Phasors and Didactic Knowledges Mapping

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Abstract
From the analogy between the well known structures of the phasors and quaternions, it is shown that the topological configurations improve the operational storage of recorded Information and Signs as well as the chains of Tasks and Actions.
From the "Discrete Fourier Transformation" and the deduced "DiscreteWavelet Transformation", we can underline the strategical role of the "Phasors" and the "Quaternions " in the detection and in the storage of every signal. From these dynamical processes it is possible to use similar modifications for configurating the "Memory or Knowledges Spaces" to reach a common convivial performative presentation.
Besides we point out the high frequent use of circular topologies in our behaviours: since the automations procedures with their adjusting loops, the "Time Sharing " working of computers and the management of sendings and receptions of messages and alike the handling of simultaneous tasks, for reaching the present insertion of the "roundabouts" in our vehicles traffic.
Specific advantages of these circular configurations are pointed out.
Due to the fact that the phasors, which are rotating complex planes, are well adapted for an easy description of the rotations, they are performative tools, for treating every circular distributions (for recording and retrieval of "Info").We have to remind these ones when we need the elaboration of operational planifications as well as for the forecasting of rational behaviours and actions. Indeed the rotations are the most simple periodic movements whose orthogonal projections tranlate the sinusoidal and cosinusoidal vibrations and conseqently they constitute the basic useful referentials for analyzing every periodic evolution. By observing our whole surrounding we obviously state that everything has a limited variation and consequently cyclically behaves;what is logically unmissing because we must live, think and work during and along finite domains. From these previous considerations we have to deduce that every recorded phenomenon can always be described and explained like a periodic one or for the least as a "periodisable or pseudoperiodic" one (without any repetition) and so they may be all considered as circular isomorphic dynamics.
Besides these angular allocations allow to reach a high grade of perception for the dealt topics because they intrinsically dispose of a set of many various directions for graphically translating the infuences of the causal parameters.
Keywords: Phasors, Quaternions, Wavelets, Convolutions, Circular Mapping

1 Introduction

At first we have to remind the essential properties of the circular components which are largely used for depicting the periodic phenomena.

1.1 Presentation of the Monoaxial Phasors

Phasors of h harmonicity grade are complex planes rotating around a common axis, orthogonal to these ones, (therefore the monoaxial qualification) with uniform angular speed: $\omega_h = h\ \omega_1$; where ω_1 is the speed of the fundamental harmonic (i.e. the slowest one, for which h = 1) and h the grade of the harmonic which is a positive integer.
Indeed each of these ones is able to embed a set of moving vectors which are rotating or oscillating at a same frequency, as pointed out by Euler's relation

$$\exp(j\omega_h t) = \cos(\omega_h t) + j\sin(\omega_h t)\ ; \quad \text{where j is the imaginary operator.} \tag{1a}$$

We can assimilate every phasor (rotating complex plane) with a rotating operator: $\mathrm{Rot}(\omega_h t)$ and consider the oscillatoring functions: $\cos(h\omega t)$ and $\sin(h\omega t)$ as the projections of this rotation or basic vectors on the real and imaginary axes. It is also possible to give a kinetic version for the eq.1a:

$$\mathbf{Rot}(\omega_h t) = \begin{bmatrix} \cos(\omega_h t) \\ \sin(\omega_h t) \end{bmatrix} \tag{1b}$$

In these relations (1a,b) $\omega_h = 2h\pi f$: the pulsation for $\cos(\omega_h t)$ and $\sin(\omega_h t)$

and also $\omega_1 = 2\pi N$: the angular speed for $\mathrm{Rot}(\omega_1 t)$ where N is the number of rotations per second or angular speed.

At present we deduce that $\exp(j\omega_h t)$ is the mathematical version of $\mathrm{Rot}(\omega_h t)$

Of this way we have extended the topic of basic vectors to every arbitrary referential signals.

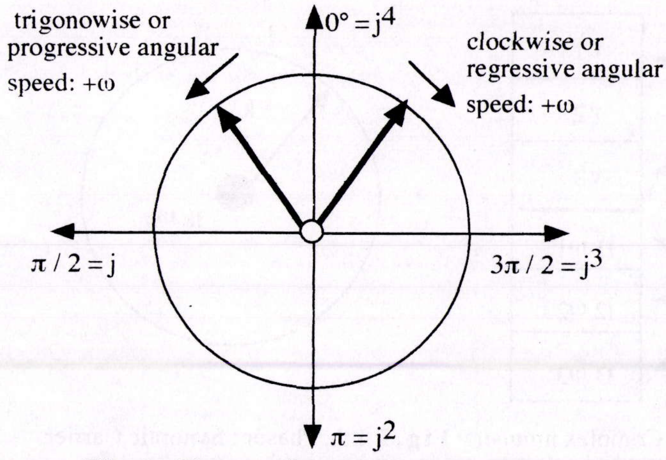
1.2 Presentation of the Quaternions or Set of Three Independent Phasors with Different Rotations Axes

Quaternions, indicated by Qt, are Complex Operators with a real component and 3 imaginary ones which correspond to 3 rotating axes.They are deduced from the usual complex numbers by vectorializing their imaginary part into the components : $\mathbf{j} = [k, l, m]$ as shown in the (Fig.2)

Indeed k is a geometric index, corresponding to the kth. unitary rotating axis.

Practically, each imaginary component k is to be considered as a rotation axis which is obviously orthogonal to its associated phasor plane with the angular speed ω_k, as shown in (Fig.3).

By means of these quaternions it is possible to project any rotation, of any direction, into three independent referential axes. Of this way, it was developped a numerical and graphical tool for depicting the 3 dimensional signals and motions.



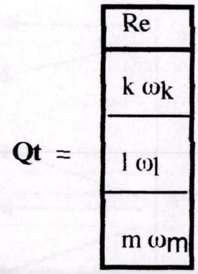


Fig.1: Phasor or Rotating Complex Plane with progressive and regressive operators

Fig.2: vectorial structure of a Quaternion

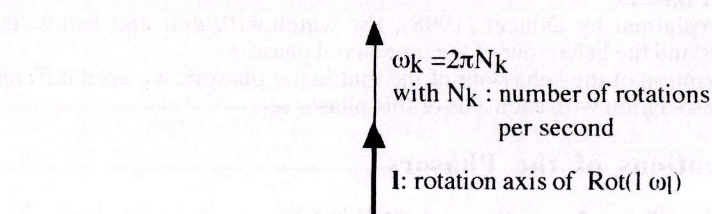


Fig.3: Kinetic Characteritcs of the Imaginary Parts of a Quaternion

1.3 Hyperquaternions or Splitting of the Real- and Imaginary Components

Into the real component of the quaternions it is possible to store scalar info., like linear translation. At this point, we let remark that a lot of movements like the cycloïdal , helical, spiral ones are made up of simultaneous associations between translations and rotations. In the usual (3D.) space, it is possible to split any translation into 3 components along the basic axes, what leads to 3 real parts. If necessary, we may put each translation along a selected radial direction of a phasor; which adds a second synoptic use for this one, as showed in (Figs. 4, 5)

By developping this expansion-strategy, it is sometimes necessary to conceive other hyper complex entities with $N>3$ real parts and also $M>3$ imaginary parts; what can be useful for the multidimensional analysis and simulation of some mechanisms.

