Resonances as Stabilizing Agents

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Abstract

Here we develop the analysis of resonance mechanism. We show functional connection between resonance and wave generation. On the other side the echoing horizons exert a particular resonance over the anticipatory trajectories and may be considered as stabilizing operators. We indicate the functional association between loops and curl(**V**) operators. Loops and curl(**V**) operators will be considered as resonators to maintain the coupling between pairs of spaces as between the electric and magnetic spaces. We observe Fourier transformation which relates the time signal evolution to the frequencies of their resonators. Consequently there is a link between resonators and oscillators. Besides resonating aromatic molecules play as light filters and the mirror as optic resonances between objects and their pictures.

Keywords: Resonances in Matter, Curl(**V**) Operator, Loops, Pigments, Waves and Mirror effects.

1 Introduction

This study proposes to explore the surprising world of the resonances, what supports a lot of physicochemical mechanisms and may also generate our personal attractions for some specific colours, shapes and domains. Indeed the resonances are the motivators for many behaviours in various sciences and techniques, from geometry, mechanics to chemistry. Resonance likely lies hidden in the bottom of our subconscious for colouring our ideas and our feelings. We let observe that resonances act by means of alternate waves exchanging reactive flows between conjugated resonators. This action plays as dynamic stabilizing agent and can develop oscillating systems at a well defined frequency, or resonating frequency, related to the composition of each resonator and to the structure of the environment where the resonating pair is located. Resonance between the bodies (A) and (B) will be noticed (A←→ B) which is the chemical notation. The detection of resonating phenomena sometimes needs an acute sensitive perception because we may meet these ones on various grades of complexities, in a large range of matters. Action and Reaction law, basic behaviour very frequent in our universe, seems the most simple case of resonance effect. The resonances will permit to discover common characteristics supported by different systems and will simplify the determination of their evolution. Indeed any equilibrium factor supplies system inertia what is advantageous for any projection through the future.

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2 Description of Resonance Mechanism

Here, we consider the most usual resonating system composed of a pair of resonators.It presents a sequence of 2 steps. Each step corresponds to a direction of the power streaming between both resonators. The resonating frequency (f_{rs}) is produced by the rate of direction inversion. Any resonance systems behave like oscillators (Figs:1-2).

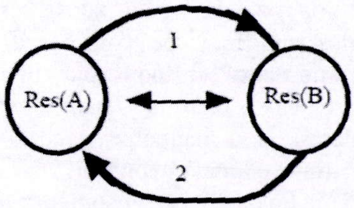


Fig.1: Description of a resonant Device

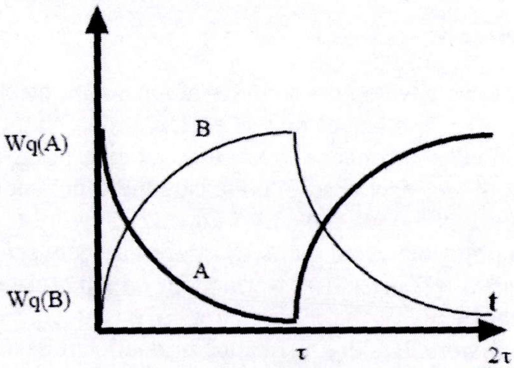


Fig.2: Time Evolutions of Energy level in each Resonator

Here after we describe the energy variations during each step:
First step what corresponds to an energy flow from the (B) resonator to the (A) resonator. This is caused by the energy (=W) level drop in (B) whose (W) level is decreasing and the energy absorption by (A) whose (W) level is increasing. (Fig.2)
Second step what corresponds to an energy flow from (A), the giver, whose (W) level is decreasing to (B), the receiver, whose (W) level is increasing.
This sequence of inversed steps acts like a reactive (push- pull) device because the (W) levels in each resonator oscillate in opposition. (Fig.2). The extreme states in each resonator remain constant and this causes the dynamic stabilization of the working. In the most of resonators, the range of ($W_{up} - W_{low}$) points out their (W) storage capacity.

Table1: Dynamical Behaviour of (A← →B)

	Resonator (A)	Resonator (B)
First step	(W) Receiver	(W) Giver
First step	Increasing (W) level	Decreasing (W) level
End of First step	Highest (W) level	Lowest (W) level
Second step	(W) Giver	(W) Receiver
End of Second step	Lowest (W) level	Highest (W) level
Storage capacities	$C_{st}(A)$	$C_{st}(B)$

We define some parameters to quantify the performance of the resonating systems. They are deduced from the electromagnetic description of the resonance behaviours

Table 2: Resonance Parameters

Parameters	Effects	Unities
Conjugated resonators (A←→B)	$D_tW(A) = - D_tW(B)$	[J]
Environment Transmittance: $^{A}Tr_{B}$	Channelling of (W) exchanges	$[\Omega]^{-1}$
Coupling flow	W(A←→B)	[J]
Level variables in resonators governing flow direction	if VA<VB, then W(A←B)	$[V] = [J\Omega/t]^{1/2}$
Grad(V), inside the resonating device	Indicator of (V) slope	[V/m]
Resonance pulsation ω_{rs}	$\omega_r = 2\pi f_{rs}$	[rad/s]
Coupling factor M(A,B)	$M(A,B) = {}^{A}Tr_{B}(C_A C^B)$	[0]
ω_{rs} related to (CA,CB)	$\omega_{rs} = 1/(C_A C_B)^{1/2}$	[rad/s]

