.

So we obtain: for each neurotransmitter a quantum cloud equal to **3x10^5** quanta, i.e. an informative unit cloud equal to **1,5x10^5**; to each **m.w.u**. **10^2** messenger, an association of at least **3** virtual masses, identical among them and to the real mass; and to each **m.w.u. 10^3** messenger, an association of at least **30** virtual masses, that are identical among them and to the real mass.

All this happens either in reception or in transmission distances to the maximum of **500** times the Böhr ray, in closeness of length to a Debye wave, and with frequencies up to a thousand times smaller than the Larmor electronic frequency.

I simulated a series of prototypes, and in all models, the essential work is in accordance with these assumptions:

- we have the configuration of balance for the **Na-K** pump;
- we can insert in it switches and replace the generic resistances with appropriate resistors, which run in fixed frequency-fields;
- opening and closing the circuits, we can create the conditions of disequilibrium, that give different productions of currents, which, each in turn, generates various signals in transmission.

In this paper I just show a model reduction (the basic, simplified prototype of the 21 I simulated for a total of 36 releases) as exposed in *Figs.* ***8,9,10*** that let me obtain the results you can see in *Figs.* ***2,3***.

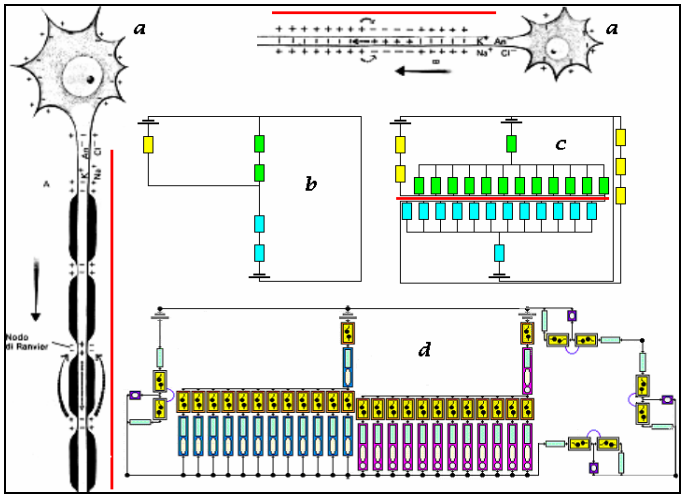


Fig. ***8***

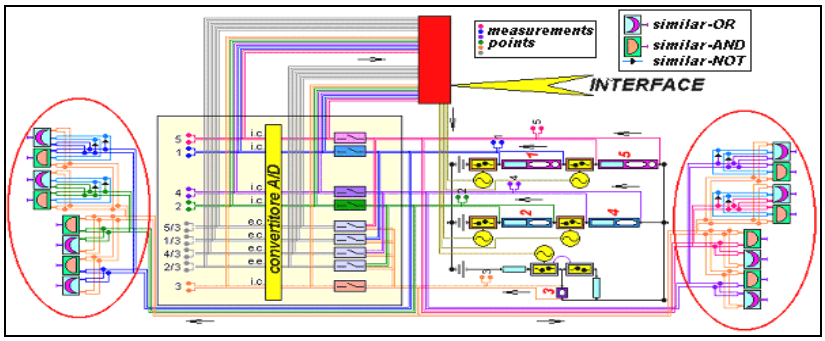
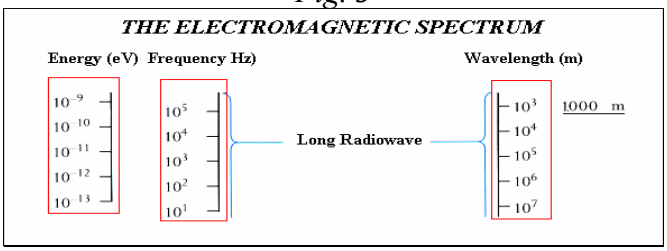


*Fig. **9***



Test (Hz) intervals for the switches

*Fig. **10***

The various signals must then be put together, placed, enlarged and transmitted.

In this very *simplified* prototype model (which consists of a single sub-stratum among **80** (40+40) sub-strata, that at its turn becomes a single element of an hexagonal group, and this single element has **5** signals instead of **27),** I have obtained an almost perfect correlation between the signals that are generated in nature and those that I have artificially produced.

Analyzing the data, I have noticed that equal signals obtained among the signals generated in nature and those that I have artificially produced can be compared, either for values and for development, to the pre and post-synaptic ones (from **-65** mV, **-75** mV to **+55** mV, volt agent, and inferior to **2** pA currents). In fact, the presented bionic simulated structure proves to be analogous to a set of staminal cells, and more-over, with the opportune modifications of the resistance elements, it is even analogous to a set of glial cells.

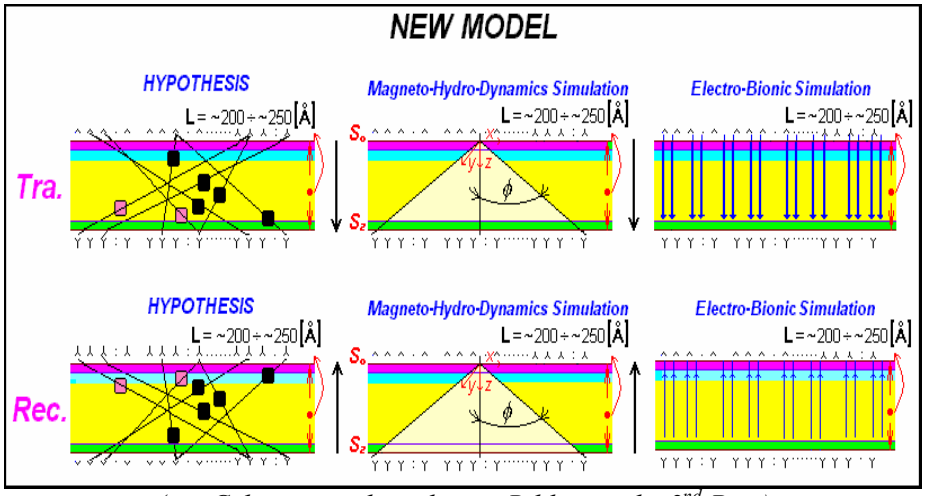
I can demonstrate that, at present, I am able to:

- build signals similar to physiological ones;
- have a bionic dialogue;
- build "3D" structures, ever more and more complicated.

I can also demonstrate that, in order to build a real and working artificial intelligence, or a specific or a particular part of it, I have preliminarily to plan an "opposite-engineering" System that, starting from the biological (and non "vice/versa"), can contemporarily define the "how", hoping it becomes also the "why". So if we want to insert communicative-informative probes (in receiving and in transmission) which can work, for now, in relatively small spaces and, also, in the

inter-synaptic spaces, we just have a suitable (mathematical-informatics-electronic) System emulating the cerebral structure or a cerebral under-structure, or simply a neural or a cellular structure.

