Neural circuits: Σ(35-59) artificial sound environments interconnected to an evolving autocentric rotating cellular cube

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ABSTRACT

Constructed by using multiple computer-fragmented WAV files retrieved from disposed digital audio data. 68 modular circuits and three ports each equipped with electronic grids, were developed. The action outcomes of each circuit are controlled by command processing, 24 partitions of an evolving rotating cube with 576 cellular blocks. Attached to each cell are wavelets, one to four plugins and a similar number of effects or a combination of both. The automaton tends to evolve from an initial random distribution of a selection of circuits, WAV files, effects and plugins to a deterministic selection of numbers used in further fragmentation processes of circuit-processed WAV files allowing accessibility in the distribution state so that wavelets can reach their destination. Circuits are part of the neural network of commands, offering machine learning capabilities. The development draws on transition adapted for modelling purposes in areas from physical and biochemical sciences

Journal: Boston Research Journal of Social Sciences & Humanities
Keywords: Comma separated keywords
Accepted: 30 May 2025
Published: 15 July 2025
ISSN: Online ISSN: 2834-4863 | Print ISSN: 2834-4855
Language: English
Research ID: c201c93b-f1ff-4a36-9e39-e84fe1240d53
Type: Peer-Reviewed Research Article (Open Source)

Read Online: https://rebrand.ly/m00idfr

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I. INTRODUCTION

'Self' and 'creation' reflect on the ability of a system to reproduce itself, or to produce and maintain itself by creating its parts; this phenomenon is applied to organic systems. In electronic modular circuitry, the life of a system is located neither inside an object nor inside a process, but inside the oscillation between processes; objects depend on a manner of time that cannot be computed within a singular universal time. A cascade of signals and signal modulations is generated. The kinetic objective of modulation is discovering the various natures, tensions, sound collisions, deformations and formations of electronic processes, and components with different speeds and latencies, forming an artificial electronic ecology. The selections from circuit selections, the 24 elementary cubic positions (faces) and cubic intracellular kinetic motions are determined by probability and programmed using MATLAB and C++.

1. Reflections on soundscape, sound environment and biological processes

The soundscape differs from the sound environment because it emphasises the interaction between humans and sound sources in the background and the sound environment's perception, understanding and feedback reconstruction. Different sound sources in this context have varying impacts on subjective human experiences. Humans differ considerably physiologically in their knowledge, education, coding and decoding state. We can say that sounds from natural, mechanical and artificial sources have dualistic natures. Natural sounds enhance or mar stress and influence cognitive states and feelings of well-being. Mechanical sounds, conversely, affect hearing and are detrimental to stress recovery, leading to positive or negative emotions and stimulating antisocial or social behaviour. Artificial sounds, being more complex, can have both positive and negative effects on soundscape perception, depending on the environment and the specific sound source.

2. Sonic expressions and interactions

Building modular circuits and creating an autonomous sustainable esoteric computer environment partially free from human intervention independent of human universal control, mismatching components (voltage or impedance) resulting in one component influencing the other so that signals are created at many points within the circuits once activated, the instability of partial connections within the network incited oscillations of diverse character, triggering a cascade of signals and signal modulations composing itself from within. The sonic expression of multiple components creates an interactive relationship between the listener and space, all within the circuitry. Σ(35-59) comprises 17 segments centred around the rules imposed by the rotating cube, cross-port transfer communication between wavelets, plugins, and effects occurs. An external observer measures each segment through the point of failure or success.

3. The electronic grid

Circuits are represented with three sound grids. The grids are coded to allow permeability access to WAV files according to their size and duration Fig.8 File Size = (Sample Rate x Number of Channels x Bits per Sample / 8) x Duration in Seconds + Overhead (around 100 bytes). Allowing activity in port1 (macro), port2 (meso), and port3 (micro) environments as they change and develop over time. Perspective shows us how wavelets introduced into the circuit coexist, react, replicate, and undergo morphological and physiological changes as they pass through the grids. The composition aims to transform an artificial to an "organic" related environment, drawing from chemical reactions. Proposed by enzymes, which are biological catalysts, are proteins in organic matter that help speed up metabolism, or the chemical reactions in our bodies. They build some substances and break down others. The molecules upon which enzymes may act are called substrates, and the enzyme converts the substrates into different molecules known as products. Anabolic enzymes catalyze biochemical reactions that synthesize larger complex molecules from smaller units using energy in ATP. Catabolic enzymes catalyse biochemical reactions that break down larger complex molecules into smaller units. Both reactions release energy and generate ATP.

4. The nature of a rotating cube

Cellular blocks in the cube influence the movement and positioning of other cells, their attachments, fragmentation and transfers are triggered as an event is generated through modulation within each port. Each evolving rotation of the cube shows a calculated representation of the three ports displayed on the screen.

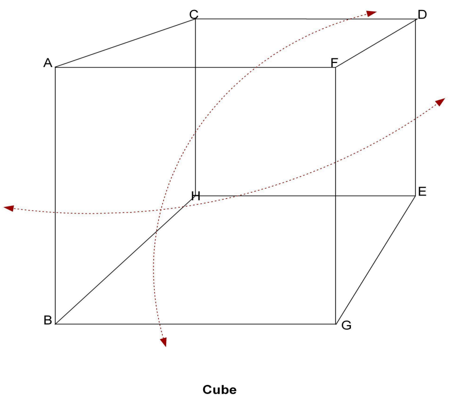


Fig 1: 4 diagonals, 8 vertices, and 6 faces. G symmetries of the cube, proposition: IGI = 24 elements or positions. 24 is 4! (factorial) therefore 4! = IS4I (symmetric group over 4 elements)

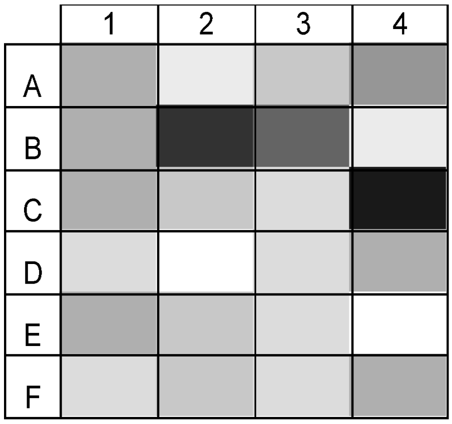


Fig 2: 24 cellular blocks in a partition representing 1 of 24 elementary cubic positions

Rules for elementary positions:

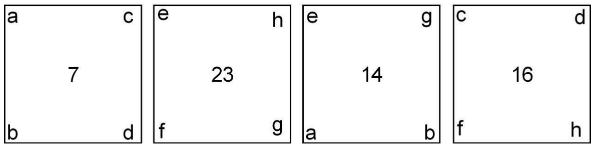


Fig 3: A rotating cube with 4 out of 24 cellular faces (positions) a,b,c,d,e,f,g,h could have 1,2,3 or 4 plugins and effects per cell (maximum of 4 or minimum 0). Each of the 4 different value adjustments is unique to each module; the values assigned to each are determined by probability.

Towards a microenvironmental order

The model of computation has some profound advantages over the rotating model because calculations can be done in a massively parallel fashion. All the 24 positions in each cell can compute their state through the flow of electric current between them. The minimum and maximum voltage threshold values characterise the cellular state, with addition of two resistors R1 and R2 and a capacitor (c) in an electric circuit, Kirchhoff's laws deal with the flow of current and voltage fluctuation in the system. Changes in cell membrane potential results in either polarization (alignment of electric dipoles, molecules with separated positive and negative charges) and depolarization (decrease in membrane potential) occurring. The cells do not rely on or change shared global information.