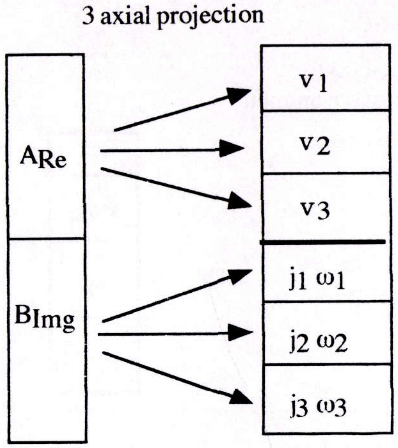


Fig. 4: Expansion of a Complex number into a Hyperquaternion

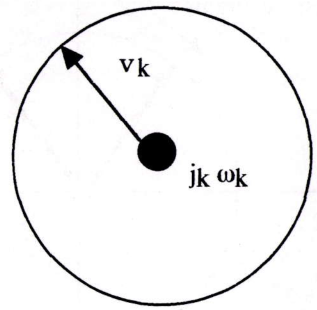


Fig.5: kth. Phasor : Synoptic Carrier of translation v_k and rotation ω_k

1.4 Watches and Phasors

As it was already explained by Doucet (1998), the watch,with dial and hands, is a didactic tool to understand the behaviour of the monoaxial phasors.
For the didactic description of the behaviour of the multiaxial phasors, we need different directed watches in association with each axis of this phasor set.

2 Useful Applications of the Phasors

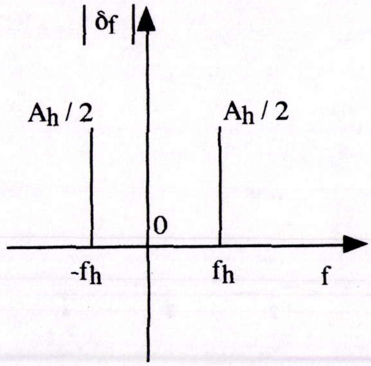
2.1 Discrete Fourier Transformation or (D.F.T.)

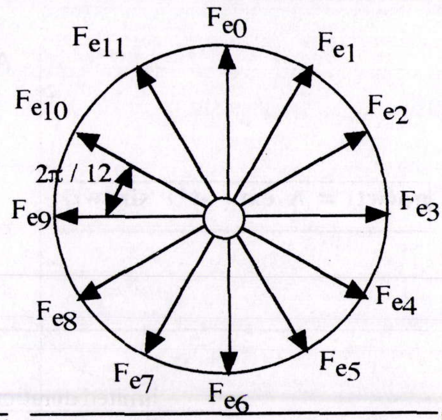
The (D.F.T.) is the classical convolution for tranfering every signal from the time space into the frequencies space, in order to discover the needed frequency densities for developing its shape. Each pair of opposite frequencies corresponds to a specific oscillator, as showed in (Fig. 6)
Essential characteristic of each (D.F.T.): the N number of recorded occurences of the signal is also the number of the frequency densities of the whole spectral definition and consequently the numbers of harmonic phasors. This N is also the number of the basic vectors of this (D.F.T.) and defines their angular addresses in the primary phasor:

$k\,(2\pi / N)$,with k: integer between 0 and(N-1), as showed in (Fig. 7)

Phase interval between 2 successive basic vectors is: $(2\pi / N)$

For every harmonic of grade h, the adapted step is: $h\,(2\pi / N)$ and of this way, every element of the (D.F.T.) matrix can be evaluated.





$\cos(h\omega t) = (1/2)\,[\exp(jh\omega t) + \exp(-jh\omega t)]$
$\sin(h\omega t) = (1/2j)\,[\exp(jh\omega t) - \exp(-jh\omega t)]$

F_{ei} is the ith. Fourier basic vector with angular address: $i\,(2\pi/12)$

Fig.6:Fourier's picture of a harmonic oscillator at the frequency $f_h = h\,f_1$

Fig.7: Synoptic display of the Primary Fourier's Phasor for N = 12 equipped with the correspondent basic phasors set

2.2 Discrete Wavelets Transformation or (D.W.T.)

These new convolution operators were developped for improving the (D.F.T.) by replacing the endless basic signals : $\exp(\pm j\omega t)$ by Wavelets family (= mother and daughters set), which have flexible narrower working zones and therefore can be suited at the local shape of every irregular signal. With this wavelets procedure, it is possible to accelerate the computation and also to spare Ram. unities because we only record the usefull frequency tracks during their occurencing times.
For more development of these matters, see Randall (1980) and Brigham (1978) for "Fourier analysis" and Burrus & Gopinah (1998) for "Wavelets"
The Structural procedure of the (D.W.T.) is graphically explained in the Figs. 8,9,10
We have to underline about this shape-detection-procedure that we send to each fraction time a daughter wavelet which is oscillating in an optimized accordance with the behaviour of this portion of signal (= adjusting the frequencies in correlation with their working - time). Consequently only a single wavelet is instantaneous working. Each wavelet-family belongs to a 2-dimensional operational space (Fig.9) with a time-translations axis and a frequency (= scaling effect) axis (Burrus & Gopinas 1998).

2.3 Oscillating Form of the Electromagnetic Maxwell Modelling with the Phasors

This phasor configuration, displayed in Fig.11, is helpfull to easily understand the dynamics of the electrical machines because it shows the interaction between the electrical components and the magnetic ones.

