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Utilization of artificial general intelligence and x-rays radiography to visual 3d inspect manufactory-on-demand

Abstract

Manufacture without inventor- loading, e.g. munitions, and utilized the "manufactory by demand" turn-key systems which requires 3D real time inspection goods. (This is not the usual mass production with I/O inventory). The software approach can be efficiently implemented on the FPGA firmware so that each item can be automatically inspected by Artificial Intelligence (AI) machine deep learning. The development of these unsupervised algorithms and the implementation in firmware will enable the precision production. The paper describes the design planning in three major sections to help real-time 3D visual inspection. Sect. I: We review the new terminology Artificial General Intelligence (AGI), which combines both supervised deep learning when samples/memory are known &unsupervised learning when samples are missing or unknown. The unsupervised leaning will make use of Helmholtz's minimum free energy (MFE) at a constant room-temperature from thermodynamics. Although AGI has been introduced in a broader catch-all workshop for MIT training classes, our AGI emulates specifically a modern understanding of human brains. In Section II we review the projection tomography and the inverse theory of Johann Radon's transform for 3D reconstruction. In Section III we combine the techniques from both Sect.1 & II together by means of the Gerchburg-Saxon phase retrieval super-resolution by extrapolation and interpolation of those occluded missing X-ray projections.

Keywords: AI, supervised deep learning, unsupervised learning, manufactory by demand, real time visual inspection

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Review of Supervised and unsupervised learning algorithms for AI

Let's mention three wave of AI

A. The 1st Wave AI "Rule-Based System," MIT M. Minsky when F. Rosenblatt built 1-layer visions failed.

B. The 2nd Wave AI "Learnable rule-based" has beaten Lee Sedol in 4:1 Mar.19, 2015.

C. The 3rd Wave AI "Human Experience Expert System" began because after Google, Uber & Tesla in US, German, Italy, Japan have spent over $100B to DAV's. Unfortunately, a DAV killed recently a pedestrian in Tampa Arizona. In spite of NASA Space Program and DARPA Grand Challenge, technologies were in no-man land. Highway TSA said semi-DAV at level 4 will be dozen years, circa 2030. DAV machine must be peacefully co-exited with crowded human society with all kinds of personality. Automation computer scientists need to endow machines with 3nd Wave AI to comprehend human fuzzy possibility thinking, so-called Zedah-Freeman fuzzy logic, in order to exit with human being society. Of course, fuzziness is not the logic, but open set Fuzzy Membership Function's (FMF's)) e.g."Young", or "Beautiful." A double fuzziness "Young & Beautiful" becomes less fuzzy. That's why we endow FMF's at execution load time to the digital machine.

The limit of next N-th Waves of Artificial Intelligence (AI) will be approaching when N>3 the Survival the fittest Natural Intelligence (NI). Exemplar: Synopsis in one page must cover (1) The Gap would be among the other, the emotional IQ for Machine, (2) The Innovation would be Human Fuzzy Logic. (3) Approach would be open set emotional membership function. (4) Anticipated Result would be safer UAV.

We will attempt to cite the original Nth Wave AI, Alan Turing introduced AI asked:"Can Machine Think?"1950, Then MIT Marvin Minsky introduced the If-Then Rule Based System as the 1st Wave;, Google Alpha Brain (British) developed Learnable Rule-Based System 2nd Wave (lost one won 4 more) and beat Korean Genius Mr. Lee SeDol on Chinese Black-White surrounding territorial game "Go" Chess Game; Unfortunately in a less than two years glory, Volvo/Uber Advanced Technology of Unmanned Autonomous Vehicle (UAV) using the *AI Machine Deep Learning* has inadvertently (with human observable on the shotgun driver seat) rolled over and killed instantly an intoxicate woman in rolling over red bicycle crossing traffic light in Temper Arizona. The US DARPA has followed Mr. David Gunning Explainable AI (XAI) initiated by Director Dr, Steve Walker with $2B funding called for the 3rd Wave AI.We review under one framework of AGI for Natural Intelligence (NI) learning cost function. The cost functions are both supervised learning using least mean squares (LMS) error energy and unsupervised learning using minimum free energy (MFE).