P326	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3
1								4					1		
2			7	8						6			5		
3	9		11			10					11				
4			15					16					13	14	
5				20	17		19		17	18					
6								24	21		23		21		
7							3							2	
8				8	5		7	8						6	
9	9								9		11		9		
10			15							14				14	
11	17						19			18					19
12		22	23		21				21			24			

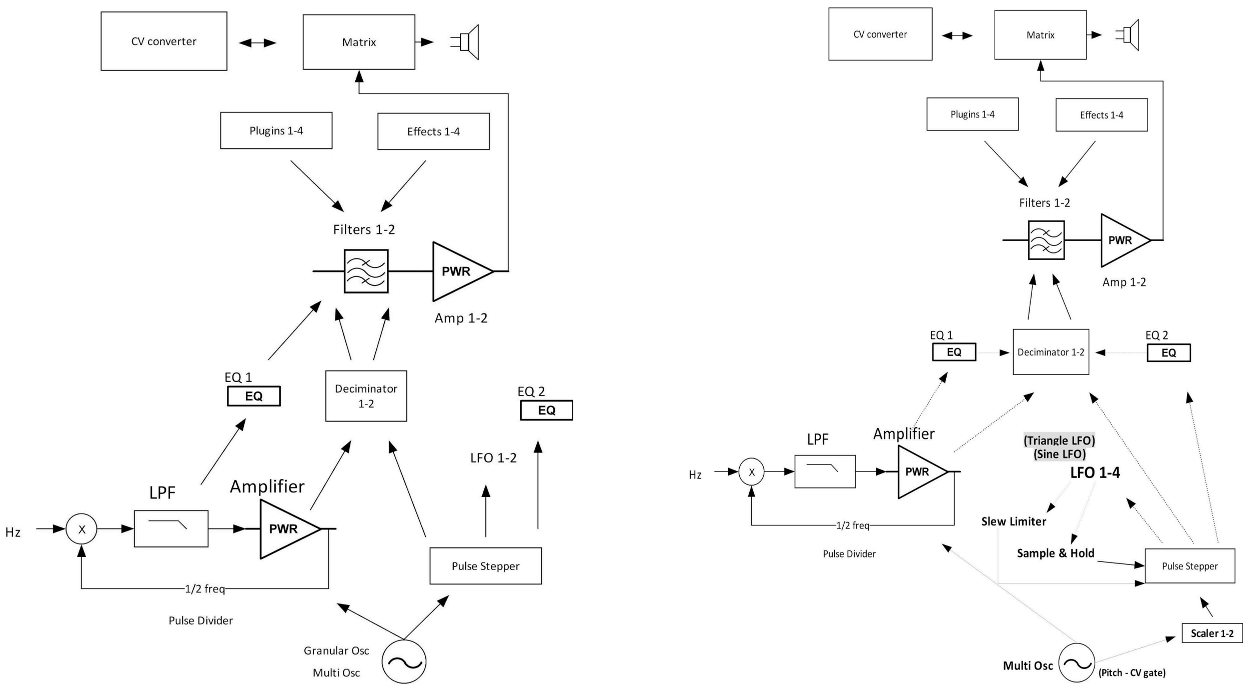
Fig 4: 8 cube rotations the outcome result is 8 partitions with 24 cells, unique bold, coloured numbers each attached with (circuit/s, wavelets, plugins and effects) are assigned to each port

Simple random process selection of wavelet

The simple random (systematic, stratified, cluster, multiphase) process expresses an uncertainty in the modelling process. In biological systems the process not only brings fragility to natural systems but is forced to redirect its processes this will also occur with machine learning e.g. A gradual course of events within a process that happens along the path A1, C3, L8, D4, is forced to redirect the path to C2, Q9, L6-8, S3 with a few similarities but different outcomes in biological systems e.g. An adult male sustained a head injury and lost his sense of taste, eighteen months later the man had recovered his taste sensations but had a list of alterations regarding taste compared to prior the accident. The process of nerve restoration redirection was similar, yet not the same.

Circuits

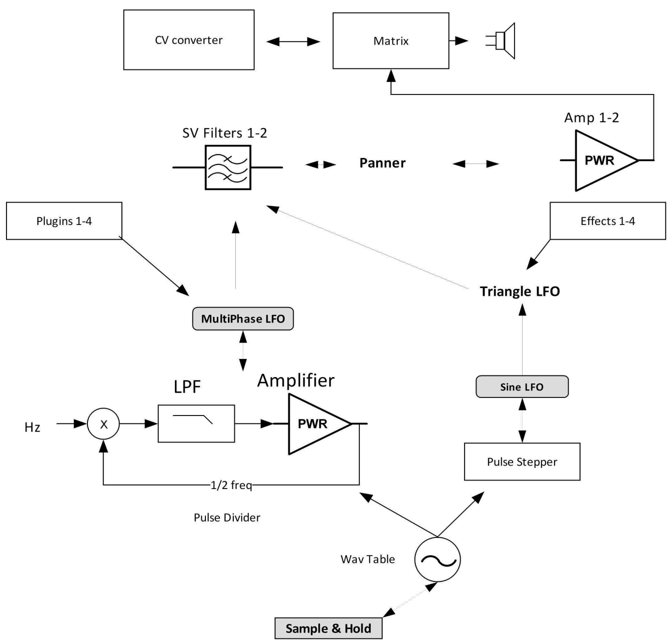
The positions in Fig.4 are numbered in bold red = circuit selection for (port 1), bold yellow = circuit selection for (port 2), bold white = circuit selection for (port 3). The cells are selected at random. Each number may have one or two circuits attached to it. Activating the number triggers the opening of a descriptive diagram together with its active circuit. The selected numbers appear on a screen. The time allowed to activate the process is 30 seconds. Exceeding the time frame selects six numbers, two per port. Selecting and not exceeding the time frame, the screen changes colour to green, and splits numbers into three port partitions on the screen. The process repeats itself and continues to generate new number combinations.



Circuit: 42

Circuit:43b

Fig 5: circuit diagrams: Segment – 9 (42) and 3 (43b)



Circuit:55

Fig 6: circuit diagrams: Segment – 15.5 (55)

Plugins and effects

Attached to each cellular (block) are between 1,2,3, or 4 Plugins/effects. Constantly changing the number of activation cells per partition shows permanent inactive, temporary inactive and active cell colouration. The circuit chosen has 1-4 plugin/effect attachments. The performer cannot replace the attachments with other plugins/effects, but could deactivate some or all of the plugins and effect attachments. If the selected number flashes, it indicates the cancellation of one or more attachments, and other selections are allowed. The following plugins and effects are used in this process: Plugins: Filters – 1 Pole – low and high pass, band pass, 2 Pole – low and high pass, band pass, notch. 4 Pole –low and high-pass.6 Pole – low pass. Envelope – Dbd, Flexible, ADHSR. LFO(S) – Sine, triangle, rectangle, saw tooth, random, multi. Effects: Natural reverb, distortion, compression, saturation.

Port 1		Port 2		Port 3	
Plugins	Effects	Plugins	Effects	Plugins	Effects
Envelope ADHSR	Compression	Filter -2 Pole – low/high pass, band pass		LFO(S) rectangle, saw tooth	Natural reverb
LFO(s) Random/multi	Distortion	Envelope FLEXIBLE	Saturation	Envelope -Dbd	Compressio n
Filter -1 Pole – low/high pass		LFO(S) – Sine, triangle Filter - 4 Pole –low/high-pass		Filter - 6 Pole – low pass	

Fig 7

Wav files

Each WAV is filed in folders, named according to category descriptive terminology; timbre, pitch, duration and size, and is selectively assigned to each port. A pseudo-random number generator determines the probability of choosing WAV numbers. The numbers selected appear on each three of the port screens. After circuit processing, the wavelet returns to the cube to be transferred to another port location, passing through the grids. The grid environments representing the macro, meso, and microstructures gradually become smaller and impermeable to particular wavelets (fig.8 and fig.9). Failure to change the processing status of a WAV file reaches a state of impermeability to the grid and cannot be transferred to other ports. Processed WAV files awaiting transfer are returned to illuminated partition of cells in the cube having the inscription, segment number (Sn), and the (file name) together with port number- to and from (Pfn and Ptn), which gives the wav file primary status for transfer to take place and to meet grid duration and size specifications to be allowed transfer access in other ports. WAV files that do not meet the size and duration specifications are transferred to the nearest neighbouring white cells to undergo fragmentation the inscription partition, donor and receiving cell numbers are added and appear on the screen (fig.10 and fig.11), when the process is triggered the cell becomes active and temporarily inactive when the process is complete. The neighbouring donor cell remains imobile next to the receiving white cell, when fragmentation is complete the white cell illuminates, the WAV file is returned to the donating cell to be transferred and mobility is restored, there is constant exchange of information between ports. WAV files not selected (fig.10) by the random number generator are returned to the parent port. The performer can observe the fragmentation process on screen and interfere by stopping procedure 1 and procedure 2 in stages 2, 3, 4 or 5.