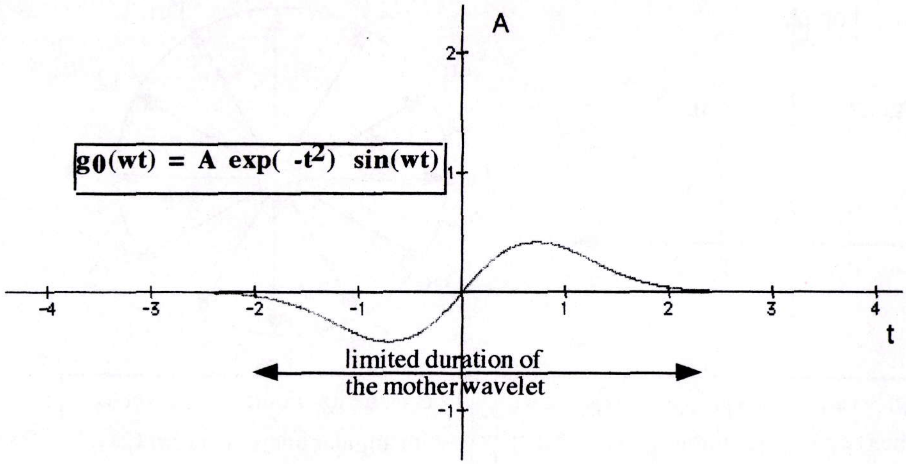


Fig.8: Morphology of a simplified Mother Wavelet

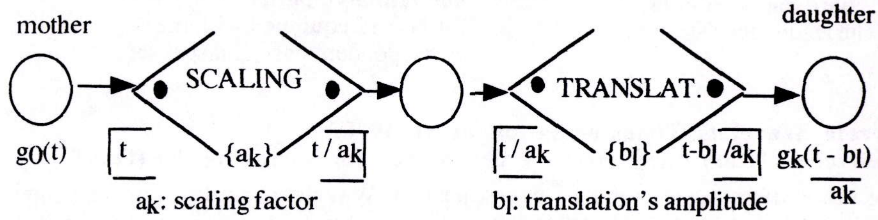


Fig.9: Deduction's procedure for the Daughter Wavelets from their Mother one

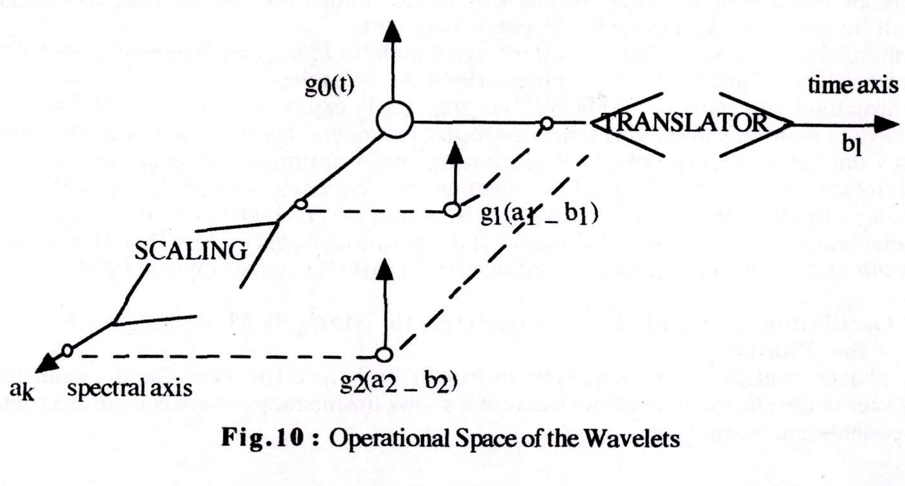


Fig.10 : Operational Space of the Wavelets

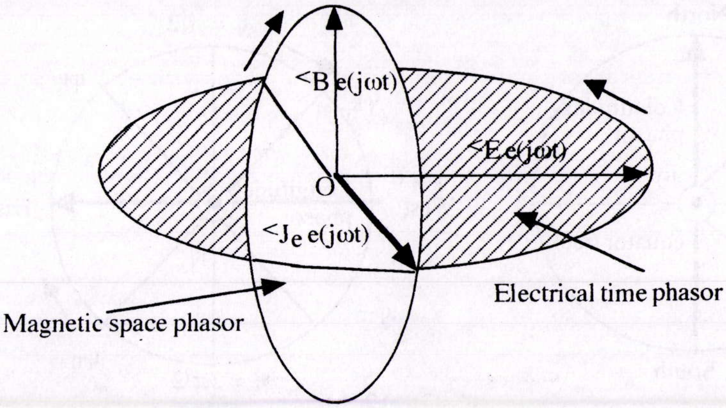


Fig. 11: Phasor topology of the oscillating Electromagnetic Maxwell modelling

2.3.1. Presentation of the electromagnetic Maxwell relations for electromagnetic devices.
The general expressions are given by:

$curl(H) = J_e$:where H = magnetic field and J_e = electons current density (2)

$curl(E) = -D_t(B)$: :where E = electric field and B = magnetic induction (3)

oscillating form:

$curl[<H\, e(j\omega t)] = <J_e\, e(j\omega t)$ (4)

$curl[<E\, e(j\omega t)] = -j\omega[<B\, e(j\omega t)]$

where $<H$, $<J_e$, $<B$, $<E$ are peak values (5)

For carrying this oscillating behaviour, it seems suitable to use a time phasor and a geometric (=space) one because in the space, the electrical conducters are always orthogonal to the directions of their associated magnetic cofactors.

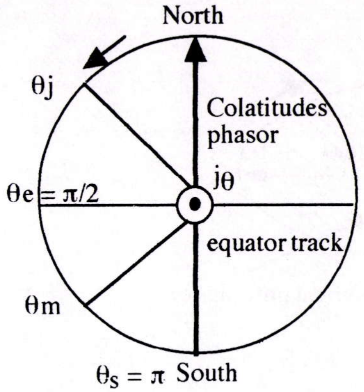
Hopkinson 's relation: $(n\, I_e)\, \mathcal{P} = \Phi$: where $\mathcal{P}$ is the magnetic permeance (6)

and Φ is the magnetic flow; and $(n\, I_e)$ is the number of electrical currents through the aeria supplying by the magnetic ring.
This (6) relation is the macroscopic expression of the (4), after the application of Stokes theorem, which is explained further.

2.4 Spherical Coordinates with Phasors

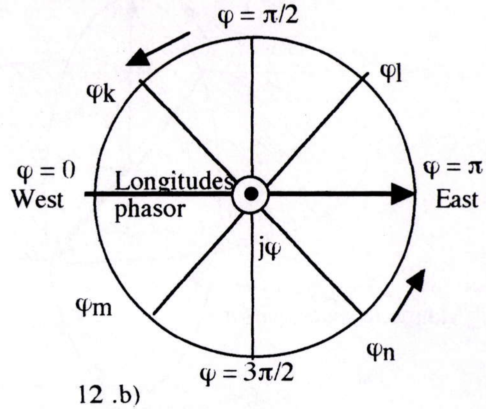
For locating points or depicting displacements over spheres, we use angular coordinates:

φ: longitude and θ: colatitude,which may be carried by a set of 2 ortho phasors as showed in Fig.12.



12.a)

Meridian Phasor: displays the colatitude variation [0≤ θ ≤ π]



12 .b)

Equator Phasor: displays the longitude variation [0≤ φ ≤ 2π]

Fig.12: Biphasor Translation of the Spherical Coordinates:

The radial coordinate corresponds to the real component and allows to express the altitude of every point relative to the spherical surface of reference.