In this new analog transmission model the neurotransmitters flow, in transmission and in receiving, in the same as the plasma-jet flow cone and their trajectories are produced in iso-frequencies. (*Fig.* ***11***)



(see Cyberneurophysiology – Bibliography 2nd Part)

Fig. ***11*** (see *Fig.* ***7***)

From the theoretical point of view (that is the basis for my researches which describe the production and the direction bus of the informative signals):

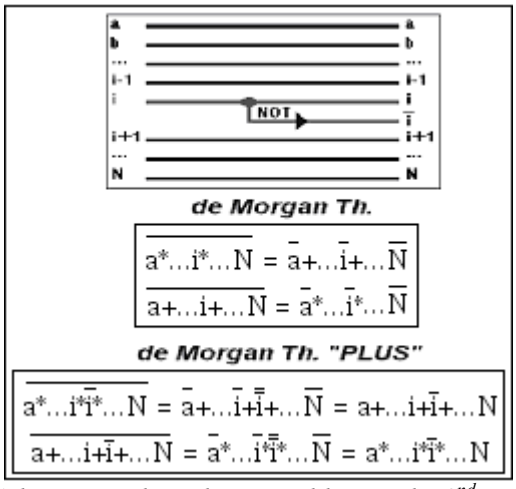
1. the new transmission neural model characteristics are:
   - the time and the neural activity are non-continuous;
   - the set of **2n** neurons is subdivided into two subsets: **n** transmission (**j** neuron), **n** reception (**m** neuron). Both neurons subsets are connected among them by unidirectional reticule connections;
   - following my Hopfield modified model, to each neuron a variable $\sigma_j = +1$ is assigned if the neuron (of subset **j**) is active (in transmission) and $\varepsilon_m = +1$ if the neuron (of the subset **m**) is active (in reception). To each neuron a variable $\sigma_j = -1$ is assigned if the neuron (of subset **j**) is passive and $\varepsilon_m = -1$ if the neuron (of subset **m**) is passive (in reception)[7];
   - the reception frequency is determined by induction from the transmission frequency;

     observation 1: these assumptions introduce a new Systemic neural transmission model from which we can assume that the neurons (even if they structurally and functionally look like the same among them), *if considered isolated*, at the very moment of their inter-relations, assume diversified characteristics in function of their intrinsic structures. In particular the neurotransmitter transit, from a

point to another of the inter-synaptic space, must follow determinate quantum laws which involve the isofrequency both in the trajectory and in the initial and conclusions points of the trajectory itself. There is, in other words, the presence of the *"Feynman path integrals"* conditions, associated to particular "extremes" of the path itself; this gives origin to a succession of times which apparently does non explicitly provide the contemporaneity (quantic non-locality);

observation 2: we know that the stability properties of the open Systems, which are far from equilibrium (and in the neural rice-transmission we are involved in this situation), can be formulated in terms of thermodynamics quantities, which present themselves as state functions. On the basis of what I say, an integrating factor, such as the turning the *Feynman path integrals* into a state function, will have to exist, just to respect the minimum production entropy theorem;

2. in the trajectories in iso-frequency, the absence of the neurotransmitter is equivalent to the inhibition;
3. the neurotransmitters, and in general the messengers flow, is equivalent (in physics-mathematics simulation) to plasma-jet flow cone;
4. in the neurotransmitters and messengers study, it is valid a non-classical statistical distribution function, obtained by the combination of the Fermi-Dirac function with the Bose-Einstein's one;
5. two synaptic Systems connected with the neurotransmitters (or with generic messengers) exchange information that we can represent through ondulatory representations which are antecedent the arrival of the masses transmitted with quantized value on the wave lengths;
6. I obtained a non-Aristotelian new Logic applying the "de Morgan Theorem", that I modified with the exclusion of the combinations "all zero " and "all one": I called it the *De Morgan Plus Theorem* (this helped the prototypes circuits simplification). *Fig.* ***12***;



(see Cyberneurophysiology – Bibliography 2nd Part)

Fig. ***12***

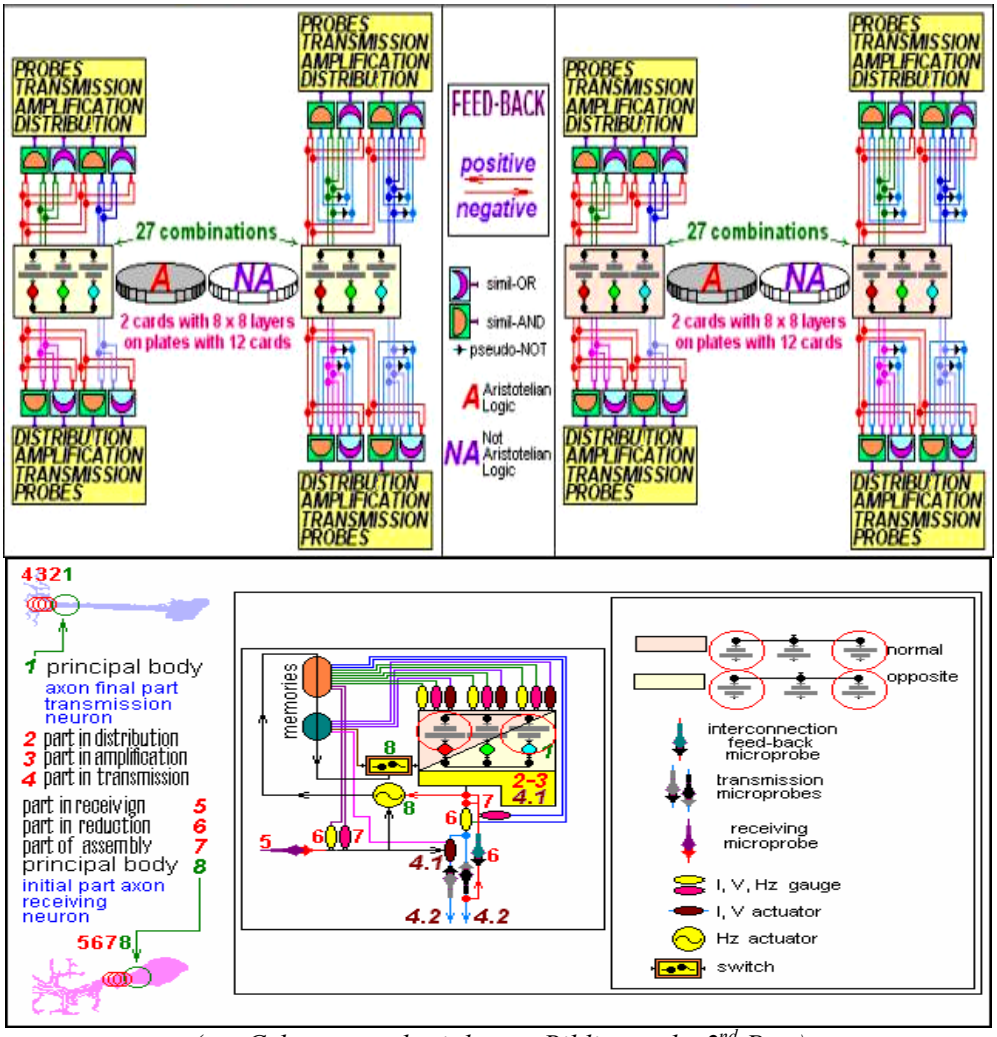
7. the Lie's algebra is functionally able to represent the synaptic micro-cosmos;
8. the Cubic Matrixes algebra can solve the holomorphic "minimum distance" function obtained with the Lie's Algebra;
9. the Cubic Matrixes algebra does non admit the "transposed" and therefore, considering the neurotransmitters in their hole, it gives us their behavioural indeterminateness: from this the "certainty" of the presence of uncertainty, the creation of fluctuation points among what is memorized in augmentative memories and all the intrinsic possibilities of the subsequent dynamic process;
10. the symmetry (considered by my model a summation of antimetries) generates the informative flux and the artificial life is represented as the emulation of the natural autopoiesis;
11. for artificial autopoiesis:
    - the interconnection, i.e. the mutual (sometimes univocal and sometimes biunique) relation among elements and/or among the Systems, and/or among structures or functions, works among nests and chains generating closed micro-Systems in the opened total System that's the organism. Also in the micro-Systems that work with feed-back, the different feed-backs are at their turn connected among them;
    - the non-linearity assumes the non-presence of (at finished dimensions) vectorial linear spaces generating a linear proportional algebra.
    - in the asymmetric (antimetric) and dissipative chaotic Systems, the (a different degree) PDE include also transcendent functions (ln, sin, cos, tag, exp, etc.).

Conclusions

The simulation I obtained refers to an artificial *and/or* bionic neural structure formed by modular electronic elements for generating and/or re-establishing a correct

communication among components of a biological structure, in particular a nervous System.