Port	Duration	Wavelet size
1	16 -32 sec	2.82MB – 5.65 MB
2	8 – 15 sec	1.41MB – 2.65MB
3	250 ms – 5 sec	44.1kB – 1.06kB

Fig 8

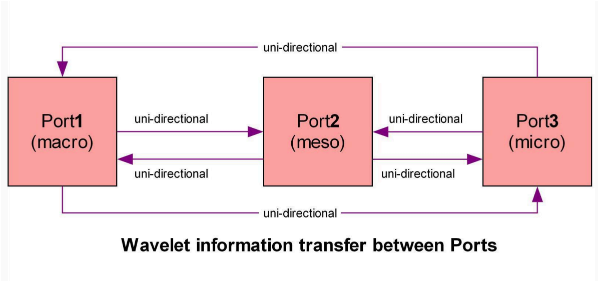


Fig 9

The sourced WAV fragments are introduced to an analytical selection process, which is reshuffled by inversion, insertion, duplication, translocation or deletion. Some are involved in other programmed processes, such as displacement into ports, which occur spontaneously and are positioned in the sound construction, contributing to a certain diversity of environments, particularly in macro, meso and microstructure. The fragment rearrangement can be mediated by general recombination between homologous sequences or by various specialised recombination mechanisms grouped into transposition and conservative site-specific recombination. The two groupings are related, having fundamentally distinct processes with different outcomes. The features reflect the physical nature of each fragmented component, the state and structure of the environment, and the variations in complexity along a continuum from basic attributes (e.g. frequency components) to more complex characteristics of the scene (e.g. timbrel profiles). Segregation is modelled using feature analysis that maps the process into building blocks ranging from simple (fragmented) components separated according to frequency, duration, dynamics, amplitude, size of wavelet and timbrel components grouped in one mechanism of various non-related categories to a source of extraction. Groupings effectively capture the interdependencies between object attributes and learn their mapping onto an integrated representational space. Scene analysis depends on two key components: (i) obtaining a rich and robust feature representation that can capture object-specific details present in the scene; (ii) grouping feature elements such that their spatial and temporal associations match the dynamics of objects within the scene.

Fragmentation

Programming in the computational software MATLAB allows for finding patterns within groupings. The separation of information, elements of sound data, is the cause of WAV files needing assistance with transfer requirements. The software executed non-deterministic computational tasks referring to Gaussian probability density functions, pitch analysis probability and continuous probability. Partially developed WAV files (each from the identified positions) were organised into bundles in files to folders with a linear time restriction between 6 - 48 seconds, and are identified for analysis. The selection of fragments underwent segregation, extraction, editing, and fusion as a final fundamental constructive approach. The sound synthesis explores the movement of simple and complex patterns amongst other parameters and draws heavily on concepts from the biological sciences and mathematics.

Procedure -1 (the use of PRNG in the selection process)

The use of a pseudo-random number generator (PRNG) referring to an algorithm that uses mathematical formulas in Matlab to produce sequences of random numbers selecting WAV fragments from files (see fig:10) in a folder, allowing calculation of a given set of numbers per file: mean value (1-12) or from split data (the values that produce the lowest amount of error between data 1-6 and 8-12), the variance values of split data (is the expectation of the squared deviation of a random variable from its mean) and the variance of the combined or pool sets (is the expectation of the squared deviation of a random variable from its mean when combining two sets of data). A position in the construction of the composition selected by the composer is introduced to the software program, requiring WAV files from the area with similar coded (35.3kB – 1.24MB) size and (200 ms – 7sec) duration, timbre, pitch and intensity to proceed further.

Files in folders consisting of a minimum of 5 and a maximum of 50 WAV fragmented data files.

Consecutive integers undergo non-deterministic computational tasks with PRNG.

Each file contains 2 subordinate files, file (a) with fragmented WAV files and (b) with non-selected WAV files which could be used further down the selection chain (see fig. 1).

PRNG produced integers 3,7,7,10, of which 7 is duplicated and eliminated, and the non-selected WAV files 3,10 are placed in file 23b, referred to as the first step.

PRNG is re-applied to 4 separate processes to split WAV files 1-2, 4-6, 8-9 and 11-12. This produces four integers 2,4,8,11, that can be used in Procedure 2, referred to as the second step.

In Procedures 2 and 3, the stochastic fragmentation model describes the fragmentation phenomenon for an infinite particle system characterised by its size, which at some random points in time splits into two separate particles. A partitioning algorithm is used (in both groupings), the sequence of repetitions determined resulted in various orders of selective positioning of sound file segments that had similarities in size and duration but were morphologically different in density and pitch. Many sound file segments are arranged into infinite clusters, each with a density of clusters of each size. The finite volume model has many particle segments arranged into clusters, where coalescence and fragmentation of clusters occur randomly. The process of a finite system is defined by the ability of the system size to converge to the infinite volume equivalent. Coalescence-fragmentation and cluster formations will add to this complex system with negative or positive possibilities; it is for the composer to decide which path to follow.

Procedure - 2 (an artificial process of selecting/splitting/assembling)

1] The WAV fragment followed a process of analysis and suggestions in selecting, splitting and assembling sound fragments, resulting in the formation of larger or smaller fragments of (size and duration).

2] (fig:11) a) Selection of areas representing the foreground sound object/s and background sound environment undergo fragment 11, area (Z) undergoes extraction consisting of two sub-areas (Z1) foreground object/s and (Z2) background environment sound. WAV fragment 2, area (C) undergoes extraction consisting of two sub-areas (C1) foreground object/s and (C2) background environment sound.

3] Fusing sub-areas (Z1 + C2) of WAV fragments produces a larger fragment (size, duration) (ZC3a) and (ZC3b) of (a larger size, equal duration) to the original fragments Z1 and C2 combined. Fragments (Z2 + C1) produce a fragment of (larger size, duration) (CZ4a) and a fragment (CZ4b) of (larger size, equal duration) to the original fragments Z2 and C1 when combined.

4] Fusing sub-areas (Z2 + C2), the WAV fragments produce a larger fragment (size, duration) (ZC5a), and (Z1+C2), the audio fragments produce a larger fragment (ZC5b) of (larger size and duration) than the original fragments Z1 and C2 combined. Sub-areas (Z1+C1) produce a fragment of (larger size and duration) (CZ6a), and (Z2+C1) produce a fragment of (larger size and duration) (CZ6b) to the original fragments Z2 and C1 when combined.

Procedure – 3 (an organic process of selecting/splitting/assembling)

The procedure prohibits selection in subordinate file b, allows selection to take place in file a (see fig.10: Procedure 1), the composer chooses certain areas in the construction where the emphasis of "organic executions" needs to be met. Three steps in the computational preparation presented themselves as suggestions: selecting, splitting and assembling sound files with a specific focus on certain criteria.

WAV files having undergone grid transfer fragmentation:

Accepted WAV files both in (size and duration) diagram: (fig11 - step3) or a combination of WAV files in a cluster/s diagram (fig.9 step4 and 5), specification requirements of each WAV file accepted are considered and allowed access but not the total (size and duration) of the combination is considered only each of the fragmentation making up the WAV file. If one fragmentation (size and duration) is rejected, the presence of the cluster would cause the whole cluster to be rejected.