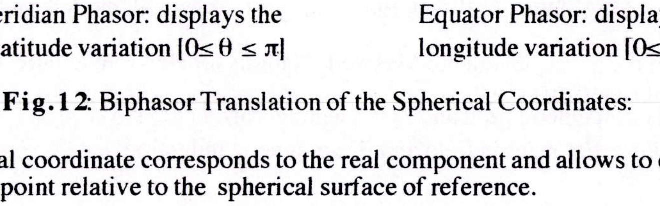


Fig.13: Symbolic Presentation of a multi movement Machining System.

2.5 Multimachining along various Translational and Rotational Axes

As we already said in the section 1.4., the hyperquaternions with N real parts and M imaginary ones are specifically developped for the numeric modelling of these multiaxial toolmachines. This use is presented in Fig. 13.

Table 1: Vectorial Kinetic Structure of a Hyperquaternion

$(v_1\_\ l_1)\ e_1$	$(v_2\_\ l_2)\ e_2$	$(v_3\_\ l_3) e_3$	$(\omega_1\_\ \Delta\theta_1)$	$(\omega_2\_\ \Delta\theta_2)$	$(\omega_3\_\ \Delta\theta_3)$

3 Circle: Geometrical Carrier of Many Different Coordinates Systems

On a circle, it is possible to use different referentials according to the considered targets. This is the superior strategy of the circular distributions in front of the axial ones.

3.1 Azimutal or Phases Referential

This first system is the most natural one, because the phases-locating is the fundamental effect of every phasor as we discover it by observing the Figs. 7, 12.
This azimutal frame is well suited for the multiparameter analysis by associating each independant parameter (λ_k) with a particular azimut (θ_k) what is efficient for recording the influence of each parameter.
Concomitant orthoprojections: $\cos(\theta_k)$ = real part and $\sin(\theta_k)$ = imaginary part are also straight deduced consequently the Euler relation $\exp(j\,\theta_k) = \cos(\theta_k) + j\,\sin(\theta_k)$. (1a)

3.2. Chords Coordinates.

This locating system allows to display the (λ) parameter influences over any function what is carried on the chords or arcs $(OP)_j$, issuing from a fixed origin $O(\lambda_0)$ corresponding to the cancellation effect due to the cancellation of (λ) paramater.
Associated angular coordinates: by building right-angled triangles on the chords$(OP)_j$ like hypotenuses, showed on the Fig.14, we obtain in relation with the α_j angle, the orthoprojections of the chords:

$$(PH)_j = (Op)_j \cos(\alpha_j) \quad (8)$$

$$(OH)_j = (Op)_j \sin(\alpha_j) \quad (9)$$

Of this way we graphically evaluate the distribution of active and reactive powers as projections of the complex power, for every work of an asynchronous motor, as in the (Fig. 15). Here, the chords are rotor-current pictures which are influenced by the rotor-slip; and the orthoprojections are the current partitions into their active and reactive components. Due to the fact that the electrical motors are fed under a constant voltage, it is obvious that every current is also the picture of the associated power.
Synoptic tool for the Info.analysis: it is possible to consider the chords like pictures of incident Informations-flows whose ampltudes are influenced by the (λ) parameter (= quality or disturbance factor).These orthoprojections of the whole flows would be useful for the info.partition into uncorrelated parts: like into the long-time and short-time memories.This correlation between the vectors orthogonality and the independent signals links the info.classification and the geometric configurations. This can lead to a synoptic improved management of the knowledges .

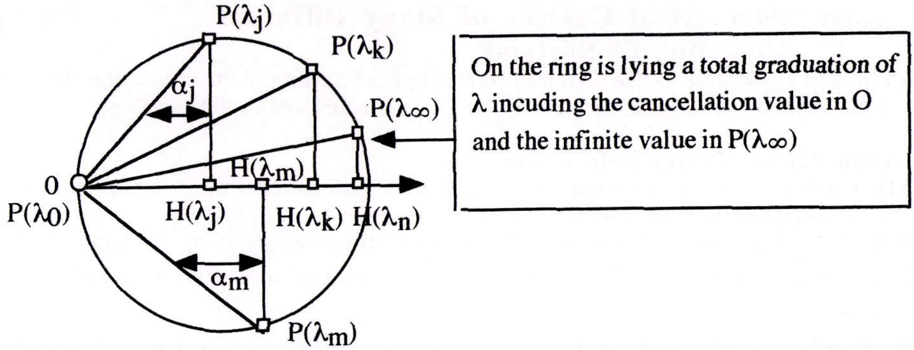


Fig.14: Chords Coordinates $(OP)_j$ and their Ortho projections $(PH)_j$ & $(OH)_j$

The angles α are the associated coordinates for computing the ortho projections of the chords. This is an additional coordinates system

$$(PH)j = (OP)j \cos(\alpha j) \quad \& \quad (OH)j = (OP)j \sin(\alpha j) \qquad (7a) \& (7b)$$

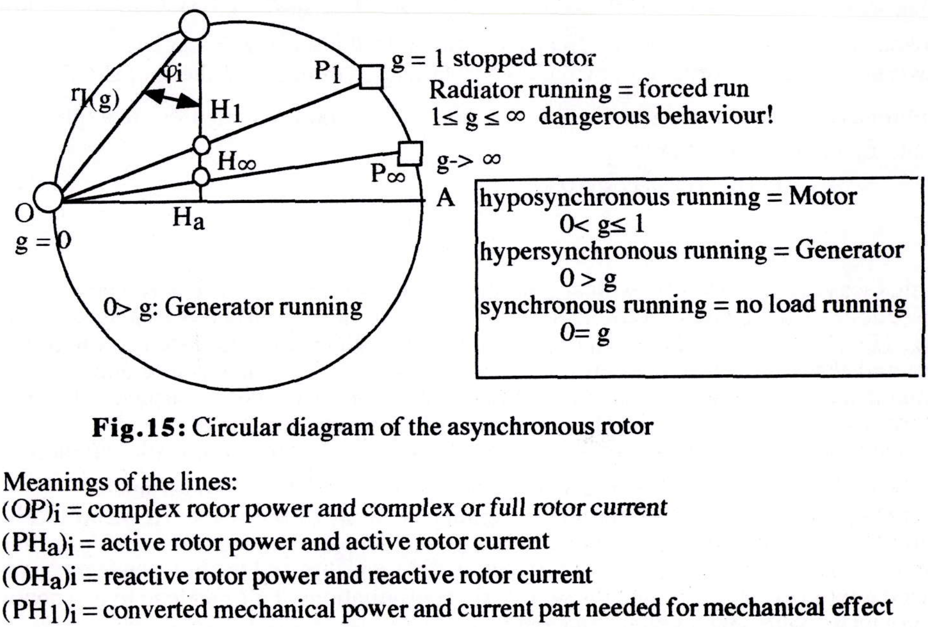


Fig.15: Circular diagram of the asynchronous rotor

Meanings of the lines:

$(OP)_i$ = complex rotor power and complex or *full rotor current*

$(PH_a)_i$ = active rotor power and active rotor current

$(OH_a)i$ = reactive rotor power and reactive rotor current

$(PH_1)_i$ = converted mechanical power and current part needed for mechanical effect

$(H_1H_\infty)i$ = dissipated power in the rotor conductors and correspondent current .