Natural Intelligence (NI) means Darwinian animal basic instincts for survival. We observe that (1) all animals roaming on the Earth have the "power of pairs" of smelling, tasting, seeing, hearing and touching/tactile senses. This might be due to the quick response necessary for survival in the hustling and bustling world: "Agreed, must be the signal; disagreed, the noise & thus rejected." No more processing is needed, until the signals enter into the brains. (2) To

help these simple perceptions their brains are kept at a constant temperature. For example, Homo sapiens are kept at 37^oC while chicken at 40^oC . Note that a higher temperature is not necessarily smarter; Proof: We ate chicken, not vice versa. Q.E.D. Seriously, Homo sapiens choose 37^oC because the hemoglobin's have the best elasticity to squeeze through the crowded and tiny blood capillaries in the brains. Physiologically speaking, this minimum free energy property of constant brain or room average temperature is known as the "homeostasis" property, which helps keep a chemical reaction at constant neural firing rates circle 100Hz for Homo sapiens. In fact, we avoid possible poisons food that one has developed the first pair of sensing for survival, e.g. the keen smell olfactory balls in pairs. Likewise, the visual sensing follows. In fact, it is interesting enough, that we observe only Homo sapiens have evolutionally lowered one of the 7 folds arm of Rhodesian molecules which become red color for detecting ripen fruits. Almost all domesticated animals have no red color cones except following their masters. Moreover, the tasting buds are likewise tessellated in pairs on our tongue; these taste buds are sensitive to detect the sweet taste but detrimental fructose, mixed with brain-need of non-so-sweet but good glucose fuel.

From these properties, we can introduce specifically for Homo sapiens the modern brain in compartmental pairs. We have both sides of brains compartments and a lower part called cerebellum connecting directly to the spinal cord. In details, we have 10 billions of Neurons as threshold I/O processor units and their associated silent partners house-cleaning servant cells call neuralgia cells about 100 billion (10 times more but 10 times smaller,) in order to usher in the transients of positive charged Calcium ions Ca^{++} repulsion along the axons pipeline. As a figure of speech, like a team of baby ducks following the mama duck and papa duck crossing the road, channeled within 10 times more neuralgia cells using their rounded end-dendrite-feet, When one baby duck is push in the channel, the other duck comes out instantly by charge-repulsion. Our brains are divided into at left hand side (LHS) brain cross-connecting the right hand to work with the precision tools, writing, learning, etc. and thus become more logical brain (about 90%). Like-wisely, the left hand is linked to the RHS brain, which is responsible for 90% of the remaining tasks e.g. the emotional art and creativities.

The lower part of brain neuron-knotty called Cerebellum above the spinal cord that controls the 4 limbs motions. We mention in passing that it turns out that in the animal kingdom the cerebellum of long-tail dinosaurs were located on their tails, rather Homo sapiens small lower part of brain, to be efficiently control and command the movements of long tail and hind legs. Another wonder is that a male shark copulates near the shallow water with a female shark, using a longitudinally rotation around female body to capture the female shark, and two pennies help a better chance to penetrate in a twisted half cycle. (cf. National Geographic Society video records). We begin with human brains which have each with 10 billion neurons, and each has two I/O states: (1) the net neuronal input state collected from the dendrite tree to (2) the neuronal output state at axon hillock threshold. The potential drop of I/O energy can be consistently derived from the homeostasis property and the Maxwell-Boltzmann Canonical probability. It turns out to yield the normalized sigmoid function σ of neuron firing rate. This is first observed in 1943 by Warren S. McCulloch,[1] a neuroscientist, and Walter Pitts, a logician, in Figure 1. In this paper McCulloch and Pitts tried to understand how the brain could produce highly complex logic prior to John von Neumann designing the computer binary logic (Figure 2).[2–9]

Figure 1 Field Programmable Gate Array (FPGA) (e.g. by Intel): Both are easier to easy integration by Field Programmable Gate Array (FPGA) firmware's Power law: P=VI of either the Ohm's Voltage V or Ampere's Current I.