The simulated model includes a central section responsible for the generation of electrical signals, as well as a first and a second end section connected to this central section and to the respective input and output terminals located on opposite sides, with respect to a point of interruption of the communication. (*Fig.* ***13***)



(see Cyberneurophysiology – Bibliography 2nd Part)

Fig. ***13***[8]

The solution at the basis of the present simulation model is an artificial analog neural structure assembled through a plurality of swinging circuits grouped in meshes. In particular, it proposes to collect together and to process analog and digital signals produced inside such meshes so as to provide compressed information bands.

According to the simulation, the proposed bionic neural structure comprises a plurality of modular Cards, connected together, suitable for producing analog

electrical information signals with various waveforms and various electrical powers.

To be able to simulate a neural communication, such a bionic neural structure works with frequencies operating in the field of radio waves and in the field of light waves.

The electrical powers, used for the generation and the subsequent treatment of signals, are bio-compatible or computer-compatible, according to the following ways:

1. for frequencies operating in the field of radio waves, the powers are bio-compatible;
2. for frequencies operating in the field of light waves, the powers are computer-compatible.

Each new band of information signals is divided into various bands of sub-signals with suitable retro-actuated phasing, which, in turn, are distributed, for example, among the modular Cards, with the mathematical criteria of the Setting, Combination, Dispositions and Permutation operations, which permit the obtaining of composite bands.

Each composite band can, in turn, be amplified (using different groups of circuits with two or more meshes, similar to the previous ones and replaced in their functions by modules or blocks, for example of the AGC and/or PGA type) and subsequently prepared for the transmission with final controls activated using further groups of circuits with two or more meshes, also similar to the previous ones and replaced in their functions by modules or blocks, for example of the AGC and/or PGA type, thus obtaining the definitive signals.

Each definitive signal, ready for analog transmission, can also be subjected to Analog/Digital converters to obtain possible immediate computerized controls.

The signals transmitted (just like those received) are also retro-actuated up to the switches of the individual branches of the individual meshes of the individual electrical schemes, to carry out both new ways of producing the initial signals (waveform, wavelength, electrical power), and the formation of growing memories that are also subjected to computerized possible controls.

The switches contained in the modules are also able (using suitable frequency adapters, waveform adapters, etc.) to receive signals from other transmission sources, signals that in turn regulate the production of the signals to be transmitted both in waveform, in wave-length and in electrical power.

The bionic neural structure becomes an instrument operating exclusively with (direct or indirect) analog inputs and outputs, whilst still being totally compatible with possible digital commands.

This bionic neural structure has numerous applications: i.e. to make

1. parts or the totality of a receiving and transmitting signal network, acting at the speed of light and with the complexity of a human brain;
2. parts or the totality of a super-computer network, acting at the speed of light and, each one, with the complexity of a human brain.

This bionic neural structure can interconnect the biological and the artificial. It has a structural configuration such as to be able to be transformed, e.g. using the methods of nanotechnology, into structures, for example fullerenic and/or of nanotubes and/or other.

Simplifications and digital similar-analog adaptation let get different spin-off for diversified applications[9].

Using the bionic neural structure, according to the simulation, and a series of analog multi-layer circuits it is possible to make biomedical devices and a super parallel calculator with the complexity of the brain.

Such structure is non only self-organising, but continually refers to itself, basically behaving like an autopoietic System, i.e. based on the processes and on their mutual relations and on the feedback among them.

The hardware structure of the bionic neural structure does non require any software programme, carrying out by itself an operating programme in a virtual, autonomous, dynamic and automatic way.

According to the simulation, it transmits and processes analog signals, in other words bio-compatible signals.

If "in the language only differences do exist" (Saussure, *1916*), if *"*the meaning of the word is its use in the language*"* (Wittgenstein, *1953*), if "the meaning of an assertion is its method of evaluation" (Logical new-positivism), and if "a mathematical object is what it does" (T. Gowers, *2002*), *than the serially (diachronically) and parallely (synchronously) interconnected physical devices, simulated in my research, evidence their differences through the functions to which they give life inside to the originating structure. In this way they are all absorbable in the mathematical language that gives a perfect simulation.*

I think that the distribution of a neuron's specific structure follows an accurate reasoning of functionalities and that the (dissipative) System, that they create, follows ordered rules, easy comparable to those of an operator field.

I am moreover convinced that a mathematical simulation of the neural System space-time distribution shows its non commutativity and that we can obtain that a (determinable) Logic exists in the distribution of the different clusters of neurons.

Obviously with specific parameters, to determine a new model of transmission founded on (analog) capacitive stimulation (and more other) and on contact.

If the specific System demonstrated itself commutative, then it is simpler to establish operating parameters of neural associativity.

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Notes

[1] See that in order to develop these complex signals, we must couple **1 Fit** composed of at least $\mathbf{2^{10}}$ **Bits** with each **Bit** (**0** or **1**) required for the signal in Traditional Logic. The **Fit**

allows the uncertainty reduction in the measurement of the biological and (in general) of the natural signals. Every **Fit** (composed of a minimum of **1024 Bits**), even if combined in parallel with every **Bit** of the **2** values Logic, obviously is not entirely sufficient, but at least it allows a better approach than a simple sequence of **Bits** that are isolated among each other and placed in a simple linear sequence (see later in the text that recalls the Note **5**).
(see also Sentieri Sistemici – Bibliography 2nd Part).

2 CyberNeuroPhysiology -neologism- (CNP: human body analog artificial simulation) is a new science that concerns an hardware simulated *apparatus*, autonomously self-structuring its own software which emits informative signals and permits analog energetic exchanges and also self-configures itself with an increasing memory: i.e. a System which determines the structure that gives the function (and/or *vice-versa*), with memorisable analog emissions and which, as a whole, is oscillation susceptible. In particular, it is a System creating an inclusive oscillations set among complex elements, that, internally and among themselves, could be synchronous or a-synchronous, and that permit intrinsic symmetries and net symmetries and probabilistic solutions in their global structure. Finally it is an artificial inter-communicating with his biological analogous Entity. The outcome of this communication is the essential problem that we have: as e.g. the successive and deriving problem concerning the D-H matrixes substantial incompleteness for robotic applications and some other analogous. Today we can find kinds of circuit that, with the VLS1 help, put at disposal Hopfield implementing variant circuits and other nets like ART1. In simpler models than ART, e.g. the feed-forwards, we use the descent-gradient/Hebb-rules which let to find a well defined training algorithm for NN: this is translated, among the other things, in simple multiplexer summative components. In the recurring nets, as in Hopfield, there are opportunely locked circuits making clustering operations easy. And these are some examples among a lot. I think, as it really is, that *biological* Nature does non use digital signals: she exclusively permits (because there is an energetic and temporal inertia connected to extra-currents) an also partially digitalized emission, with analog signals towards every direction and time. That is to say that she determines quantized events whose discretized information follows a well precise quantum Logic, but it is non subjected to the usual rules of quantum mechanics. Such discretized information must follow statistic, an so probabilistic, laws that are neither Maxwell-Boltzmann, nor Bose-Einstein or Fermi-Dirac, but intermediate *and including*. As a matter of fact the weights calculus in Nature can non follow the mere artificial transmission circuits rules and so, e.g., it does non follow literally Kosko BAM that, always e.g., achieves stability as energetic minimum when the due to feed-back oscillations are completely damped. I am fully convinced, at least up now, that in order to simulate Nature herself, methods as the pattern-matching ones are non yet, and for certain aspects, fundamentals for the implementation of a System which is sensible to environment. In fact I think that *biological* Nature must have a kind of super-net which organizes the net's weights also through other nets' weights (but in an innovative way as to the traditional), and doesn't have a specific software successively inserted in his hardware. I.e. what Nature has organized *ab initio* is at the same time either hardware or software. In a simulated artificial super-net, the *sine qua non* condition is to put gnosiologically somewhere *a centre* which is the *global coordinato*r which can have or determine an intrinsic *almost natural* genetic super-algorithm that, at its turn, can sub-stay, as a foundation, to all those other genetic algorithms which constitute themselves as partial and specific innovative nets controlling and directing the whole. For this purpose we can define a barely formal but intuitive analogy