This resonance composed of 2 steps is a complete resonance. Besides it acts like an ideal reactive oscillator, without any dissipation, and this is practically impossible to realize. Therefore we introduce a dissipation element, noted by R which influences the $^{A}Tr_{B}$ value, because

$$({}^{A}Tr_{B})^{-1} = {}^{A}Z_{B} = {}^{A}(R + \mathbf{j}X)_{B} \qquad (1)$$

Where $^{A}X_{B} = {}^{A}C_{B}$ = Channel reactivity

Unity explanation:

[J] = Joule: energy unity

[W] = Ohm: impedance unity $[W]^{-1}$= $(Ohm)^{-1}$: admittance unity

[JW/t] = [V] = Volt: voltage unity

[V/m] = Volt per meter: electric field unity

[rad/s] = Radian per second = angular frequency unity

3 Mathematic Description

The circular functions: $\sin(\omega_{rs}t)$ and $\cos(\omega_{rs}t)$ follow a perfect oscillating evolution and subsequently are used for the describing of the oscillators or resonators. Besides we know that: $D_t^2(A\sin(\omega_{rs}t) = - A\,\omega_{rs}^2 \sin(\omega_{rs}t)$ (2)

Rel.(2) may also be written , for a generalization, as follows:

$$[D_t^2 + \omega_{rs}^2](\Psi t) = 0 \qquad (3)$$

Where $\Psi t = A(\omega_{rs}t)$: wave function

The solution of this differential equation is:

$$\Psi t = A\exp(\mathbf{j}\omega_{rs}t) + B\exp(-\mathbf{j}\omega_{rs}t)] \qquad (4)$$

Relation (4) displays the superposition of a pair of rotations with the same speed, a progressive one and a regressive.

On the Laplace space, (Ψt) is represented by a pair of conjugated imaginary points: $\mathbf{j}\omega_{rs}$ and $-\mathrm{j}\omega_{rs}$, which are the marks of a resonating system without dissipation.

Modification for a dissipative system caused by the introduction of an attenuation factor (a) <1, what corresponds to the following differential equation :

$$[Dt^2 + 2\omega_{rs}\alpha Dt + \omega_{rs}^2]\ \Psi t = 0 \qquad (5)$$

The new wave function is: $\Psi t = \exp(-at)\ [A\exp(\mathbf{j}\omega_d) + B\exp(-\mathbf{j}\omega_d)]$ (6)

Where $a = \alpha\ \omega_{rs}$ is the attenuation exponent,

$\omega_d = \omega_{rs}(1 - \alpha^2)^{1/2}$ is the damped pulsation.

On the Laplace space, (Ψt) is represented by a pair of conjugated complex points, with a real part ($a = \alpha\ \omega_{rs}$) and an imaginary one (ω_d).

a is the mark of a dissipative resonating system.

Dynamical behaviour of resonating systems: the alternate (W) flow between the conjugated resonators supplies the dynamic stability because the level ranges (W_{up} - W_{down}) in each resonator are time invariant.

4 Resonance and Symmetries

To discover a symmetry it is necessary to consider at least, a pair of points or figures, whose an element may be conjugated to its homologous, in relation to their symmetry centre. Indeed the symmetric elements play as static resonators because they create a geometric pair, defined by their symmetry centre which is the generator operator of this configuration. Besides the pair of symmetric elements may be permuted by means of simple transformations, whose partial rotations are the most frequents. (Fig. 3)

Circular symmetries give sets of multiple resonances which are illustrated by the regular polygons. Indeed the regular polygons with (n) sides are composed by (n) isosceles triangles which may be permutated around the polygonal centre or the figure centre.

Here there are (n) apices which play as static resonators and their reciprocal resonance is pointed out by a rotation of a ($2\pi/n$) magnitude. These transformations introduce movements or a kinetic behaviour what produces mobile configurations and converts the static resonators into dynamic ones. To give a firm base to these considerations we have to remind Euler's relation:

$$\exp[\mathbf{j}(2\pi/n)t] = \cos(2\pi/n)t + \mathbf{j}\ \sin(2\pi/n)t \qquad (7)$$

Relation (7) shows the dependence between a rotation: $\exp[\mathbf{j}(2\pi/n)t]$ and their orthogonal projections which are oscillating signals: $\cos(2\pi/n)t$ and $\sin(2\pi/n)t$ (Fig. 4)

This deduction seems important because it establishes that rotating configurations provide oscillations between the symmetric resonators. Consequently they win a dynamical behaviour like in each resonance.

It is also useful to remind that the foci in conics are generally symmetric points around the figure centres.