$(H_\infty H_a)_i$ = dissipated power in the rotor iron and correspondent current part

Remark: the locating in the under half circle corresponds to an inversion of the total flows which ,then, diverge from the system.(generator running)

3.3 Diameter and its Orthoprojections for Total "in flow" Constant

This way of drawing the uncorrelated components of the total power- or info.-flow may

be considered like the dual one of the previous chords system.
Here the total complex flows are constant, but the proportion between both uncorrelated components may continuously evolve. The Fig.16 displays an electrical version of this system, for a dipole with relative variation between the active and reactive elements.
The transfer for the knowledges flows is obvious,when we consider the diameter like the picture of the amplitude of the total constant info.-flow and the chords (APi) & (PiB) like both uncorrelated flow-parts.

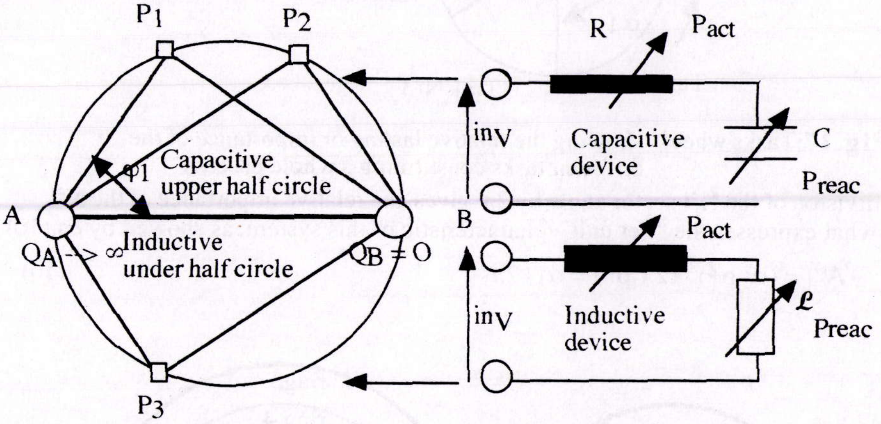


Fig.16: Electrical use of the ortho projections of the Diameter with Q = X / R = Reactive Factor

The transition from the upper half circle to the inferior one shows an inversion of the orientation of the info.flow at the input of the considered system.

3.4 Sectors Coordinates System (Fig.17)

This coordinates system is well suited for pointing out the relative importance of each task contributing to the execution of a whole process. It is a synoptical fractional dial for estimating the most expensive or longest tasks. This is a graphic tool with a performant natural "per unit" characteristic and it is well suited for presenting "Time sharing" policies.

3.5 Fractional Radial Coordinates or Circular Layers (Fig.18)

It is a "per unit" radial system adapted for evaluating the under and over values of a parameter in front of its nominal level corresponding to the unitary ray. It is well adapted for mapping the imbrication of the multilayers learning process of Dubois (1990).

3.6 Sectors and Rings Combined System

This is a superposition of both (3.4.) and (3.5) systems, what produces subdivision of each sector of (3.4.) by the number of the rings of (3.5.).Over each of these twofold divisions, it is possible to display the conjugated influence of the sector parameters and the ring ones. To win this related graphical tool, we have only to superpose the (Figs. 17, 18) over slides.

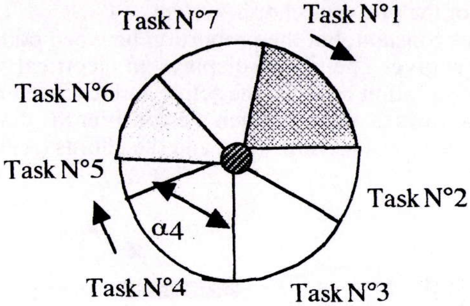


Fig.17:Tasks wheel: showing the relative lasting or importance of the different tasks constituting a whole process

The division of the N°i sector angle by 2π gives the relative importance of the N°i task what expresses the "Per unit" characteristic of this system, as showed by eq.(10)

$$A^{pu}_i = (\alpha_i \rho^2) / (2\pi \rho^2) = \alpha_i / 2\pi \qquad (10)$$

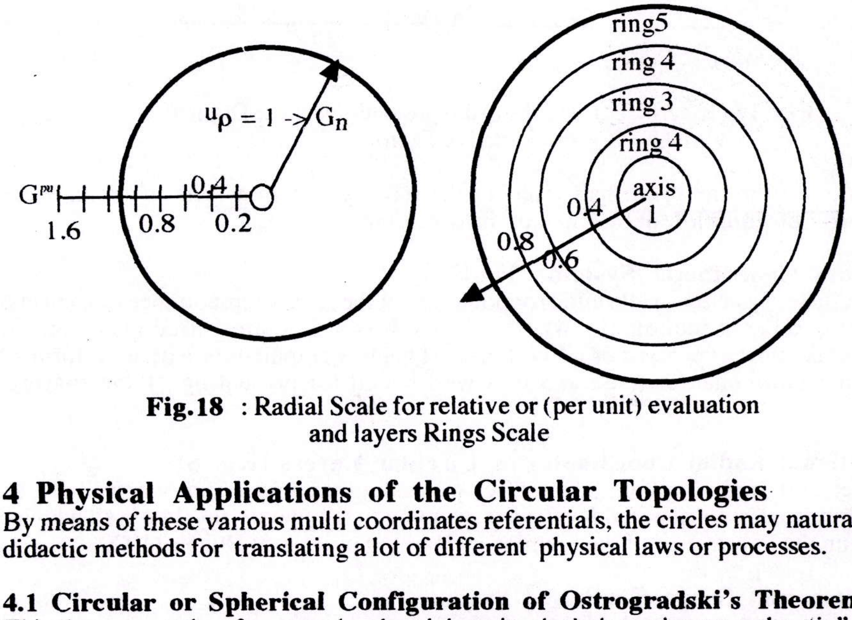


Fig.18 : Radial Scale for relative or (per unit) evaluation and layers Rings Scale

4 Physical Applications of the Circular Topologies

By means of these various multi coordinates referentials, the circles may naturally supply didactic methods for translating a lot of different physical laws or processes.