that I tried to follow. The organism is like a super-net coordinating the whole (but of which we don't know the centre): the organ or the tissue or both are one or more partial and specific nets; and the cell is a single artificial circuits cluster simulating the biological in their complexity. I think that the true solution consists in starting from a correct circuit, identifiable also varying either the Hopfield neural transmission model and other mathematics referring models. Today my experimental outcome is the modelling of multi-stratus analog chips as basement of a cerebral complexity super-parallel computer. It is an innovative hardware which needs no kind of software because it can autonomously, dynamically and automatically make it up *itself*. The System does non only organize itself but it makes continually reference to itself, as it was autopoietic, i.e. it is based on processes and their reciprocal relations and among their feed-backs. In such a way, according to Maturana, the limits defining the natural organisms are fixed. But, as this case concerns bionic elements, we are here much nearer to Chew boot-strap (among hadrons), as there is the forming of relations nets among linked states, sometimes without a pre-established but probabilistically determinable, even if only dynamically, limit. At last in this way we can establish the interdependence between process and structure, which refers to a probable gnosiologic and epistemological end of the dichotomous and occidental mind-material comparison: the fundamental Manichean relation with all its implications.

3 Bio**n**ethics -neologism- (Bio-N-Ethics): in many countries there is a great interchange of ideas between a laic and a religious world vision. Bionethics enters in this debate, widening the laic vision and trying to enlarge the bioethics concept to an autonomous, self-sufficient and thinking engine (a Cyborg) that inevitably will be constructed within this century. Research is now trying to extend the studies on human ethic to implement the robots' memory just to fix in them relationship behaviour. It concerns "robonethics", that is a "technoethic" directed specialization. But this constitutes only a sectional and a merely human vision and so unfit to a global approach. Bionethics begins considering human beings at first only partially bionic, than still partially bionic but who can become almost totally bionic, up to totally bionic individuals. We must also consider how a partially or totally bionic individual could form or enter in a group, a community and a society, through his new active participation: that is a more or less physiologically different individual presence. That's why Bionethics becomes the new social living foundation: and from this we must derive a new kind of artificial intelligence plan (AI) asking mainly the following question: *whom will the new Robot be image and likeness of?* For this purpose some years ago Cyberneurophysiology is born with a long demonstration about an initial conjecture (or mental experiment) based on the existence of artificial behaviours emulating natural ones that can be transferred into reality (see: Cyberneurophysiology). Among the effects of this "transference" we also see emerging what forces to face new problems that is which is defined Bionethics: ethics applied to bionics. This appears no more founded on those factors that generally form the evaluation characteristics which are usually based on bioethics parameters or on the existing official, usual and uncompleted robotic project conceptions. The new concept foundation is based on a specific assumption: *the biological natural Entities sub-set and the Cyborg Entities sub-set, both emerging for differentiation, in their inner self or better into the set containing them (that is the complex society set), could be compared to particles sub-sets in evolution into a single, maybe also deformable, container-System*. The Bionethics concept is born and nourishes itself in the overwhelming of the last human race taboo: that one of the brain substitution. The Brain-Mind identity, as is at present formulated, seems in fact to be the last obstacle. This can however be overcome considering

the brain as a highly specialised engine, but just an engine, And this against restructionism that leads to a simplification that considers an existing fixed space in which mind, spirit and soul are located. While with this my new vision, they are cause and fruit of a global harmony: i.e. even a deep physic alteration does non remove or substantially alter their presence. A new ethic-moral, juridical and pedagogic problem arises connected either to this new vision feasibility and its comprehension or even to its acceptation that is the interrelation with a new race which theoretically could emerge or derive from the actual.

4 Fundamental assumption. We need to recall the fundamental assumption that underlies this research: in the neurotransmitters transmission, in the intersynaptic space (electromagnetic field), **2** emission quanta, at a given transmission frequency, correspond to **1** bit, with its own frequency given by the (vectorial) sum of the same 2 quanta frequencies. The Bit can be considered a virtual particle which can get 2 states: the state [**0**] and the state [**1**].And only in those two states it will also have an informative value. As a virtual particle, it will acquire virtual values of mass, speed, momentum, energy, Hamiltonian, wavelength etc. And also a (virtual) charge, since it is a particular motion within an electromagnetic field. *From now on we will avoid the subscript "v" to indicate the "virtual", as the whole argument will be all based on virtuality.*
As a simple hypothesis we can consider the brain section in pictures of *Fig. **1***

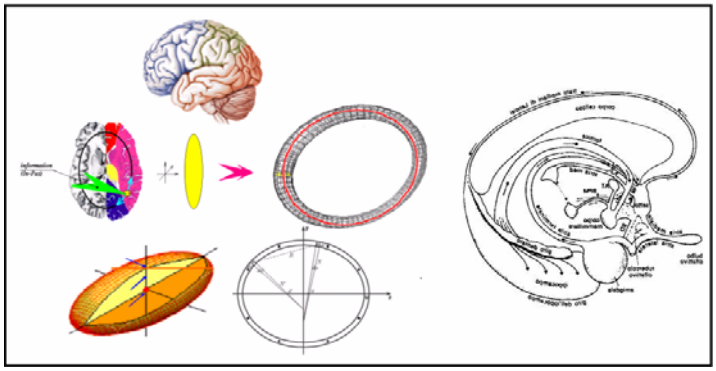


*Fig. **1***

as an isolated System and like all the isolated Systems, even in it we will be in presence of *observables* which evolve according to the Schrödinger's equation:

$$\partial/\partial t\ |\psi_i\rangle = -i/\nabla H\ |\psi_i\rangle$$

We are now able to make an analogy with which we can compare the informative stress (capable of covering the entire indicated brain surface or at least the elliptical highlighted crown) with charge fields that originate or better that are existing and modifying themselves, W and B.
According to the Standard Electroweak Model, let us try to represent in a unified theory the week and electromagnetic pseudo-fermions interactions in an informative pseudo-bosonic sea. The gauge symmetry that we consider is $SU_T(2) \otimes U_Y(1)$.
The pseudo-fermions are present in the Lagrangian as helicity selfstates h, where h is hold for null mass particles (*such as the connected information flows*).
Then:

$$f_L = ½(1 - \gamma_5)f \qquad \textit{left-handed} \qquad (I_3 = -1/2)$$
$$f_R = ½(1 + \gamma_5)f \qquad \textit{right-handed} \qquad (I_3 = +1/2)$$

where f is the pseudo-fermionic field and γ_5 is a Dirac matrix.
Now let's consider the left-handed pseudo-fermionic states as grouped into weak isospin doublets while the right-handed ones, such as isospin singlets:

$$\chi_L^l = \begin{pmatrix} \nu_l \\ l \end{pmatrix}_L \quad ; \quad l_R \quad \text{with } l = e, \mu, \tau$$

$$\chi_L^q = \begin{pmatrix} u \\ d \end{pmatrix}_L \quad ; \quad u_R , d_R$$

The coupling between gauge pseudo-fermions and pseudo-bosons is the standard one:

$$-g\vec{J}^{\mu} \cdot \vec{W}_{\mu} - \frac{g'}{2}(J_Y)^{\mu} B_{\mu}^0$$

where W^i and B^0 are, respectively, the two loaded vector fields , W^+ and W^- and the two neutral W^0 and B^0, able to define the gauge pseudo-bosons physical fields with the following expressions:

$$B_{\mu}^{\pm} = \frac{1}{\sqrt{2}}\left(W_{\mu}^1 \mp iW_{\mu}^2\right)$$
$$Z_{\mu}^0 = B_{\mu}^0 \cos\theta_w - W_{\mu}^0 \sin\theta_w$$
$$A_{\mu} = W_{\mu}^3 \cos\theta_w + B_{\mu}^0 \sin\theta_w$$

in which θ_w is the Weinberg angle [$\sin^2(\theta_w) \cong 0.23$].