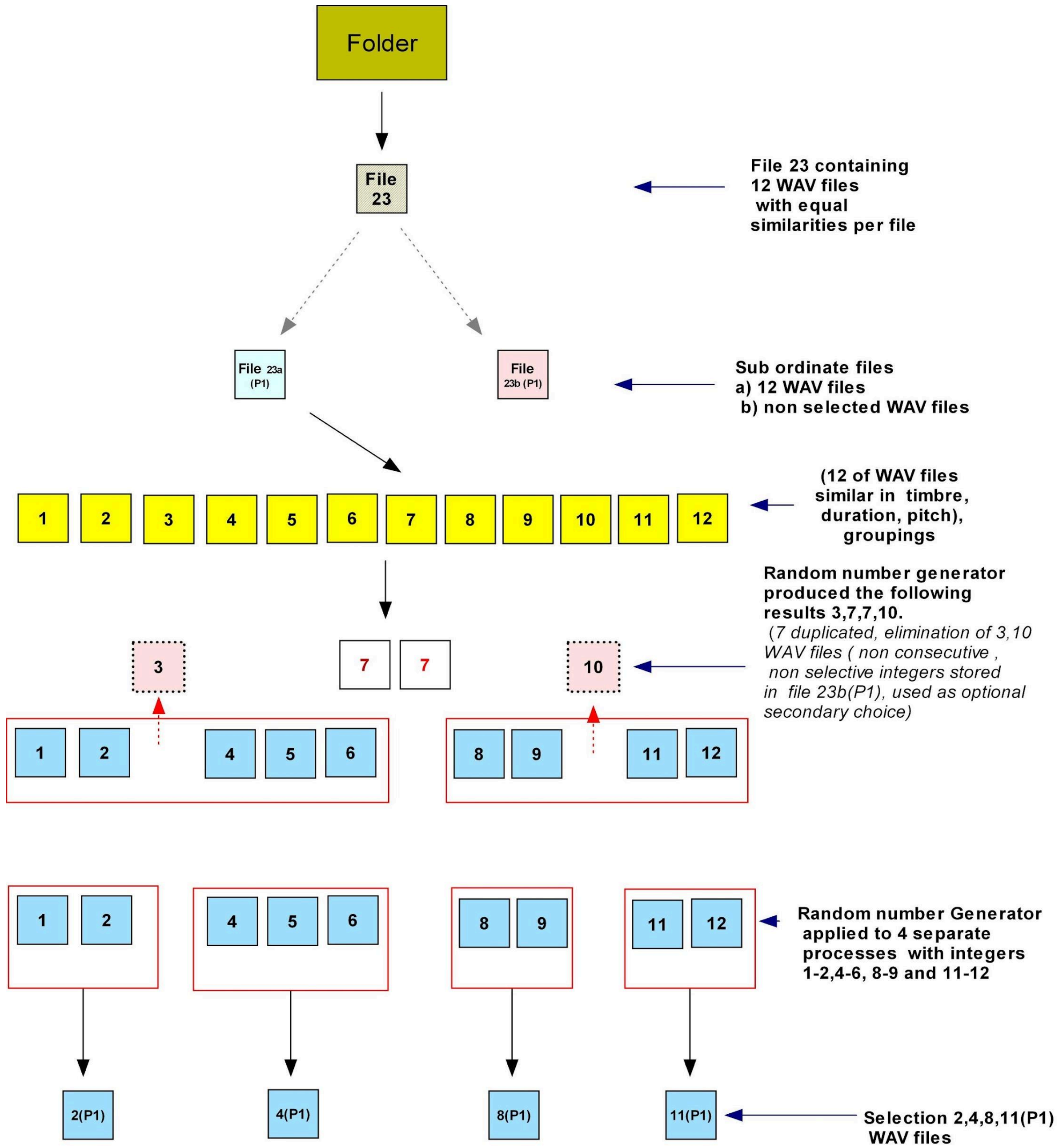


Fig 10: Random number generator selecting 2, 4, 8, 11 WAV fragments from consecutive chain of integers

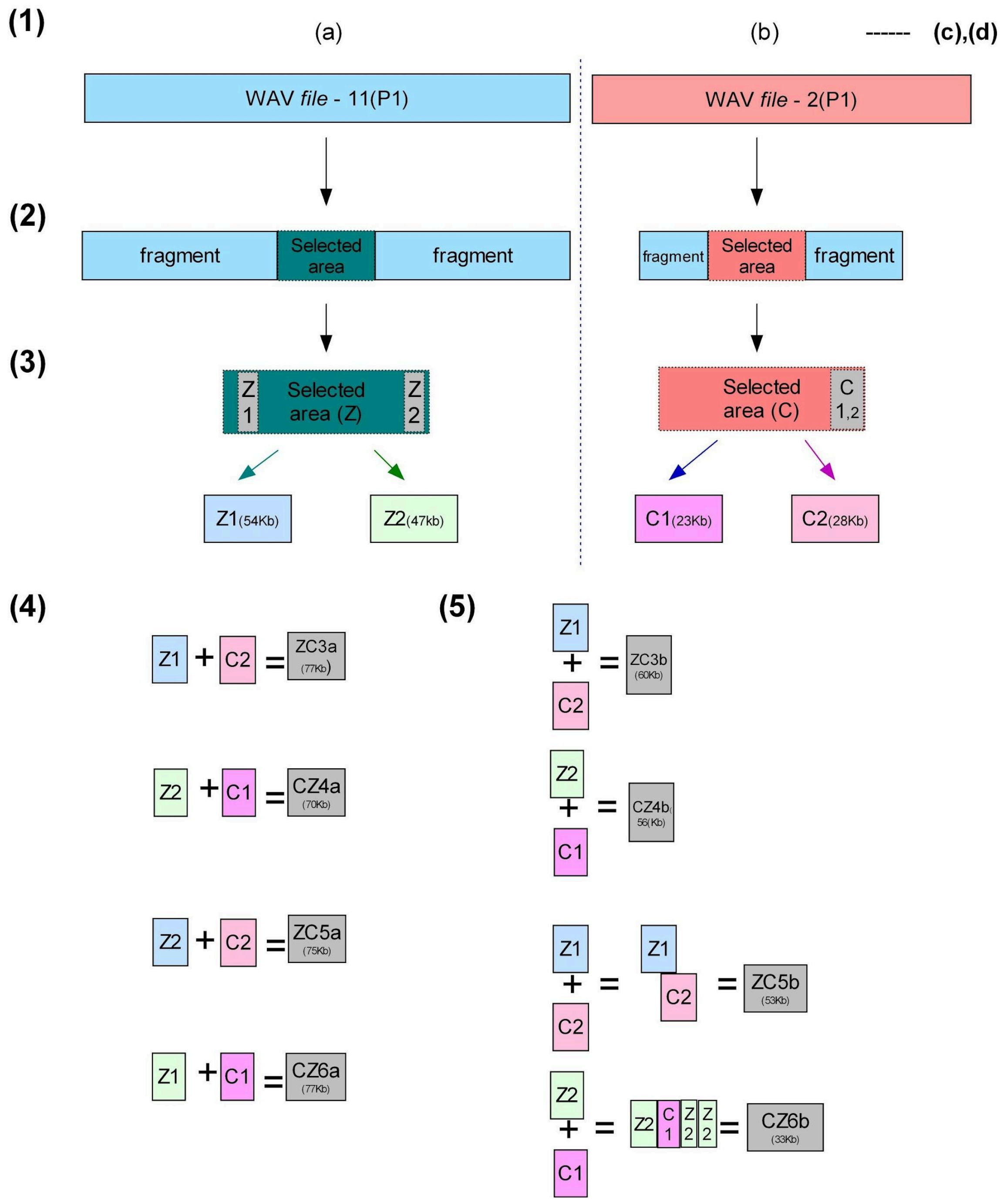
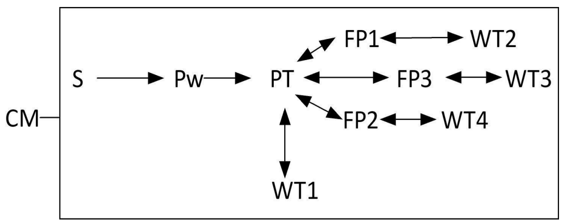