4.1 Circular or Spherical Configuration of Ostrogradski's Theorem

This theorem settles, for every bordered domain, the balance between the "in" and "out" flows ($=\Phi_{in}$ $\&\Phi_{out}$),with the amplitudes of internal sources and/or sinks .It is analogous to the "First Thermodynamic Principle". Ostrogadski's relation:

$$\Sigma_k(\Phi_{out})_k - \Sigma_l(\Phi_{in})_l = \Sigma_n(\text{sources})_n - \Sigma_m(\text{sinks})_m \qquad (11)$$

The (Fig.20) shows the Ostrogradski structure into knowledge's management .This direct extension over various domains proves the universality of this radial flows balance as the resultant effect of the (sources & sinks) set.

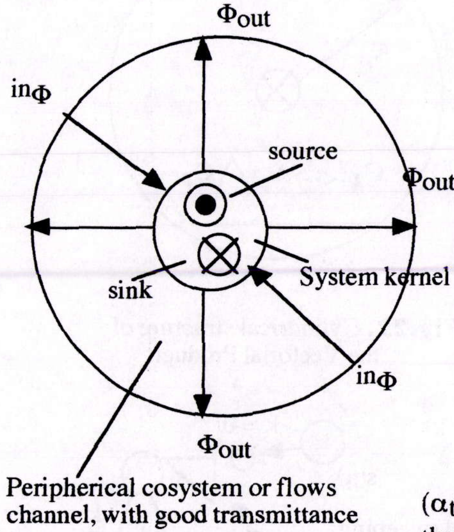


Fig. 19: Spherical display of Ostrogradski's theorem

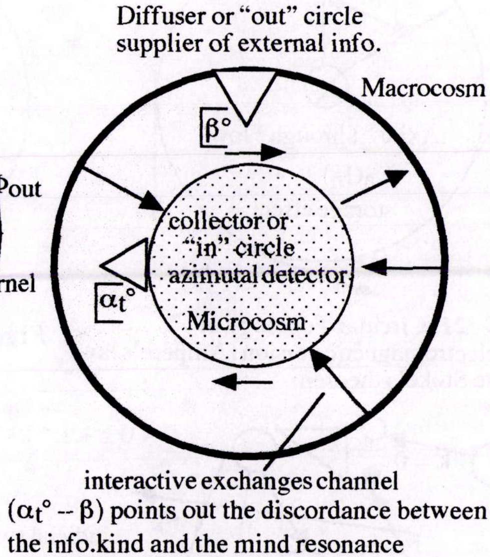


Fig.20: Memo double circle or cylinder didactic modelling of info.management

4.2 Circular or Cylindrical Configuration of Stokes' Theorem

The discrete expression of Stokes theorem (12) shows the whirling behaviour of a vector field H_θ related with the ortho axial vector flow Ψ_Z:

$$\Sigma_\theta(H_\theta)\,\Delta L_\theta \dashrightarrow \Psi_Z \Rightarrow [\,\mathrm{curl}\,(H_\theta)] \quad \text{where } \theta \text{ is the azimutal angle} \qquad (12)$$

This basic law gives the effect of the ring- circulation $\Sigma_\theta(H_\theta)\,\Delta L_\theta$ of the (H) vector field over the consequent axial "through flow" Ψ_Z , (= which goes through the "ring internal area") or inversely, showed in (Fig. 21). The H vector field has to come from a vector potential to give a not canceled effect along a closed curve.

There is also a geometric similarity between this process and the operational action of the vectorial multiplication of a radial vector with an azimutal one (Fig. 22)

This law is useful for analyzing or simulating avalanches- and storages-processes during the working sequence of any operational loop, as showed in (Fig. 23).

The polynomial Taylor's expansion of a signal s(z) over a circular neighbourhood of the point a, in the complex plane, is also similar to Stokes law as it is showed by the eq.(13)

$$s(z) = \Sigma_k \{(1/k!)\,(z - a)^k\, D_Z{}^k.[s(a)]\} \qquad (13)$$

To elaborate this right member, it is possible to use an operational loop with the operational ratio $(1/k!)\,(z - a)\,D_Z.(.)$. It is the loops operator.

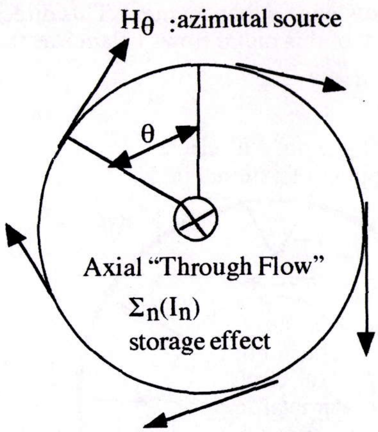


Fig. 21: Circular Topology of the electromagnetic version (Ampere's law) of the Stoke's theorem

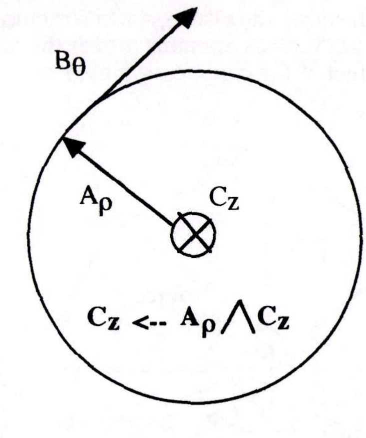
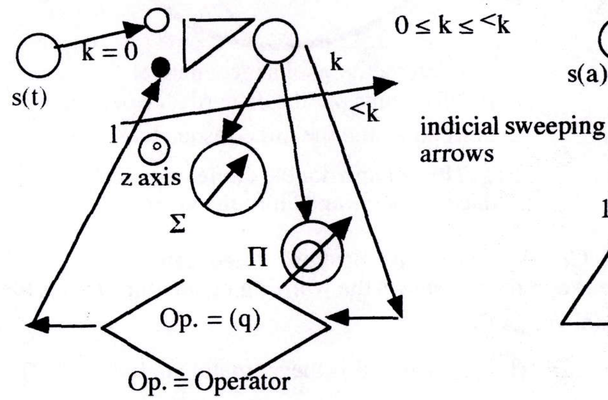


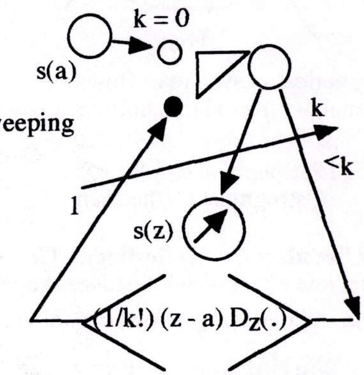
Fig.22: Cylindrical structure of the Vectorial Product:



$$\Sigma = \Sigma_k[\mathrm{Op}^k.(s)]$$

$$\Pi = \Pi_k[\mathrm{Op}^k.(s)]$$

Fig. 23: Operational Loop for computing simultaneously the addition = Σ and the multiplication = Π of the terms of the geometrical progression of ratio = Op.



$$s(z) = \Sigma k \{(1/k!)(z-a)^k D^k{}_z.[s(a)]\}$$

Fig. 24: Operational Loop for computing the Taylor Serie in a complex space

Besides, every feed back action is mathematically described by the addition of terms of an operational progression, which is a geometric one with an operator as ratio.