If we now introduce the expressions of A_μ and Z_μ, we obtain for the electromagnetic current, the following expression

$$J_{em}^{\mu} = g \sin\theta_w \overline{\Psi}\gamma^{\mu} I_3 \Psi + \frac{1}{2} g' \cos\theta_w \overline{\Psi}\gamma^{\mu} Y \Psi$$

where I_3 is the third component of the weak isospin and Y is the hypercharge.
From the expression of the electromagnetic current we obtain also for the brain section the electroweak unification relations:

$$Q = I_3 + \frac{Y}{2}$$
$$e = g \sin\theta_w = g' \cos\theta_w$$

All mentioned above is in support of two conjectures (at the beginning of this paper) that can show how the signals distribution within the brain works.

5 Analog signal and its converting into digital.
Fig. ***1*** represents the neural membrane potential and it is so relative to the informative signal impulse.

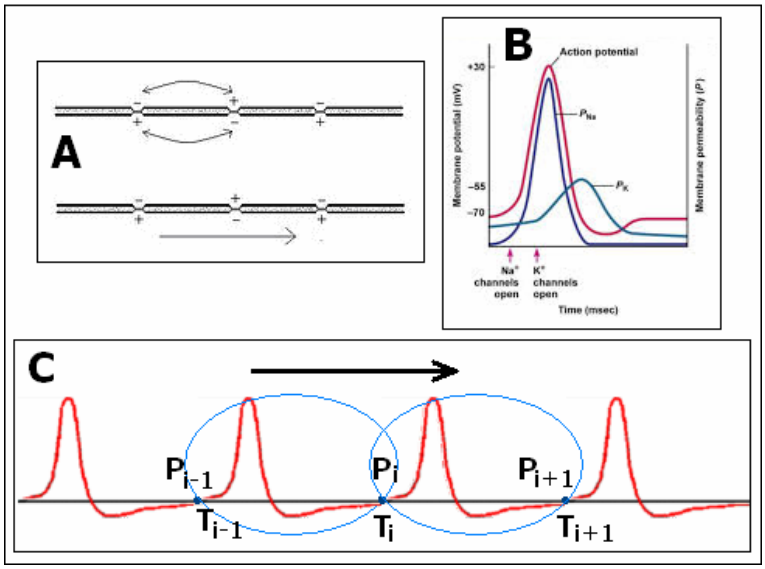


Fig. ***1***

Each $\mathbf{P_i}$ represents a Ranvier node (**A**) (see in the paper *Fig.* ***4***) in which the change in the membrane potential (**B**) has cause and from which springs the *nervous impulse*. Consequently, it is plausible that the impulse can be represented with a curve that is at least analogous to that of the membrane potential (**C**). As a source, $\mathbf{P_i}$ belongs to the curve range that follows it and it is a discontinuity point as to the previous interval. The same for $\mathbf{P_{i-1}}$ and $\mathbf{P_{i+1}}$. As we can see, it is an analog informative signal that is piecewise continuous having discontinuities on the left in the various points **P** in the time **T**. Mathematically it can be considered a piecewise continuous function. As for *Fig.* ***1***, in the single intervals of the domains $\mathbf{P_{i-1} - P_i}$ and $\mathbf{P_i - P_{i+1}}$, the function, in its various codomains, shows its difficulty in being totally convertible into digital, also saving as much as possible the informative signal. Let's analyze the meaning of the points **P** in the times **T**.

We need a preliminary statement.

Any polynomial (or in case an implicit function) has no informative meaning in itself, i.e. it is only a relationship among the single parts that make it up. It becomes informative if the same polynomial (or any implicit function) is equated or "compared" to **0** (zero) or to other, that is, if it is transformed into an equation, and thus it provides solutions, for the independent variable, for which the dependent assumes specific values. And if all becomes **0** (zero) the function is vanishes, then collapses. In particular, and only for example, in what we call the "variational collapse ", the variational theorem is suitable only for the lower states of each symmetry that allow that an approximated excited state has a *lower* energy than the exact one. Usually the elements of a quantum superposition of states, correspond to the quantum superposition element. This is due to that postulate of quantum mechanics which deals with the measurement of the observable and its consequent projection on the specific eigenstate.

Just basing on this postulate outcomes, if we want to achieve a specific result, all the differences must converge on a single result, getting what, always in quantum mechanics, is called "wave function collapse" which seems to be reversible as it is shown lately. This said, we note there are at least four ways to approach the concept of "collapse" that is analyzable from various points of view: from the (functional, tensor, topological) mathematical point of

view, from the standpoint of theoretical physicist (as for the wave function and also for the gravitational wave), from the (engineering, biological) technical and theoretic point of view, and also from the (physiological) sensory point of view. These concepts are not so easily convertible from one area to another because the specific specialized languages are not interchangeable.
So, in presence of what we call, for example, stall, that corresponds to an interruption, we may as well question what it is, but the question about the cause does not allow a simple answer, because there may be causes that actually are the effects of earlier causes or there may be contributing factors we do not know and that may be significant for the discovering of the truth. The same is valid for the effects on a set element or on the same set, considering the relationships that can be present among a single element and everything else. Nothing "really" knowledgeable may also happen since a mathematical analysis, for example, produces the probabilities range and not certainties. Thus, for the definition of the points **P** in the times **T**, we see that they correspond to collapses of a complete and complex function, that is piecewise continuous: they are turning values of the various ranges of the function existence but only one of the two belongs to the single intervals. We may as well think about the hypothesis that the curve as a whole, could be made up by a succession of non-linear polynomial. All this in the complex field. See also the Hamiltonian theoretical approach for the soliton in quantum biochemistry.
As we already said, in Nature there is nothing digital. Obviously everything can be digitized but realizing an adequate filtering; just to remove the maximums or the minimums on frequencies or amplitudes, they have to remove parts of signals, maybe mystifying them for noises or for something other. As we know, a discrete signal is obtained from a continuous signal with a time sampling operation, studying the signal in spaced time of a constant interval and transforming the continuous function **S(T)** in an endless sequence of real numbers. But if the sampling frequency is higher than the Nyquist frequency, because of the superpositions, all the upper signals are cut and recopied in low-frequency, appearing as "ghost" signals. In the human body nothing is redundant and if we find in it something apparently superfluous this has a reason to be there: therefore, for the construction of a functional model, each curves point must be thought important; it follows that it needs to be present even in the simulation. If digitalized, the analog nervous signals arising from the impulse (*Fig.* ***1***), would become like those in *Fig.* ***2***, so preventing the knowledge of the overtone presence, which are necessary for the whole evaluation, not only of the target in itself, but of its neighbourhood.