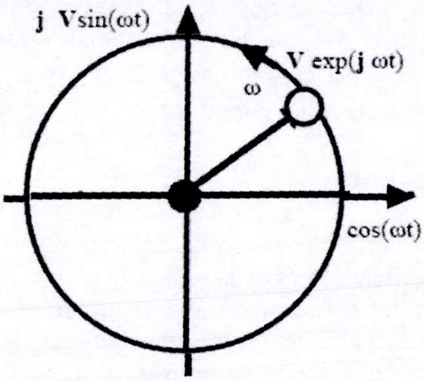


Fig. 4: Illustration of Euler's relation

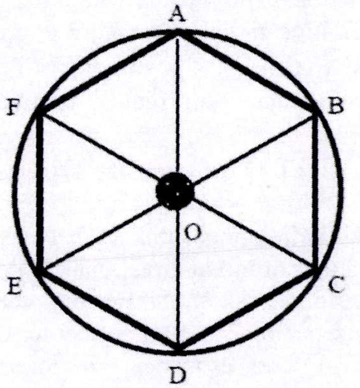


Fig.3: Hexagonal Symmetry
6 isometric Triangles

5 Resonance Effects

It is advantageous to inventory the various resonance indicators to be able to detect any resonating behaviour in many technologic applications and scientific phenomena.
The resonating behaviours oft lead to procedure standardization what presents substantial gain for studying and mastering these actions. A list of the main resonance effects is noted in the table 3

Table 3: Resonance Effects

1	Resonators as foci in their system
2	Resonators act as antennae for exchanging flows or waves
3	Bidirectional channels or loops between resonator pairs
4	Conjugated points or intersections of topologic configurations
5	Mirror effects or symmetries for permuting the focus roles
6	Resonating frequencies for producing peaks of absorption or emission
7*	Reactive tanks with constant extreme states: stabilizing agent
8**	Anarchic amplification of the oscillations: destroying agent

*The usual resonances oft play as stabilization factors for system evolutions because the resonators act as reactive tanks. Resonance behaves as a spring and keeps constant the levels of extreme states of the conjugated resonators. Therefore resonance introduces the derivative or integration operators along the time what bridges past, present and future. Consequently to this effect, the forecast of evolutions will be extrapolated from the recorded past information. It results that any resonance occurrence may help to stabilize the anticipatory procedures.
**However there are other resonating phenomena which involve anarchic evolutions of the internal states of the system components. Here we meet destroying resonances which progressively amplify the oscillations magnitudes and involve whole breakdown of the structures. These resonance types (= avalanches) heavily damage the system

functions and make then outer use. However these destroying phenomena give a definitive certain forecast of the future system behaviour because the system nevermore will work! These destroying effects occur when the periodic forces [$\mathbf{F}(\omega_{rs})$] present the resonating system frequency and is noted like [$\mathbf{F}(\omega_{rs})$ ←→ System(w_{rs})]

6 Curl (A) as specific Operator of Resonance

The bidirectional linkage between a pair of conjugated resonators, can be transformed in a pair of mono directional arcs what inserts the resonators in a loop. Any loop may be considered as the trajectory for a curl or rotation operator applied to a vector, consequently to Stokes theorem. This consideration bridges the gap between loop, curl(**A**) and resonance. The loop brings a geometric support to resonance, the curl(**A**) supplies a vector meaning. The curl operator allows a bond between 2 spaces which will become consequently a pair of conjugated resonators. (Fig.5)
Maxwell relations display a powerful application of inter space resonance due to an opposite pair of curl operators, as shown hereafter.

$$\mathrm{Curl}(\mathbf{H}) = \mathbf{J} + q\,\mathbf{v} \qquad [\mathrm{A\ m^{-2}}] \qquad (8)$$

$$\mathrm{Curl}(\mathbf{E}_{dy}) = -\,\mathrm{Dt}(\mathbf{B}) \qquad [\mathrm{V\ m^{-2}}] \qquad (9)$$

Where: (**H**) is the magnetic field, **J** is the surface density of electric current
q is an electric charge, **v** is the velocity of this charge
$\mathbf{E}_{dy}$ is an induced electric field, **B** the magnetic induction ($\mathbf{B} = \mu\mathbf{H}$)
The Maxwell relations indicate the operational linkages between the electric and magnetic spaces. This supports the electromagnetic resonance.(Fig. 6) [3]