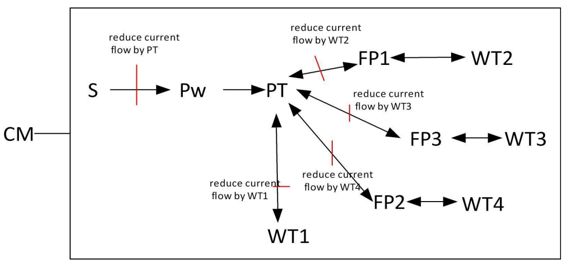
Fig 11: Demonstrating selection, editing (fragmentation) and fusion (coalescence , clusters) of sound segments 11 and 2

An electrical process regulated by feedback inhibition

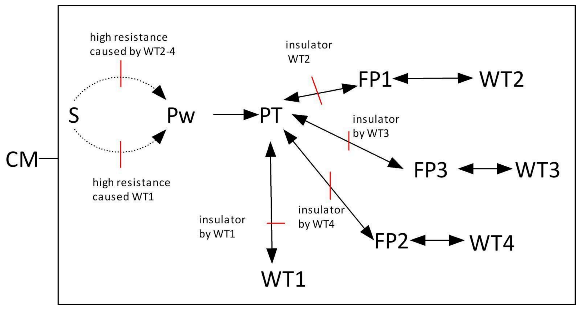
CM = cellular mobility, S = selectivity, Pw = processed WAV, PT = Port transfer, WT1= WAV files direct for port transfer not requiring fragmentation, FP1, FP2 , FP3 = Fragmentation procedures 1-3, T2, T3, T4 = WAV files from FP1-3 ready for port transfer. Take note of the steps that have bi-directional paths.



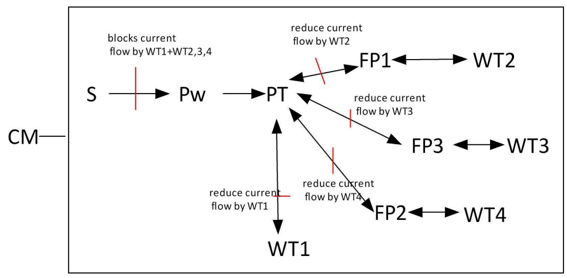
A high number of fragments WT1-4 are produced that would reduce current flow between steps (Pw – PT) the high number of WT1 would prevent the synthesis of WT2-4 if there were a deficiency number of WT2-4, the regulatory scheme is not optimal.



Sequential feedback control - current flow can be stopped or altered by a negative feedback systems, the feedback signal opposes the input signal, reducing gain and potentially limiting current flow – WT2 reduce current flow between step PT-FP1, WT3 reduce current flow between step PT-FP3, WT4 reduce current flow between step PT-FP4, WT1 reduce current flow between step PT-FP1 and PT reduce current flow between step S-PW .



Resistance multiplicity – presence of a high number of fragments in WT2-4 and WT1 causes a high resistance that blocks current flow in step (S-Pw). WT2 high resistance build up between step PT-FP1, WT3 insulator between step PT-FP3,WT4 insulator between step PT-FP4, WT1 insulator between step PT-FP1.



Concerted feedback control - a resistor limits the flow of current, creating resistance in the circuit.

Cumulative feedback control – The first common step (S-Pw) is partially inhibited by each of the final products. Each final product acts independently of the others.

WT1 decreases the rate of (S-Pw) from 100 to 60 sec^{-1} , WT2 decreases the rate 100 to 30 sec^{-1}, WT3 decreases the rate 100 to 25 decreases the rate 100 to 30 sec^{-1} , WT4 decreases the rate 100 to 10 sec^{-1}. Then the rate of S-Pw step in the presence of high levels of fragments of WT1-4 would be (0.6 x 0.3 x 0.25 x 0.1 x 100 sec^{-1}) = 0.45 sec^{-1}. The inhibitory processes help to manage the volume of fragments displaced per unit time by regulating the amount of current flowing through the system and reducing depolarization of cells.

Cellular rules and colour functionality

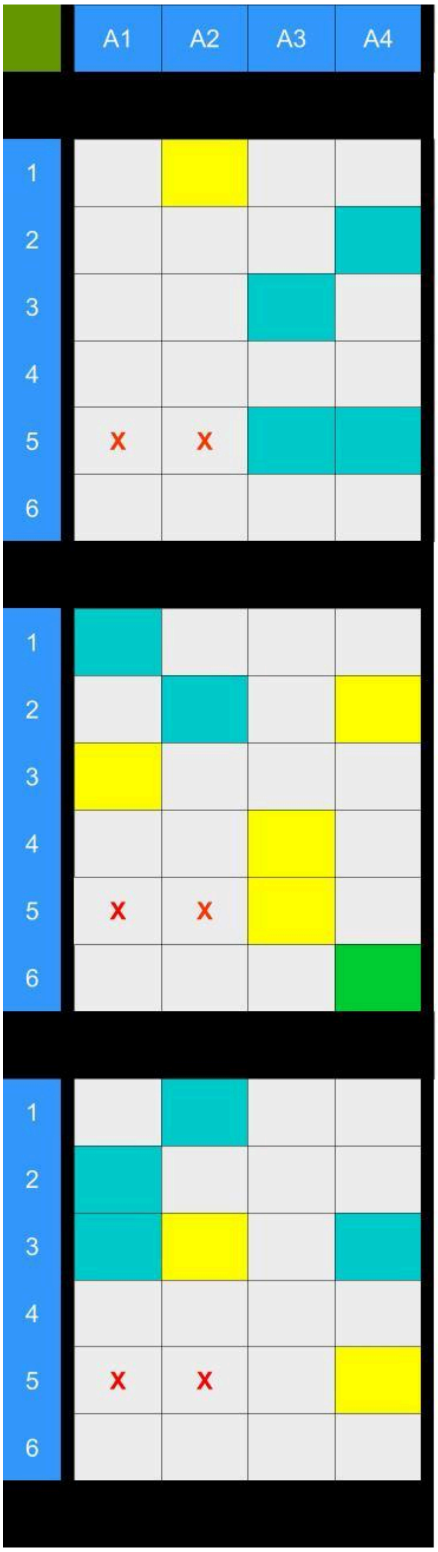


Fig 12: Ports 1–3

Rule 1a – Yellow cells act as active neighbours (open cells), allowing movement of blue cells into their area.

Rule 1b – Yellow cells with no neighbouring blue active cells remain inactive unless a blue cell occupies a neighbouring position, allowing neighbour activity, e.g. cell 2/A4, cell remains inactive, 4/A3 layer 2 with a possibility of changing its status, cell 5/A4 layer 3 remains inactive.

Rule 1c – Yellow cells introduced into the cell in random order, some could be referred to as active neighbours, others not; this depends on their positioning in the presence of blue cells.

Rule 1d – In a transfer amongst layers, when a yellow cell gets superimposed on a yellow colour, then the cell will change to X white (*to be discussed further in Rule 6*).

Rule 2a – White cells allow fragmentation to take place and remain temporarily inactive with the donor cell until the process is completed.

Rule 2b – White cells marked with an X remain inactive without the possibility of changing, prohibiting colour change and movement of other cells within their space.

Rule 3a – Blue cells are active cells with the ability to change the activity of yellow cells.

Rule 3b – Transferring amongst ports: a blue cell is superimposed on another blue cell, then the transferred cell moves to a neighbouring position (competitive repositioning *to be discussed further under Rule 8*).

Rule 4a – Green coloured cells are active with additional calculated abilities.

Rule 4b – A green cell is transferred amongst ports and gets superimposed on a yellow cell it will be placed in the nearest white cell available in (East/West position), however if there are no white cells available the green cell returns to layer where it was transferred from attempts to be retransferred to another port, if the same problem persists the green cell changes its new placement to a white with X making the cell inactive.

Rule 4c – A green cell is transferred amongst ports and is superimposed on a blue cell. It will be placed in the nearest white cell available (North/South position). If no white cells are available, it will seek placement in a clockwise rotation to the nearest white cell available. If no placements are available after having completed the rotation cycle, the green cell with its calculated abilities can shift the blue block to make placement space. (*to be discussed further in Rule 7b and 9*).