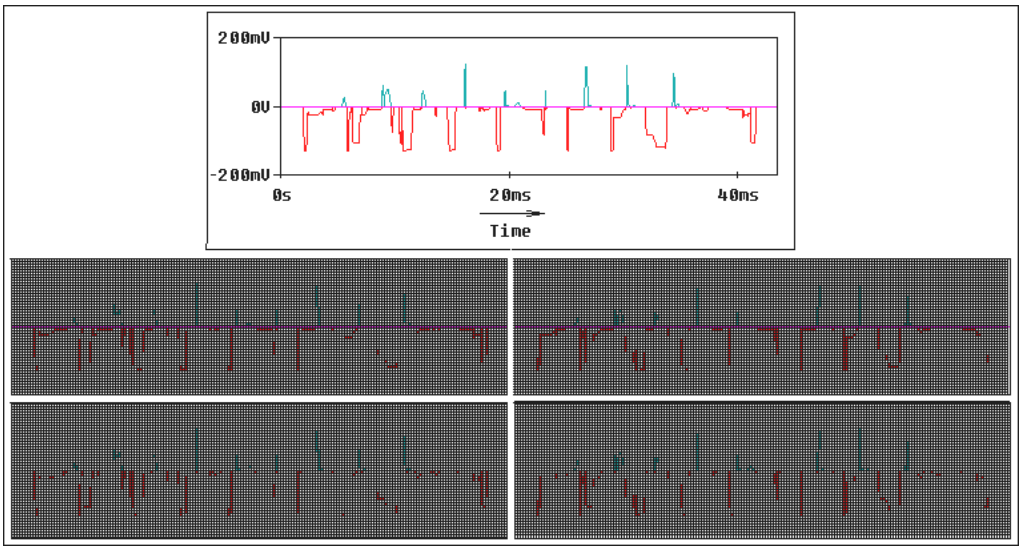


*Fig. **2***

I don't really think that a digital unity with a pre-programmed memory, even if it has converters **D/A** and **A/ D**, can effectively communicate with an autonomous analog system; this digital unity could not "understand" the feed-back signals if they were not previously inserted in its data-base. I also believe that dichotomies such as the analog-digital and the continuum-discrete have a meaning only from a practical point of view and not in a natural global vision.

In particular, what is analog can be analyzed in some of its "phenomena" which can be digitally studied, even if they aren't really digital.

The same is appropriate for the continuous and the discrete.

For example, a cage of the universe, which is considered point-like, is irrelevant for a wave analysis.

For example, when studying a field, a plane wave, we consider the stress and the resulting deformations among structures, the same as in Mathematics where the concepts abstraction allows the structural evaluation not only of a single figure which may be view, but the of the whole complexity.

A trivial example: the Koch curve construction.

It is a recursive procedure which leads, in the time, to a curve that is parameterized by a continuous function on a certain interval: specifically, the interval ***0-1***.

The curve we obtain is continuous because it is uniform, it is self-similar because one of its parts is an affine linear transformation of the entire curve, and furthermore, in any scale it is identical to itself and so it is not derivable as any discontinuous form.

It actually is a Cauchy sequence in the Banach space.

It really is an simple example of fractal; a profile which, however, admits the existence of vast areas, which can be uniform descriptive, and whose dimensionality, as for Hausdorff, is about **1,262**.

This means that we begin with a linear segment in dimension **1**, we implement it in the planar dimension, that is **2**, and we get a curve that does not have an easily conceivable size.

In nature it is easier to find fractal expressions, let's think about an island's contours, whose dimensionality is immediately uncertain but mathematically calculable.

So we can no more speak simply about *discrete* and *continuous* when in the Reality we want

to simulate, these concepts, which are separated and selected in isolation, no longer have the meaning we conventionally confer them.
Finally, we consider the *analog* and the *digital* simply from a technological point of view.
If we want to simulate an *analog* we have to make an *analog*.
In is impossible to face an analog reality with a digital one looking for any kind of symmetry: the *analog* assumes, for its structural definition, its "alter ego".
To conclude the **"it"** isn't only **"from Bit"** but also ***"from [Fit + Bit]"*** (see Note **0**).
(see also Sentieri Sistemici – Bibliography 2nd Part).

6 The fundamental component for the neural simulators charge and discharge.
In *Fig.* ***1*** we can see the potential and intensity current development and the development of the Fourier series, of the same component. The frequency distribution is clearly optimal for the bionic dialogue among, non only the neuron (the signal target), but also among all the other cells nearby, creating, in this way, synchronicity among the interconnections. But other waves can be noticed from this circuit: for example the values we obtain are similar to the intracellular signals and to those signals which, opportunely combined with the discharge element (the third condenser), are similar to the extra-cellular ones".

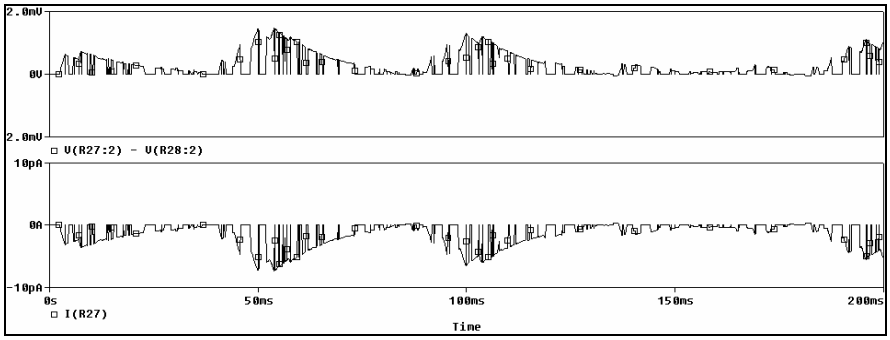


Fig. ***1***

If up to some years ago we believed that the neural information transmission occurred through the pre-post-synaptic connection between two neurons and that nothing was interposed, we have later noticed that in reality it seems to occur in presence of glial cells (atrocities) that non only incorporate the "*pre*" of a specific neuron considering the "*post*" of the following neuron, but also they are interconnected with many others that surround them.
I had to notice this when in my simulations I evaluated the upper harmonicas of a transmission (*Figs.* ***1*** and ***2***), and I could calculate the quantitative of energy that was apparently dispersing, looking redundant considering a single neuron-target. It was then that I understood that the apparent dispersion was like a cloud, that I simulated like the cone of a plasma-jet, which collide with a neural surround, and in this way all what was considered the boundary was informed of that happened on and about the fundamental neuron-target.

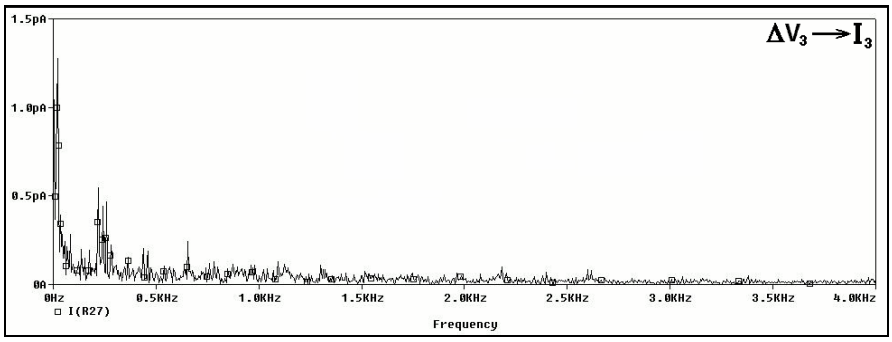


Fig. ***2***

The simulation was made on the concrete neural ability to transmit, i.e. either biochemically through mediators and electrically through contact: the first way was unidirectional while the second was bidirectional. Just to have an approximate idea of what I could obtain on the upper harmonicas with the simulated **NA-K** similar-pump.

7 The Hopfield's and the new models.
We see in *Tab.**1*** the essential differences between the two models

HOPFIELD'S MODEL	**NEW MODEL**
The time and neural activity are non-continuous.	**The time and neural activity are non-continuous.**
The neurons are geometrically arranged in a reticule form and are connected to each other.	**The set of 2n neurons is subdivided into two subsets: n transmission (j neurons), n reception (m neurons). Both neuron subsets are connected between them by unidirectional reticule connections.**
To the m^{th} neuron a variable σ_m = +1 is assigned if the neuron is active or σ_m = -1 if it is passive.	**To each neuron a variable σ_j = +1 is assigned if the neuron (of subset j) is active (in transmission) and ε_m = +1 if the neuron (of the subset m) is active (in reception). To each neuron a variable σ_j = -1 is assigned if the neuron (of subset j) is passive and ε_m = -1 if the neuron (of subset m) is passive (in reception).**
	The reception frequency is determined by induction from the transmission frequency.