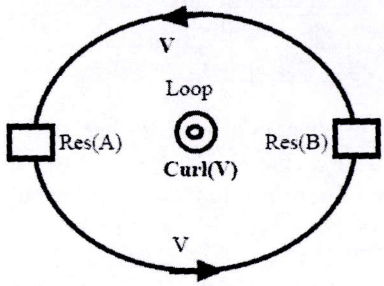


Fig.5: Loop between 2 conjugated Resonators

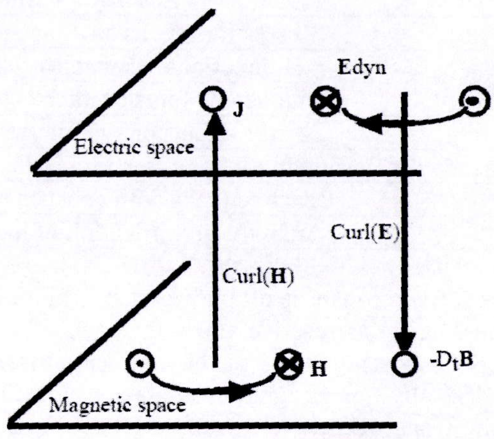


Fig. 6: Coupling between electric and magnetic Spaces

7 Loops as Resonance Suppliers

From the equivalence between loop and resonance, established in chapter 4, each sequential accumulation effect through an iteterative operator is similar to a resonance, decreasing if the loop operator produces a damping or increasing if this operator gives an amplification. This case of the increasing resonance is very dangerous and can involve the system explosion or dislocation. Similar to an avalanche.

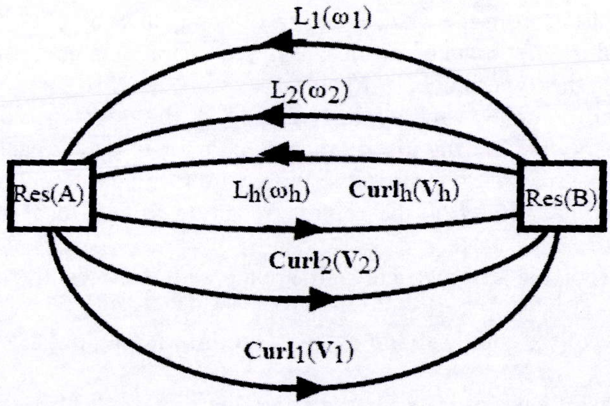
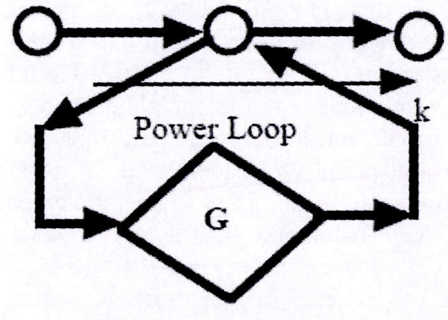


Fig. 7: Set of harmonic Loops between 2 conjugated Vector Resonators

The geometric expansions are well known cases of loop resonance, where the loop operator is their multiplication factor (r). When the (r) value is lower than 1, this gives a decreasing or stable resonance, but when the (r) value is higher than 1, it produces an increasing resonance or divergent resonance (= avalanche). The damped numeric resonance appears by the sum of the successive terms of this progression given by the following formula:

$$\Sigma_k (n_0\, r^k) = n_0/(1-r) \qquad (10)$$

Where: n_0 is the first term of this progression, (r) is the amplificatory factor between two successive terms. (Fig. 8)



$$Y = X + G\,X + (G)^2\,X + (G)^3\,X + \ldots$$
$$Y = X\,(1 + \Sigma_k\,(G)^k)$$

Fig. 8: Series of repeated operational Loops

The extrapolations, following Taylor's relation, may be also considered like resonance effects because they may be illustrated by operational loops (Fig. x)

Taylor's relation: $g(z_0 + \Delta z) = g(z_0) + \Sigma_p [\mathbf{D}^p g(z0)]/ p!$ (11)

Where: $g(z_0)$ is a signal located in a phasor, $\mathbf{D}^p$ the derivative operator of (p) order.

8 Geometric Resonance in the Conics

These curves, resulting from the planar section of cones may be classified in 2 groups: the conics with a single branch: circles, ellipses, parabolas and the conic with 2 separated branches: the hyperbolae. [5-6]

Actions of the foci in conics: each conic is shaped by the geometric distribution of its focal pair. Indeed the foci are the discriminatory pair for selecting each conic type and consequently the foci play as shape drivers. Where are located the foci in each conic?

For circles: the foci are located in the centres, resulting from a focal absorption by the centres.

For ellipses: the foci are symmetrical pairs relative to their centre; (F_1 F_2) is finite distance.

For parabolas: one of the foci is flying away to the infinite region, along the symmetry axis.

For hyperbolae: each focus is located in the concave or internal subspace of each branch with symmetry relative to the centre. The external region is located between the branch pair.

The pairs of foci play as conjugated resonators. This involves that every emission from a focus is necessary received by its conjugated one.

In ellipses and parabolas, the curve points act as reflectors or mirrors, performing the trajectories between the conjugated foci. These curves are impenetrable and constitute tight borders between internal and external subspaces.

On the contrary, the hyperbolas have to be porous to allow a resonance linkage between the foci located in the concave side of the 2 different branches.

At first we will explore the resonance properties of the conics with a single branch.