Rule 4d – A green cell only when it superimposes a yellow and blue cell, follows procedures in (4b,4c).

Rule 5 -

Cells in Vertical and Horizontal positions

One or more (blue) active cells found in *series* in either vertical or horizontal position (active original layer), information will not be passed on to the other layers. Cells in *parallel* or *other positions,* information can be passed on to other layers (*to be discussed further in Rule 7b*).

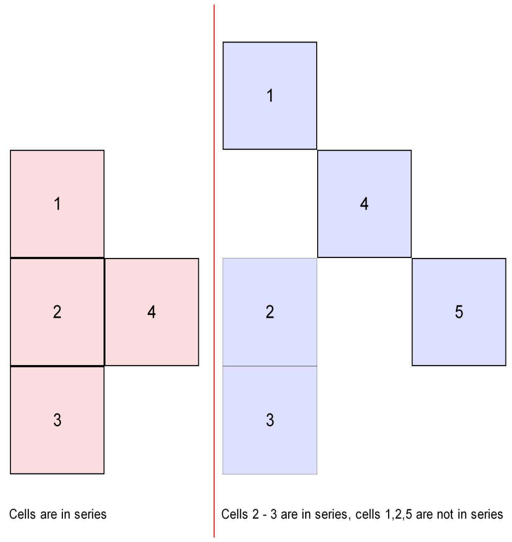


Fig 13: Active and Inactive Cells

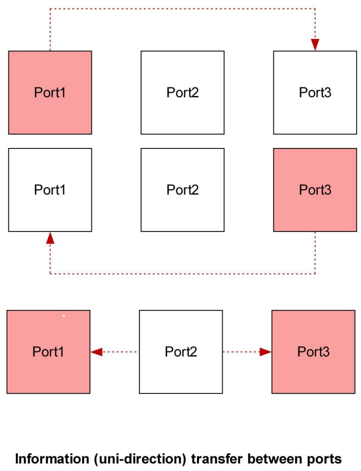


Fig 14

Rule 6 -

Port transfer locations
Port 1 (donor) - transfer to port 3 (receiver).
Port 3 (donor) - transfer to port 1 (receiver).
Port 2 (donor) - transfer to ports 1 and 3 (receivers).

The colour of the cells changes in port transfer

a] The port releasing the processed Sn, name, Pn of the WAV file is highlighted in green .

b] Once the processed WAV file has reached its destination in the illuminating partition of the cube it attaches to the cell irrespective of its colour but it will not attach to a permanently inactive cell X.

c] A blue cell (active) cell transfers to an exact localized position in the destined cell of that port which is also of the colour blue then the cell in the transferred port will change to green (additional calculated abilities) and the transfer will be accepted.

d] All other coloured cells in port transfer (blue, white, yellow), (see cell status in Rule:1-4, and Rules:5-9) will occur but transfer will not be accepted; the cell remains dormant until the cellular colour changes to green.

e] The cell in port 2 selected to transfer a WAV file/s is allowed access to specific positions in ports 1 and 3; all other cells receive T (a temporary inactive status) as the transfer is in progress.

f] Once the transfer has been accepted the WAV file gets stored in the destined port and appears in the top left hand corner of the screen the name only in red lettering appears.

g] The delay time for the transfer procedure taking place offers the performer time to further process sound in the circuits before selecting the WAV file returned to the destined port.

Rule 7a –

Splitting and binding within the cell

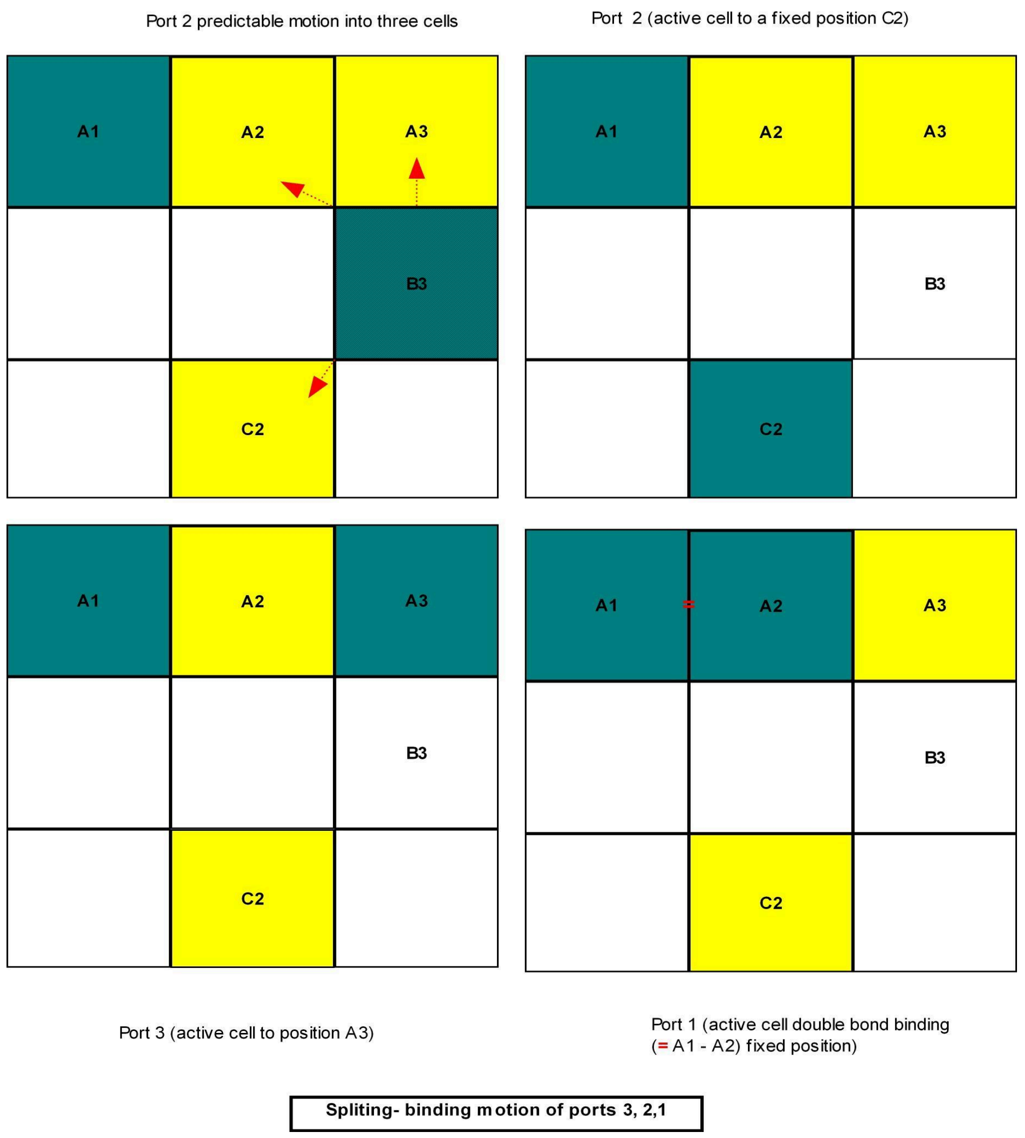


Fig 15: Active cell B3 can move into 3 active neighbourhood cells A2, A3, C2 (fixed position C2, active position A3, or binding position A2)

Cells transferring information

The double bond between A1 and A2 (fixed position) will allow transfer at once in Fig:15. A two-cell destination position is chosen in other ports, single bonded or other cells chosen to move both positions between ports 1 and 3 are available simultaneously, the process is nullified. Ports of destination chosen should be for both to move e.g. from port 2 to 1 or from port 2 to 3.