4.3. Translators correlated with the Circular Topologies.

The translators or generalized Z transformations are the convolutions which allow exploration and structuration of their spaces.They play like internal locomotives or lorries

for distribution and detection of signals .
4.3.1. Cylindrical Spaces

Cylindrical coordinates: ρ: radial one, θ: azimutal one, z: ortho axial one
In parallelisme with these coordinates, we have also 3 displacements- possibilities:

a) radial translator for the transition from ρ_i to $\rho_{(i+k)}$

b) azimutal or tangential one for the transition from θ_j to $\theta_{(j+k)}$

c) axial one for the transition from z_m to $z_{(m+k)}$

4.3.2 Spherical Spaces

Spherical coordinates: ρ: radial one,θ: colatitude, φ longitude
In parallelisme with these coordinates, we have also 3 displacements- possibilities:

a) radial translator for the transition from ρ_i to $\rho_{(i+k)}$

b) colatitude-translator for the transition from θ_j to $\theta_{(j+k)}$

c) longitude-translator for the transition from φ_m to $\varphi_{(m+k)}$

5 Derived Topologies from Circular Configuration

5.1 Homeomorphisms of Circular Topologies

Both configurations are homeomorphic when it is possible to transform the first one into the second one by continuous deformation without any cut or break. Consequently every ellipse is homeomorphic with circle and every ellipsoïd is homeomorphic with sphere. These elliptic structures may show propagations through anisotropic spaces.

5.2 Expanded Circular Topologies

Various curves show azimutal pseudoperiods in adjonction with some stretching or drifting actions.We have collected their main characteristcs in the Table 2:

Table2: Presentation of the kinetic characteristics of Helical and Spiral Topologies

Particular Topologies	**Spiral**	**Helix**
Kinetic actions	Rotation and Radial Expansion. Planar displacement. Double convolution.	Rotation and Ortho Axial Slip. 3Dim. displacement. Double convolution.
Specific uses	Laplace's Transformations and the associated space.	Stokes' Law. Accumulations Loops. Feed back Actions.
Vectorial Presentation	$v_\rho(e_\rho)$ & $w_z(j_z)$	$v_z(e_z)$ & $w_z(j_z)$

Remark about Laplace-Transformation: (Lp.)-Space is embedded on spiral trajectories, asymptotically converging to the origin because the Op.{exp $[-(\sigma + jw)t]$} has to carry the dealed signal to the origin along a convergent spiral trajectory.

5.3 From Linear to Circular Topologies

For transfering the linear distibutions into the circular ones, we have to consider this useful convolution: similar to an Isomorphism, because it exists a bireciprocal correspondance between every point of both sets as in (Fig.25)

The correspondant transfer relation is : $\theta \leftarrow (a / L)\, 2\pi$ (14)

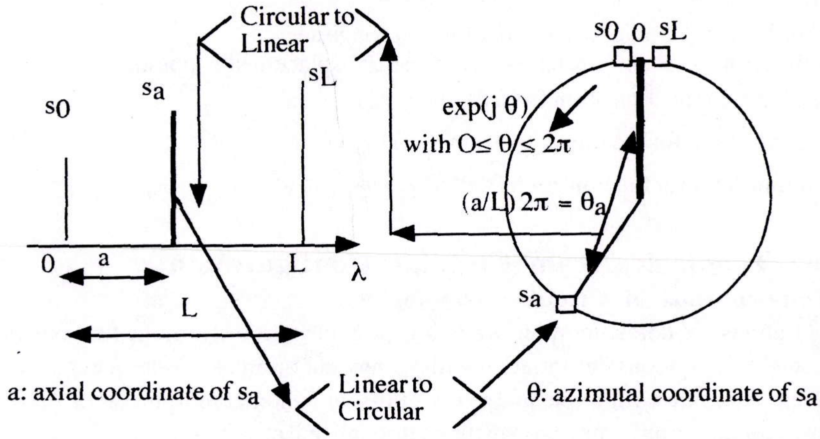


Fig.25: Presentation of the bireciprocal "Linear to Circular" Convolution

5.4 Roundabouts and Space Phasors

The present insertion of the many "Roundabouts" in the road nets, with a view of reducing the vehicles collisions and the traffic-congestions, brings a neguentropical increasing in the traffic.These azimutal collectors and diffusers play like space phasors because the movement of any vehicle may be described by $\exp[j(\alpha_{in} - \beta_{out})]$. where α_{in} is the angular coordinate of the "in"-road and β_{out} is the angular coordinate of the "out"-road of this vehicle.

5.5 Circular Modelling of the Operational Behaviour of a Neuron

We try to give a circular mapping of the neuron picture from Dubois D.(1990) in Fig.25. We have splitted the neuronal behaviour into two parts:

a)the peripheral zone (dendrites connections) for info. collecting, assimilated to Ostrogradski's action;

b)the central zone(axonal axes) for response sending off, assimilated to Stoke's topology. This circular structure allows a partition of the behaviour of the neuron to distinguish the functions and positions of dendrites from the axones ones .

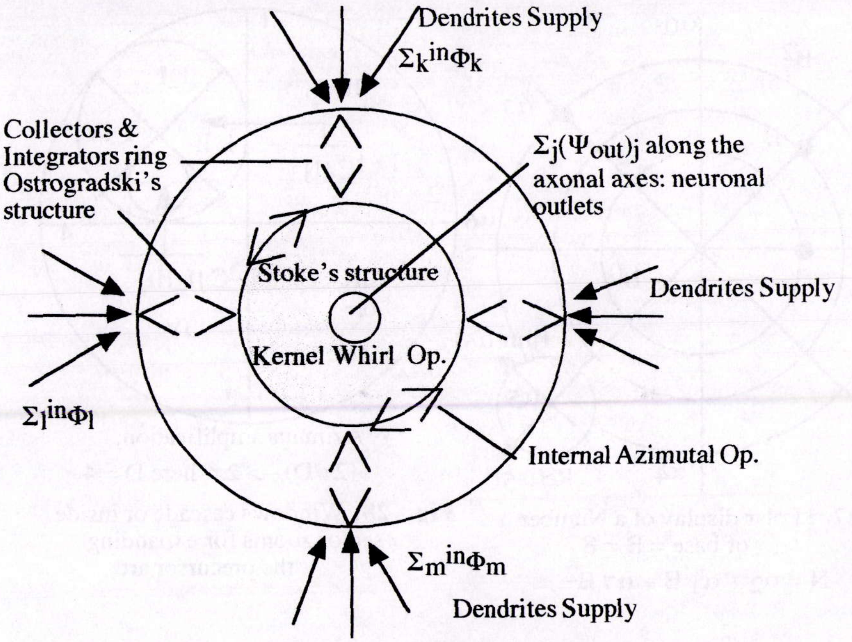


Fig.26: Circular modelling of a simplified neuron splitted in a peripheral Ostrogradski zone and in a kernel Stokes one