Circles: the pairs of foci are located in the centres what could provides internal resonances inside the centres, if it would be possible to explore and to detect the communications in the subspace inserted in these centres. The possibility of resonating centres shows the insertion into a point of cascades of infra universes resulting from a infra analysis. These very near focus locations point out that it is impossible to exchange information between the inside points and their external neighbourhoods. From these affirmations it is possible to deduce that concentric circles are mutually hermetically sealed because any circle is like a point consequently to a scale modification. Circle and point periphery play as impenetrable armours against the wave transit and these impenetrability phenomena between inside and outside are probably caused by the isotropy of these forms. Indeed in each circle any internal wave is reflected to the internal domain. It is similar for any external incidence which is also reflected to the external domain. These circular armours create anti resonating effects between their internal worlds and their external ones. It is convenient to remind that circles are special elliptic forms [5-6].

Ellipses: the foci are symmetrically located along the symmetry axis. Here the mirror effect of the periphery is necessary to establish a linkage between the conjugated foci. (Fig.9)

Parabolas: it is to remind that each parabola derives from an ellipse by a continuous extension what throws a focus of the pair to the inaccessible asymptotic zone. The parabolic form is used to link an emitter and a receiver very distanced from each other. The curve points play as mirrors to focalise the parallel radii to the near focus. (Fig. 10)

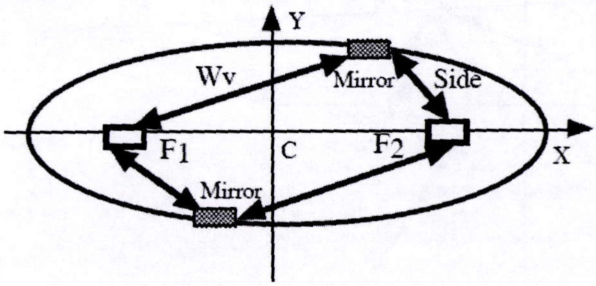


Fig. 9: Ellipse with its focal Pair.

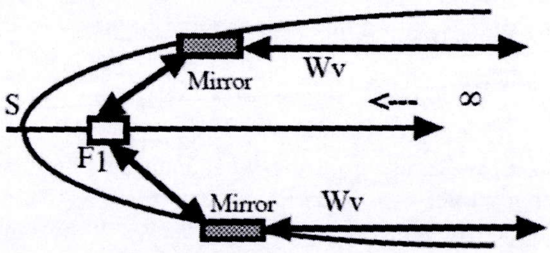


Fig.10: Parabola: its Focus (F_1) related to (F_2), very far

The hyperbolic resonance, as already announced, is different because it is necessary to pass through the 2 branches to join the 2 foci. The emission radius issued from a focus cut the nearest branch through an emission window, without no deviation to reach the second branch along the same straight line. It is the first focal vector. At this transit point the radius penetrates this branch where it is deviated to the receiver focus by a refracting point. It is the second focal vector. It is obvious that the opposite emission undergoes the same operations through the branches in the order of their meetings. From this ballistic optics, we deduce that each point of the branches can play 2 different roles: emission window from the concave side to the convex side and refractor window from the convex side to the concave side.

Focal vectors constitute bonds or transmission channels between the 2 hyperbolic branches, what gives an associative resonance.

This set of resonances in conics is supported by pairs of conjugated foci and is suited by the curve shapes.
The quadrics such as the spheres, ellipsoids, paraboloids, and hyperboloids exert similar resonating behaviours in their three-dimension spaces, because they also contain foci pairs along their axes.
Each focus may be considered like an antenna.

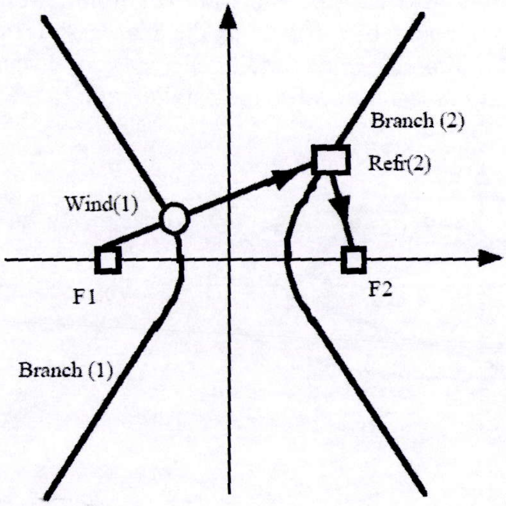


Fig.11: Hyperbola with a Wave relating its Focal Pair: F_1 and F_2

9 Intersections between Curves

Each intersection point may belong to a few crossing curves what induces a few sub points, each located on each crossing curve. An intersection can play as a few communication gates or very short channels between these crossing curves at the same speed.
Each sub point may be considered as a resonator conjugated with the other ones. Each intersection may be equivalent to a mini resonating sub system. This resonance topic transforms sets of secant curves into nets of channels for transporting or exchanging energy flows or travelling waves.
Vector resonance: sets of secant loops support multi resonance between their common pair of intersection points. Because each loop performs a resonating behaviour between each resonator pair, there are 2 different channels when a pair of loops are crossing. Each crossing loop appears like a resonating channel between their intersection points. Consequently this pair of crossing loops introduces the vector resonance. To make a generalization of this procedure, we have to consider (n) crossing loops on the same pair of points: the intersection points are vector resonators and the (n) loops illustrate the (n) components of this vector resonance. For noticing this multi loop resonance, we use the following relations

2 dimension resonance: L1 + L2 → Res1 + Res (12)

Where: Res_1 works along loop L_1 and Res_2 along loop L_2

N dimension resonance $L1 + \lambda\, L2 \rightarrow [Res_n]$ (13)

Where: λ is an integer parameter with (N) possible values defining N different loops supported by the loops L_1 and L_2 ,with the same intersection points.