Rule 7b –

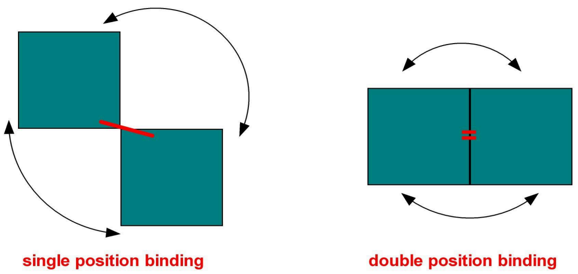


Fig 16

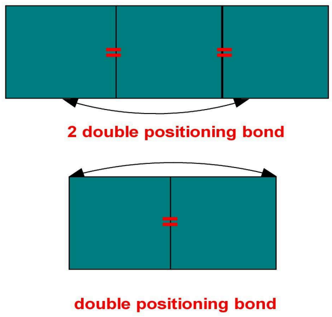


Fig 17

Two active cells bind in an angular position, which would allow for single-position binding because of two single positions involved in attachment, the cell detaches and repositions itself. Two active cells bind with each other to form a single or multiple double positions. This is due to the four positions of two cells involved in attachment. Detachment is prohibited.

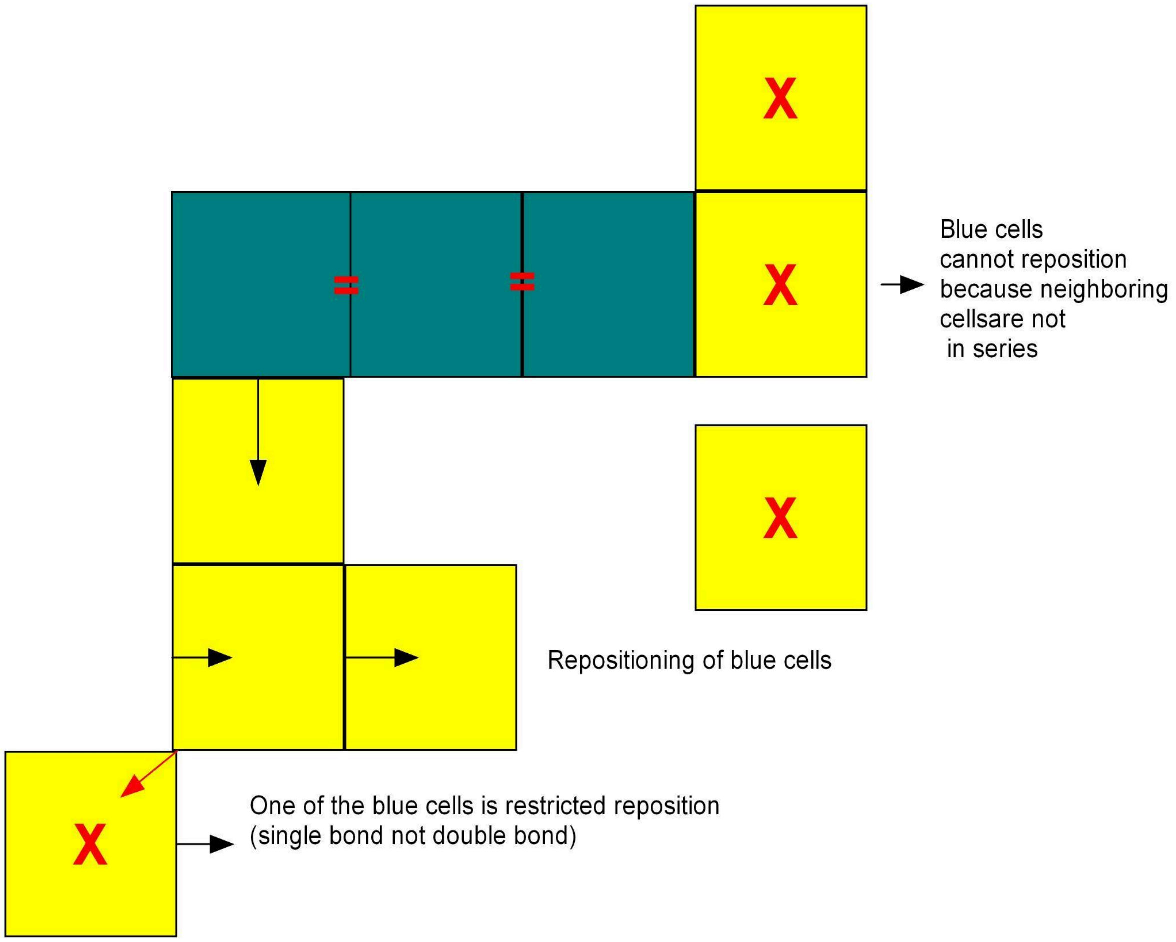


Fig 18: Three cells double position binding, to detach and re-position them, three yellow neighbour cells in series are needed (without affecting the original bonds), if neighbours are not present, then re-positioning will be blocked.

Rule 8 –

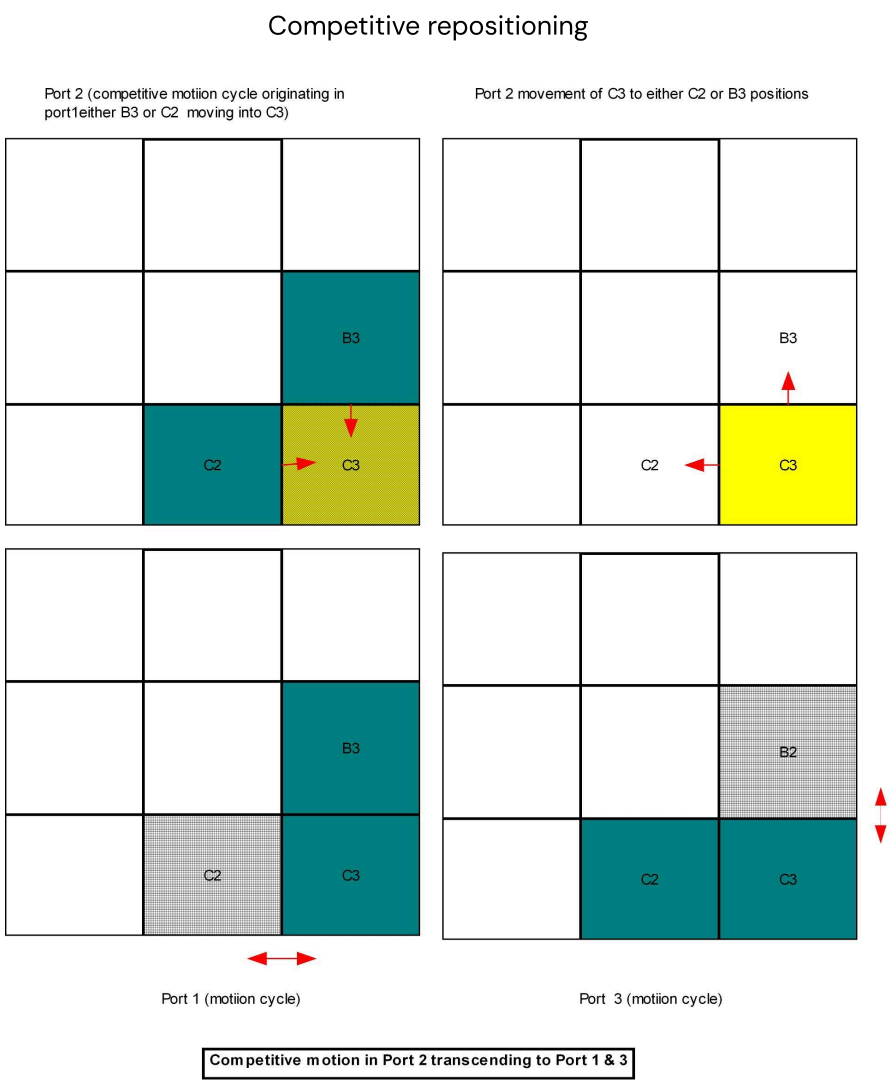


Fig 19: Cells B3 and C2 in Cell 2 are involved in competitive repositioning because of equal competitiveness; C2 will occupy position C3, and B3 will occupy position C3. These positions will be reflected in Cells 1 and 3. Cell2 will show activity indicated in the diagram above.