Tab. ***1***

We so obtain diversified behavioral simulations and in particular:

- as for the Hopfield Model:
  The potential that the m^{th} neuron receives from all the other neurons can be represented in this way:

  (1) $\quad h_m = \Sigma_{j \neq m} J_{mj} \sigma_j$

where J_{mi} is the synapses action intensity that the neuron j performs on the m neuron.
The neuronal activity with θ threshold can be stated introducing the neuronal activities vector $\sigma(t)= (\sigma_1(t),\ldots, (\sigma_n(t))$ at the time t.
At the t+1 time the activities are specified by the law

$$(2)\quad \begin{cases} \sigma_m(t+1) = +1 \ \textit{if} \ \Sigma_j J_{mj}\sigma_j > \theta \\ \sigma_m(t+1) = -1 \ \textit{if} \ \Sigma_j J_{mj}\sigma_j < \theta \end{cases}$$

The relations can be rewritten in a more compact form:

$$(3)\quad \sigma_m(t+1) = \text{sgn}\,(\Sigma_j J_{mj}\sigma_j - \theta) \qquad \text{[sgn: signum function]}$$

From (3) we derive the two (parallel and serial) dynamics.

- <u>As for the new model:</u>
The potential (the intensity) I_{lm} that the reception m^{th} neuron receive (through its l^{th} receptors) from all the other j^{th} transmitters j^{th} neurons (through their i^{th} transmitters) can be represented with

$$(4)\quad \Sigma_{ijlm} = \Sigma_j \Sigma_i H_{ij}\, \sigma_{ij}$$

Where H_{ij} is the synaptic action intensity performed by the neuron j with the transmitter i.
The neuronal activity with threshold θ can be stated introducing the vector of the neuronal activities $\sigma(t) = (\sigma_1(t),\ldots, \sigma_n(t))$, or $\varepsilon(t) = (\varepsilon_1(t),\ldots, \varepsilon_n(t))$, at time t.
At time t+1 the activities will be given by the law:

$$(5)\quad \begin{cases} \varepsilon_{lm}(t+1) = +1 \ \textit{if} \ \Sigma_j \Sigma_i H_{ij}\, \sigma_{ij} > \theta \\ \varepsilon_{lm}(t+1) = -1 \ \textit{if} \ \Sigma_j \Sigma_i H_{ij}\, \sigma_{ij} < \theta \end{cases}$$

the relations can be rewritten in a more compact form:

$$(6)\quad \varepsilon_{lm}(t+1) = \text{sgn}\,(\Sigma_j \Sigma_i H_{ij}\, \sigma_{ij} - \theta)$$

where $\varepsilon_{lm}(t+1)$ is such as:

$$(7)\quad K_{lm}\varepsilon_{lm} = I_{lm}$$

We can evaluate the following *Tab. **2*** that shows, in the time, the real values of σ and of ε in function of threshold values θ, that are assumed equal either in transmission and in reception, supposing an isofrequency in the informative flux canal:

$t_1 = t$	$\sigma_{ij} = -1$	$\varepsilon_{lm} = -1$
$t_2 = t + 1$	$\sigma_{ij} = +1 \ \textit{if} \ K_{lm}\varepsilon_{lm} > \theta_{lm}$	$\varepsilon_{lm} = -1$
	$\sigma_{ij} = -1 \ \textit{if} \ K_{lm}\varepsilon_{lm} < \theta_{lm}$	

$t_3 = t + 2$	$\sigma_{ij} = -1$	$\varepsilon_{lm} = +1$ *if* $H_{ij}\sigma_{ij} > \theta_{ij}$ $\varepsilon_{lm} = -1$ *if* $H_{ij}\sigma_{ij} < \theta_{ij}$
$t_4 = t + 3 = t_1$	$\sigma_{ij} = -1$	$\varepsilon_{lm} = -1$

Tab. ***2***

We consequently obtain the equations system which describe the new model:

$$(8)\quad \begin{cases} \sigma_{ij}(t+1) = \operatorname{sgn}\left(\overset{r}{\Sigma_m}\ \overset{s}{\Sigma_l} K_{lm}\,\varepsilon_{lm} - \theta\right) \\ \varepsilon_{lm}(t+2) = \operatorname{sgn}\left(\overset{p}{\Sigma_j}\ \overset{q}{\Sigma_i} H_{ij}\,\sigma_{ij} - \theta\right) \\ I_{ij}\rfloor_{t+1} = I_{lm}\rfloor_{t+2} \quad \Rightarrow \quad H_{ij}\,\sigma_{ij}\rfloor_{t+1} = K_{lm}\,\varepsilon_{lm}\rfloor_{t+2} \end{cases}$$

whose connected symbols are explained in *Fig.* ***1*** and in *Tabs.* ***3-4***, and in which **r**, **s**, **p**, **q** are such as (also if in *Tab.* ***4*** we don't consider the inhibition) it must really be:

n° neurons that are inhibited in reception
n° receptors (of the reception neuron) that are inhibited in reception
n° neurons that are inhibited in transmission
n° transmitters (of the transmission neuron) that are inhibited in transmission.

From the system (8), with its specifications, we can derive the two (parallel and serial) dynamics subdividing the transmission and the reception and the subsequent inhibitions
In *Fig.* ***1*** and in *Tabs.* ***3, 4*** we show either the graphic model and the general math simbology and the restrictive one used for the object of this paper.

NB: for *Fig.* ***1***.
In the intersynaptic space any transmitter neuron is able to transmit a cone of neurotransmitters to any other receiver neuron. The neurotransmitters trajectories are linear in isofrequency inside the cone of flow, but not all these trajectories are allowed to. Those ones that are not allowed (the ones inhibited) transmit or receive neurotransmitters vacuums, i.e. a kind of reception and/or transmission of anti-neurotransmitters.

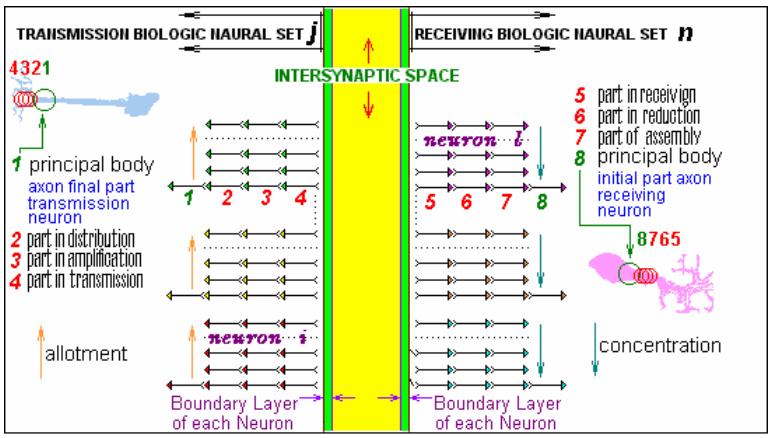


Fig. ***1***

n'	= elements number of the transmission neurons set
n''	= elements number of the reception neuron set