Besides $\lambda = 0$ gives the L_1 and $\lambda \rightarrow \infty$ gives L_2

Loop vector and harmonic phasors:

Because a phasor is a rotating complex plane with a constant angular frequency, when each loop (L_h) is run at the speed ω_h, it acts like a (h) harmonic phasor. Besides each loop can support a curling operator and consequently a set of (N) secant loops at (w_h) or phasor associate a specific (h) vector curling operator.

Here the resonance harmonics are illustrated by loop sets. (Fig.7)

Because (N) harmonic phasors or loops may define (N) frequencies ($f_h = 2\pi\omega h$), these loops select (N) levels in a discrete Fourier's space. We may consider each secant loop like a Fourier's component. Fourier's transformation indicates that the oscillator sources of each evolution are defined by the set of its specific angular frequencies (ω_h) what provides the well known following relation:

$$S(t) = \Sigma_h [A_h \cos(h\omega t) + B_h \sin(h\omega t)] \quad (14)$$

Where A_h is the projection of S(t) on the (h) even axis and B_h on the (h) odd one.

Fourier's Phasors are orthogonal between each other: indeed each (h) harmonic phasor is moved by means of a circular operator : $\exp[jh\omega t] = \cos(h\omega t) + j \sin(h\omega t)$

Besides, it is well known that the $\cos(k\omega t)$ and the $\sin(h\omega t)$ form orthogonal series, because: $\int \cos(h\,w\,t)\cos(kwt)dt = 0$ and $\int \sin(hwt)\sin(kwt)\,dt = 0$

From such a way, it is established that 2 phasors of different angular frequencies are orthogonal and cannot exchange energy flows between them. Consequently each Fourier's phasor keeps its own energy during the time. A phasor can exchange energy with vibrating space of same frequency as its own. All these deductions synoptically prove Parseval's relation which asserts that the total power of a signal is equivalent to the sum of its harmonic powers:

$$W[s(t)] = \Sigma_h Wh(Sh) \quad (15)$$

10 Curling Operators as Homogeneity Creators in fluid Spaces

Because the curling operators are developed by circular vectors, they develop turbulence in any fluid space if these vectors run along their loops with an angular velocity (ω_h). This turbulence performs a mixing of the constituents in its domain and develops a convection mechanism. These kinetic behaviours improve the homogeneity of the domain. Because the curling operators and loops are illustrating devices of resonance, we deduce that resonances may develop space fluidic uniformity and consequently play as space stabilizing agents.

11 Resonance in linear Operators

Each operator has characteristic directions where it works with maximum intensities designed as its characteristic values. These directions whose number corresponds to the operator grade, define the geometric referential of the operator. Relation (16) describes the transformation exerted by an operator along one of its k characteristic direction:

$$[Op]\ G_k = \lambda_k\ G_k \tag{16}$$

Where G_k is a specific function along this k direction with λ_k as associated specific value. (Fig.12)

This working way contains a resonance specificity which is shown by a maximized action. The resonating pair is composed of the operator and its specific function.

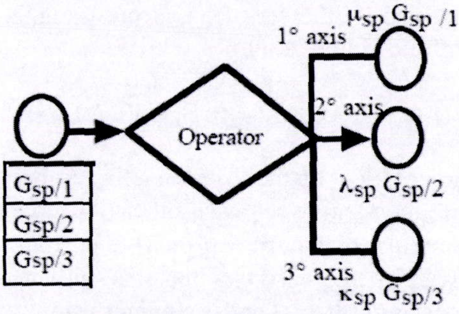


Fig. 12: Resonating operator with its specific Functions along the specific Directions in its associated Space

12 Chemical Resonance

In the most matters there are internal vibrations whose frequencies are related to the molecule architectures. This phenomenon is produced by the thermal energy related to the temperature. Each molecule acts as a pico oscillator which sometimes can develop resonance under specific circumstances. These resonance frequencies are also influenced by the external shape and the mass of the considered object. For a reliable machine working, it is important to know the range of the resonating frequencies and the frequencies of functional efforts.

In a lot of specific molecules there are spontaneous resonances. Among these resonating structures, we may consider some aromatic ring structures or benzene derivatives where the double bonds oscillate permanently on their pairs of successive polygon sides. As example we choose naphtalene which is composed of an association of 2 benzene cycles. (Fig.13). [2]

The described structures correspond to 3 extreme configurations of the molecule. These resonating structures establish very stable molecules because they give a delocalization of electrons, what corresponds to an entropy increase related to the fuzzy electron location. It is to note that the resonating behaviours improve the acidity and reduce the basicity of these substances. The chemical resonances act as pico oscillators and improve the molecule stability. This molecular resonance is produced by the permanent oscillation of the double liaisons around the benzene hexagons.