Rule 9 –

The green active blocks and additional benefits

a] Two blue active cells connected to the green cell with single or double positioning bond connections change the colour of the green cell to yellow.

b] Two blue active cells connected to the green cell with two double positioning bond connections change the colour of the green cell to X inactive.

c] Two blue active cells connected to the green cell with two single positioning bond connections change the colour of the green cell to active blue.

d] Two blue active cells superimposed on each other turn green

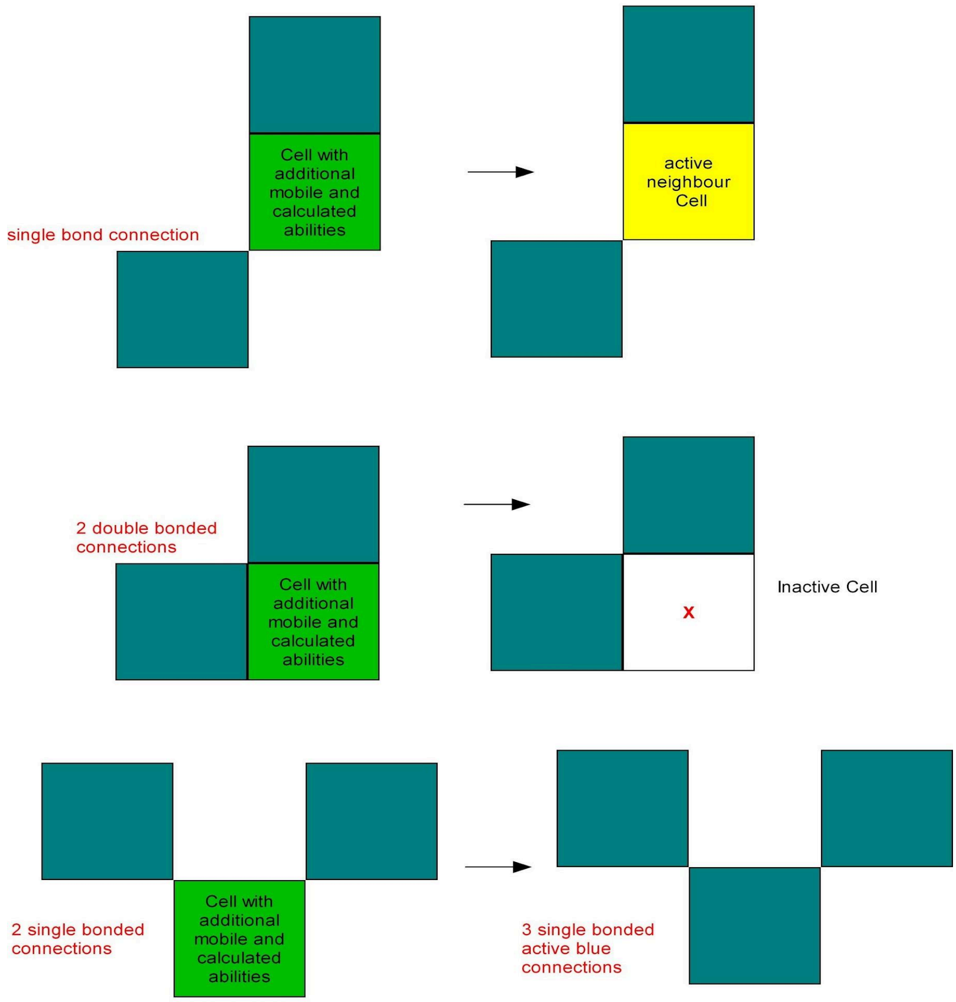

single bond connection
Cell with additional mobile and calculated abilities
active neighbour Cell
2 double bonded connections
Cell with additional mobile and calculated abilities
x
Inactive Cell
2 single bonded connections
Cell with additional mobile and calculated abilities
3 single bonded active blue connections

Fig 20

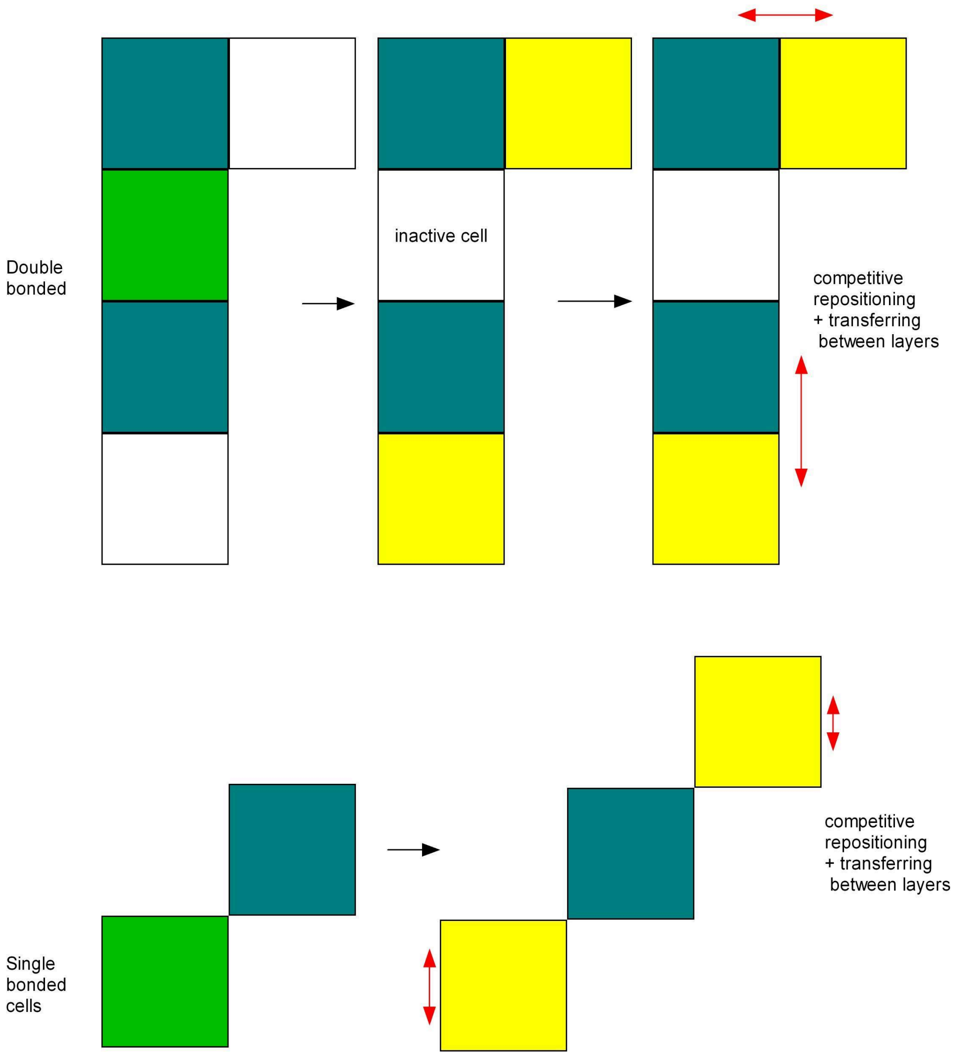


Fig 21

a] Two blue active cells connected to a green cell, with (two double bonds) change the colour of the green cell to X inactive white. Together with two yellow active neighbour cells, result in competitive repositioning and transfer between layers.

b] A blue active cell connected to a green cell with a single position bond changes the colour of the green cell to yellow with an additional single position bond to the yellow neighbour cell, resulting in competitive repositioning and transfer between ports.

Other compositions using the cellular rotating cube technology are found in the Σ series.

II. CONCLUSION

Inspecting principles of three biosynthetic pathways, processing the breakdown of a WAV file, cross-cell communication and feedback inhibition, are selectively incorporated to control the functionality of modular circuitry centred around information exchange from a rotating cellular cube, where further processing occurs, changing the current state of WAV file size through fragmentation and reposition files within ports. The integrated network has rules and commands to follow, allowing processes to take place. The artificial environment in Σ(35-59) evolves within spatially heterogeneous spaces, associating with natural systems that perform in a fragile, irregular manner. These activities are controlled by random forces; whose primary aim is not to try and mimic natural environments but to observe the micro-artificial systems within.

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