n''' = elements number of the transmitters set of a transmission neuron
n'''' = elements number of the receptors set of a reception neuron
NT_j = j^{th} transmission neuron
T_{ij} = i^{th} transmitter of the j^{th} neuron
NR_m = reception m^{th} neuron
R_{lm} = l^{th} receptor of the m^{th} neuron
H_{ij} = synaptic transmission intensity send by the i^{th} transmitter of the j^{th} neuron
K_{lm} = synaptic reception intensity received by the l^{th} receptor of the m^{th} neuron
σ_{ij} = synaptic transmission activity in R_{lm} transmission
ε_{lm} = synaptic reception activity in reception from T_{ij}
$\Sigma p \le n'$ $_{j=1}$ NT_j = non inhibited transmission neurons number
$\Sigma q \le n'''$ $_{i=1}$ T_{ij} = non inhibited transmitters number of the j^{th} transmission neuron
$\Sigma r \le n''$ $_{m=1}$ NR_m = non inhibited reception neurons number
$\Sigma s \le n''''$ $_{l=1}$ R_{lm} = non inhibited receptors number of the reception m^{th} neuron
$\Sigma q \le n'''$ $_{i=1}$ H_{ij} = total synaptic activity transmitted by the j^{th} neuron
$\Sigma s \le n''''$ $_{l=1}$ K_{lm} = total synaptic intensity received by the m^{th} neuron
$\Sigma q \le n'''$ $_{i=1}$ σ_{ij} = total transmission activity of the j^{th} neuron
$\Sigma s \le n''''$ $_{l=1}$ ε_{lm} = total reception activity of m^{th} neuron
$\Sigma p \le n'$ $_{j=1}$ $\Sigma q \le n'''$ $_{i=1}$ H_{ij} = total synaptic intensity transmitted by the non inhibited neurons set
$\Sigma r \le n''$ $_{m=1}$ $\Sigma s \le n''''$ $_{l=1}$ K_{lm} = total synaptic intensity received by the non inhibited neuron set
$\Sigma p \le n'$ $_{j=1}$ $\Sigma q \le n'''$ $_{i=1}$ σ_{ij} = total transmission synaptic activity of the non inhibited neurons set
$\Sigma r \le n''$ $_{m=1}$ $\Sigma s \le n''''$ $_{l=1}$ ε_{lm} = total reception synaptic activity for the non inhibited neurons set
$\Sigma p \le n'$ $_{j=1}$ $NT_j * \Sigma q \le n'''$ $_{i=1}$ T_{ij} = total non inhibited transmitters number
$\Sigma r \le n''$ $_{m=1}$ $NR_m * \Sigma s \le n''''$ $_{l=1}$ R_{lm} = total non inhibited receptors number

*Tab. **3** -* **General Notation** (see *Fig. **1***)

Hypotheses

- 1° Hp: sets equality: $n' = n''' = n_1$; $n'' = n'''' = n_2$
- 2° Hp: non inhibition in transmission and in reception: $p = n' = q = n''' = n_1$; $r = n'' = s = n'''' = n_2$

From the two Hp we obtain:

n° emission points = n_{21}
n° reception points = n_{22}

- 3° Hp: $n_1 = n_2$

Positions:

1°P.: $H_{ij} = K_{lm}$
2° P.: σ_{ij} ; ε_{lm} = [0,1]
$I_{ij} = H_{ij}\sigma_{ij}$ = transmitted intensity;
$I_{lm} = K_{lm}\varepsilon_{lm}$ = received intensity;
$I_{ij} = H_{ij} \Rightarrow I_{lm} = 0$;
$I_{ij} = 0 \Rightarrow I_{lm} = K_{lm}$.
3° P.: the relation $T_{ij} \rightarrow R_{lm}$ occurs following the scheme

$$[a_{ij},\nu_{ij}] \rightarrow M_{ij,lm} \rightarrow [a_{lm},\nu_{lm}]$$

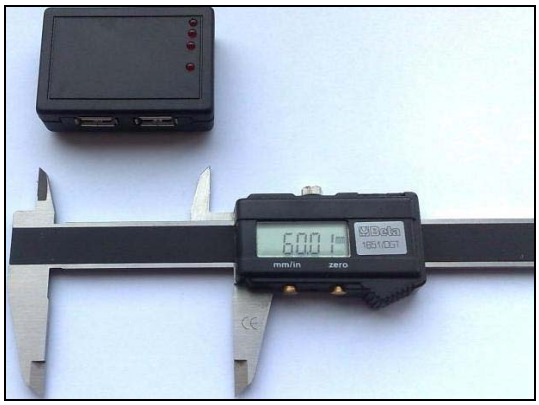
in which:
M = involved neurotransmitter mass
a, ν = in transmission or in reception wave train amplitude and frequency

Tab. ***4*** **- Restrictive Notation** (see *Fig.* ***1***)

In this paper the mathematical development (basis in *Tab.* ***4***) was merely concerning the simplified part that is applied to the base element (module) shown in the figures.
The obtained positions let me make a simplified neural model.
The biological-artificial coupling was verified through non usual models in order to deal with non homogeneous sets.
The choice of the notations **σ** and **ε** is due to the analogy between the pre/post neurons interconnection and the Hooke law regarding the applied tension and the obtained deformation.
In this case, the elasticity module corresponds to the total inertia of the transmission and of the reception (and the associated relaxations).
As in the elastic interval, in which the tension stopping involves a reinstallation of the equilibrium conditions, with an approximate (even if minimal) relaxation time, the same stress response needs a determined reaction time (see the analogy with Ohm's laws, where the proportionality constant is given by the electrical resistance and/or by the inductance and/or by the time constant, or the analogy with the second law of dynamics in which the resistance is given by the mass; and the analogy with other laws).
Therefore to **σ(t)** follows **ε(t+Δt)**, in which **Δt** is negligible but real.
In the equations **t+1** and **t+2** describe the times that are immediately following to **t**.

8 Derivations from *Fig.* ***13***, from *Figs.* ***5***, ***6***, ***8***, ***9***, ***11***, ***12***, and from Notes **1**, **5**.
By the cubic matrix (see *Fig.* ***12***), that does not make possible a "determinate" Transpose, I think that we can and must try symmetry operations also on irreversible processes, such as the biological ones.
A condition of synchronicity does not exist in an energy and information real neural transfer, which presents energetic and temporal inertia both in transmission and in reception; there is instead a synchronicity in the entire body perception of the totality of the problem.
A parametric inversion, that is mentally conceivable, is possible only if we consider the necessary inevitability of a transpose cubic matrix that gives the uncertainty on the considered Process(es) inversion.
The uncertainty does not lead to a lack of knowledge, but only to the probability of a verifiable knowledge of a finite and limited number of variables in their possible universes, with respect to all the various variables taken into consideration.
A biological system can be considered covariant if it admits only contravariant processes in its internal: as if to say that (in biology, in physiology, and certainly in some other scientific disciplines) *the Covariance is given by a summation of Contravariances.*
In this case, we can speak of system symmetry with processes asymmetry: it represents one of the artificial neurons various combinatorial possibilities for the building of 3-dimensional tissues.

9 Simplification and digital similar–analog adaptation to get different spin offs for diversified applications on the biological context (*Fig.* ***1***, KDK, a spin off).



*The **KDK***
*Fig. **1***

KDK is a small device for e-mail crypting and decrypting in order to strictly safe privacy. KDK is external to the computer and connected through USB gate; it is programmed by the user in an individualized way and can be easily used to send and receive reserved messages in a safe way. In a easy to handle shape, it is formed by a pocket size box, containing 2 UBS gates and a transparent connection UBS to the PC, which can be used by whatever computer, making the message to pass through after being crypted. KDK device works in pair or in star; either for the couple or for the star links, it exist a principal box while the other, or the others, are secondary. Only the twin-link can decrypt and eventually answer in an analogous way to the initial message. It is non necessary that the user of the corresponding twin-link pen drive must know the crypting key-files. The key-files are charged by the owner of the principal pen drive and the second or all the others, obviously programmed in the same way, work (receiving and sending) in link with the principal or among themselves. Compared to the traditional crypting algorithms which are inserted internally in the software of the computer itself, and so easily attacked by the hackers, KDK device is much safer because it is separated (transparent respect to the System) working like a simple pen drive small box to insert at need. The prototype device KDK, compared to the traditional crypting algorithms which are inserted internally in the software of the computer itself, and so easily attacked by the hackers, is much safer because it is separated (transparent respect to the System) working like a simple pen drive small box to insert at need. The Crypting and Decrypting operations are locally executed by the KDK System without the help of the PC to which it is connected. This System, non linked to a classical PC structure, doesn't use in the processing, an operative System like MS-DOS, Windows, Linux…etc but it is based on a particular (similar-analog) program which has nothing in common with other large diffusion programs like Word or others. This means that the files produced in the encrypting time haven't a structure which is, one way or another, identifiable or comparable to other devices.

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