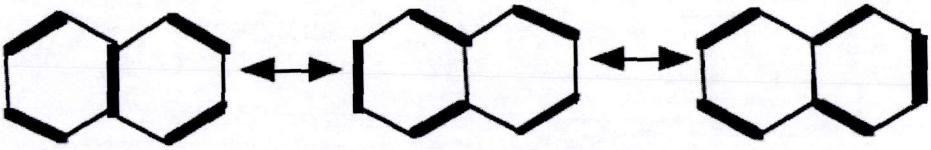


Fig.13: Resonances in a Naphtalene Molecule

13 Production of coloured Matters

Each matter absorbs a series of light waves and reflects the complementary spectrum. The colour is given by the reflected wave frequencies, whose lengths are located between 400 and 800 nm (10^{-9} m). From these assertions, the colours of our environment result from selective absorptions what are resonating phenomena between electrons and electromagnetic waves. Besides the molecules with alternative successions of simple and double bonds (= conjugated system) can exert colouring effects. When the double bonds absorb light wave they reflect in the visible spectrum and display a colour related to this reflected wave length. Consequently the most organic chromophores belong to the benzene group because the resonating rings present conjugated cycles.[2]

14 Electromagnetic Resonances

In the electric domain there are conjugate reactive devices: the inductances (ωL) and the capacitances (ωC). The perfect resonance is reached when their impedances are equal, indicated by the relation (8) which also deduces the expression of (f_{rs}) (Fig. 14)

$$X_L = \omega L = X_C = (\omega C)^{-1}$$
$$\text{Or } \omega_r = (L\,C)^{-1/2} \rightarrow f_{rs} = (1/2\pi)\,(L\,C)^{-1/2} \quad (17)$$

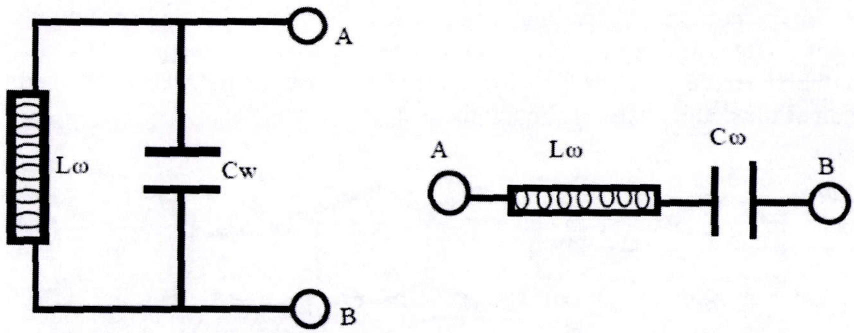
Besides there are 2 types of connections: series connection where the system impedance is cancelled :

$$Z_{rs} = \mathbf{j}(X_L - X_C) = O \quad (18)$$

Parallel connection, where the system admittance is cancelled :

$$Y_{rp} = \mathbf{j}\omega_{rs}C - \mathbf{j}/\omega_{rs}L = \mathbf{j}[\omega_{rs}^2 CL - 1]/\,\omega_{rs}L = \mathbf{j}[1-1]/\omega_{rs}L = 0 \quad (19)$$

It is to notice that this parallel resonance is the basis of any electronic oscillator.



(a) Parallel Resonance (b) Series Resonance

Fig. 14: Electromagnetic Resonances

15 Mechanical Resonances

In the mechanical domain the technical resonators are formed by springs and oil dampers.

The spring working when an axial force (**N**) is applied is described by the relation (20):

$$\mathbf{N} = k_{sp}\, \mathbf{\Delta z} \tag{20}$$

Where k_{sp} is the rigidity of the spring; $\mathbf{\Delta z}$ is the length variation of the spring

The oil damper, composed by a piston gliding in a fluid cylinder, plays as a dynamic damper and due to the action of the force (F)

$$\mathbf{F} = B_d\, \mathbf{D}_t(z) \tag{21}$$

Where: B_d is the viscous damping coefficient; **D**t(z): time variation of the piston progression through oil.

To absorb the shocks transmitted to a vehicle from a stony ground, it is useful to associate a spring and a viscous damper in parallel. (Fig. 15)

Another resonance procedure occurs when a ship undergoes pitching and rolling on a heavy swell. Here the conjugated resonators are the ship and the rough sea. This resonance sometimes can follow an àvalanche process and leads to the ship break and its sinking into the sea (Fig 16).

16 Mirror Effects

When a mirror makes appear the picture of an object, it introduces an electromagnetic copy of the object. In a planar symmetry, the picture is the object after a rotation of (π) There is a chirality correspondence between this resonating pair (object← → picture), like between a right hand and a left one. With a few mirrors it is possible to obtain a picture series what performs a chain of virtual resonance This optic multiplication of forms is used for transmission and suiting of information about forms and drawings because it is easy to amplify or to reduce forms by means of optical instruments. (Fig.17).