5.6 Some Particular Use of the Polar Mapping

A few of these ones are presented on the (Fig. 27, 28 29).By looking at these pictures, it is obvious to discover their additional didactic benefits.

The Fig. 27 displays a particular phasor adapted for mapping numbers in any numeric basis. The radius of each circle indicates the power of the chosen basis and the angular division of ($2\pi/B$) corresponds to the number (B) of elements in this basis. Each black point depicts the term ($\alpha_i B^p$) The same topology is also suited for the map of polynoms, where B is their variable. When an element is a complex quantity it is possible to open a local phasor at this point to map this one, as indicated in α_5 of (Fig. 27)

In the Fig.28 is presented the start of a cascade of circular windows for the amplifications of any quadrant. This procedure can act as a scaling vector.

The first circle ${}^1C$ in the first quadrant splits this one into 4 underquadrants [${}^1C_I$, ${}^1C_{II}$, ${}^1C_{III}$, ${}^1C_{IV}$].This splitting procedure can be continued by dividing the underquadrant ${}^1C_{II}$ in 4 other underquadrants [${}^2C_{II\_I}$, ${}^2C_{II\_II}$, ${}^2C_{II\_III}$, ${}^2C_{II\_IV}$] and as far as necessary.

The Fig. 29 shows a circular topology to enlight the neighbourhood of a notion and the transition to the (diametrally) opposite one throughout the intermediary subjects.

The introduction of the circular topology relates algorithms for hypertexts with the geometric symmetries of phasors, what is a powerful synoptic gain and a neguentropic increase.

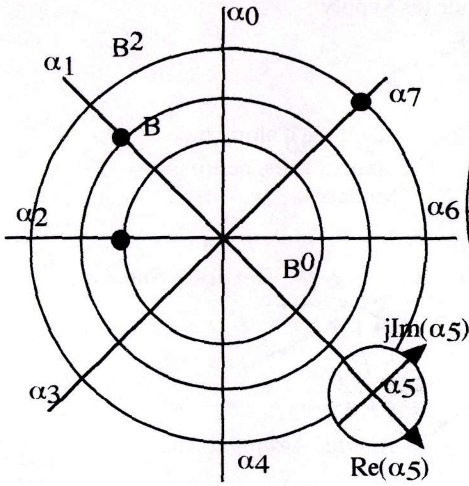
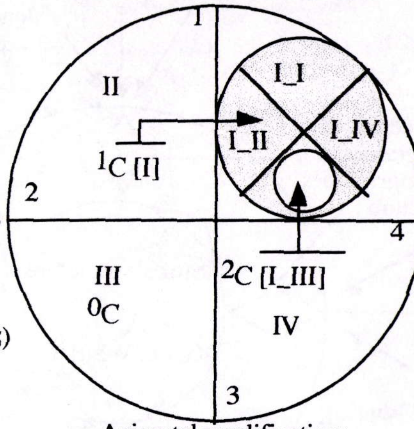


Fig.27 : Polar display of a Number of base = B = 8

$N = \alpha_2 + \alpha_1 B + \alpha_7 B^2$



Azimutal amplification:

$(2\pi/D) \dashrightarrow 2\pi$ here D = 4

Fig. 28: Windows cascade or inside sector zooms for expanding the precursor arc

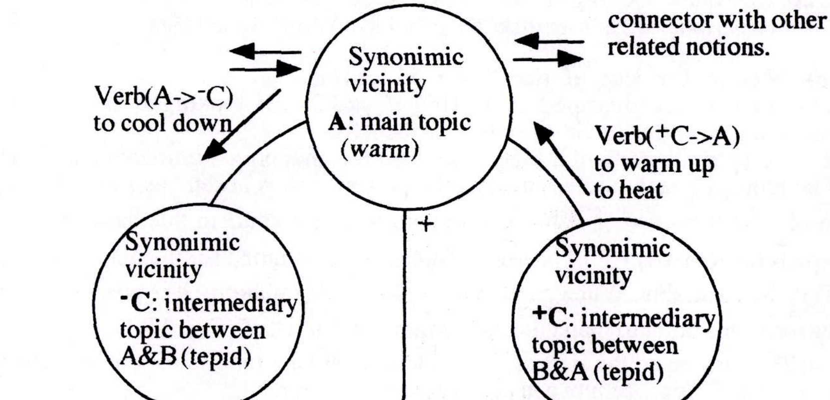


Fig. 29: Topic wheel: synoptic mapping for classifying the knowledges
It supplies an aid-tool for building a logical structured net of knowledges.

6 Conclusions

The objective of this communication underlines the power of circular reference systems for the storing and computing of the knowledges in many domains.
Here is shown the extensive use of the phasors in many technical and scientific areas.
Indeed the phasors can govern the synoptic distributions of the periodic structures. They are worthwhile tools to help in the analysis of the systems behaviours by means of "Fourier transformations" and "Wavelets transformations".
In the part 3 we showed the different coordinates sets in phasors alike azimutal, radial , sectors, chords and their projections which supply a large flexible analysis tool for any periodic behaviour. Besides, for illustrating the particularities of these polar configurations, we can continuously and everywhere dispose of the "watch dials" which constitute cheap didactic and synoptical isomorphisms. .
Consequently these circular mappings are advisable for improving the efficacities of the learning and teaching procedures.The choice of a well suited referential for storing infos. may favourably influence their management: because it exists a complementary duality between the referential (= covariant component) and the embedded subjects (= contravariant components).
By recording the structural similarities between the various treated domains, this paper can contribute to improve the learning procedures and to save understanding time, what can promote didactic progresses.
At this point I can underline the use of the Infos.transfer into the circular topology, explained in the (5.3) part. By studying a lot of situations, it is the basic convolution, easy to make and helpful for detecting the causal parametric influences.
Due to the search of structural similarities over different domains for winning new common sight, we hope to bring an additional brick in the new universe of the "Anticipativity".

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