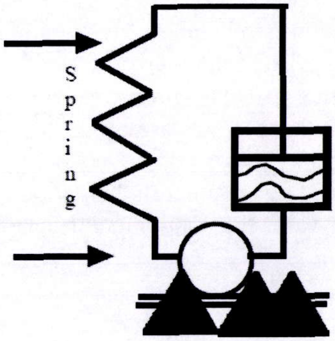


Fig. 15: Vehicle Damper

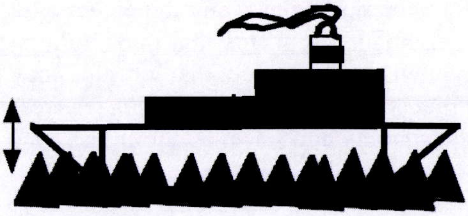


Fig. 16: Resonance between a Ship and the rough Sea

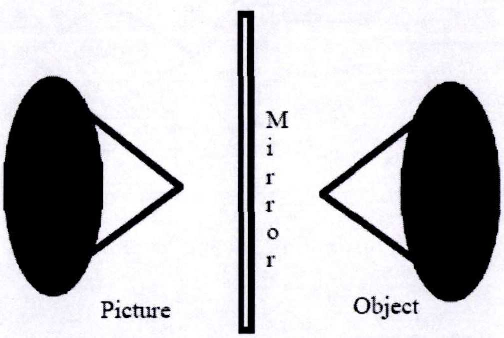


Fig. 17: Mirror Effect or optic Resonance

16.1 Resonances, echoic Horizons and Forecasts

Previously it was shown that resonance acts as a spring in oscillation between 2 conjugated resonators. From this, it is deduced that each echoic horizon exerts resonance with any arriving wave and returns a part of the wave energy. This returned wave develops a feedback effect between this horizon and the previous one. This echo plays as a stabilizing action in forecasting by giving information from the future what partially compensates uncertainty. (Fig.18)

17 Mind Resonances

The resonances are deeply inserted in our minds and they direct our ideas, our feelings and our behaviours. Indeed somebody is attracted by a specific colour or by a defined shape, without any logic justification. It is also resonance effects which push us to explore certain domains and to neglect other ones whereas these trends are different for our neighbours. It seems that our intuitive power is strongly influenced by resonating phenomena or conversely that intuition may be the garden of our resonating behaviours. Our mental profile is shaped by a few resonances which form the fundamental net of our personality and select our abilities.

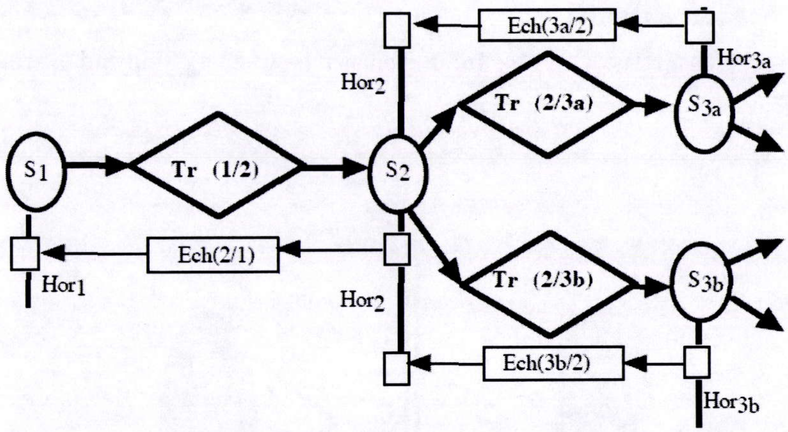


Fig. 18: Echoic Horizons and Feedback for anticipatory Procedures

18 Resonance and Life Quality

The resonators are wave producers and these waves are carriers of colours (= electromagnetic ones) and of sounds (mechanical ones). From these behaviours , we can deduce that resonances develop space communications and consequently act as information vehicles.

A world without resonance effect would be a dull space because neither colour nor sound would cross our surroundings. Without resonance, the universe would be dark, cold and inert, without any communication agent, due to the wave eradication. In this non resonating world, anybody would be prisoner in his own silent dark sphere without external exchange. From these considerations we can deduce that resonances play as necessary factors for our development in every domain.

19 Conclusion

This report presents the main resonances with their locations, actions and consequences. The resonances are located in various domains and they oft act like oscillators between a pair of conjugated reactive elements what stabilizes the system evolutions. However there are also destroying resonances which are designated as avalanches. Molecule resonances are acting in the bottom of the matter and therefore it is logic that resonance appears in macro structures. We have underlined the crucial role of loops in resonating behaviours and curling operators. This functional analogy between loops and harmonic phasors allows a synoptic interpretation of the Fourier expansion. This transformation points out the resonating frequencies which involve the shape of the evolution of systems. We have also shown the relations between resonances and our behaviours. This study shows the correspondence between resonators, antennae and foci, where they are defined (in the conical forms). Resonances between echoic horizons and anticipatory waves bring a stabilizing action for improving the anticipatory procedures.

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