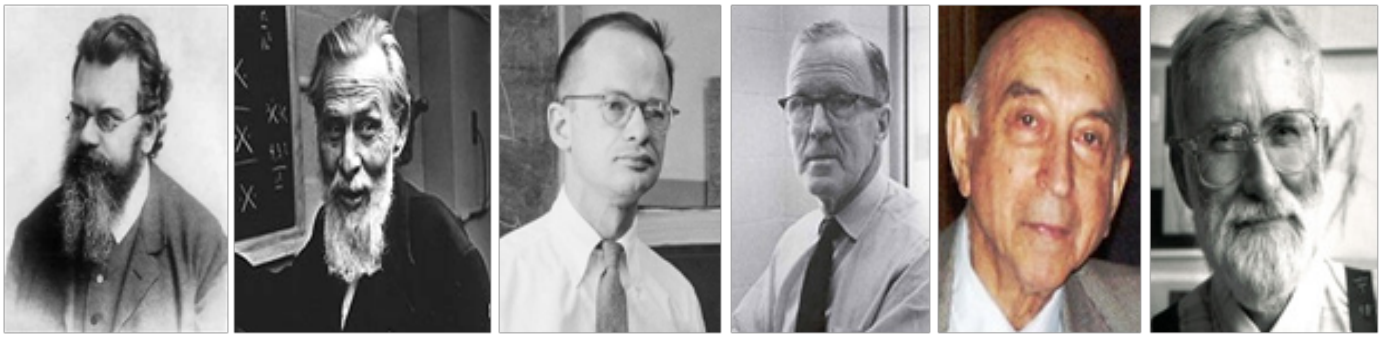

Figure 2 Neuroscientists contributed human brain dynamics. Theoretically Ludwig Boltzmann introduced a measure of the degree of uniformity called the entropy at statistical molecular level. Then, macroscopically, Warren S. McCulloch (1943) U. Illinois; Walter Pitts (1943) U. Chicago; Donald O. Hebb (1949) U. Toronto, followed much later Lotfi Zadeh (2017) UC Berkeley introduced the seminar work of open set fuzzy membership function logic concept, (in short Fuzzy Logic) and Walter Freeman (2017), UC Berkeley found a dynamic equation approach to the open set fuzzy logic.

Prof. Ludwig Boltzmann introduced historically the concept of total entropy S as the measure of the degree of 'uniformity,' meaning: having 'no information'. For example, the archeologist would visit a mountain top for non-uniform rock information that had more energy information, less entropy than the uniform white sand beach. In fact, the sea beach has been dissolved from rocks corrosion and evolutionally for million years washed down by rains and winds, and through the river to the sea. Mathematically, he defined, without the space-time such an irreversible thermodynamics with

$$S_{tot} = k_B Log\, W_{MB} \tag{1}$$

(by pass the French mathematician Poincare time reversal paradox), where the proportional constant $\boldsymbol{k_B}$ has appended with a upper case letter B in honor of Boltzmann. The magnitude of $\boldsymbol{k_B}$ is best represented together with the hot room temperature 27^oC in terms of the absolute Kelvin Temperature T

$$27^oC + 273^oK = 300^oK = \left(\frac{1}{40}\right)eV \tag{2}$$

$$W_{MB} = \exp\left(\frac{S_{tot}}{k_B}\right) = \exp\left(\frac{(S_{brain} + S_{env.})T_o}{k_B T_o}\right) = \exp\left(\frac{S_{brain}T_o - E_{brain}}{k_B T_o}\right) = \exp\left(-\frac{H_{brain}}{k_B T_o}\right) \tag{3}$$

Thus, human brain temperature is kept at $\boldsymbol{T_o} = 37^0C$ which is optimum for the elasticity of hemoglobin. On the other hand, the chicken is kept at 40^0C for reason of hatching eggs. However, a higher temperature of brains is not necessarily to be smarter, because we "ate chicken, not vice versa. Q.E.D. Maxwell-Boltzmann Probability W is derived time-independently from the third law of thermodynamic called Neal's law at non-zero temperature that insures the incessant collision mixing homogenizing the degree of uniformity measured by the total entropy

$$S\uparrow = S_{env} + S(x_0)\uparrow = k_B Log\left(W_{MB}\uparrow\right); W_{MB}(x_o) = exp\left(-H_{brain}(x_o)/k_B T_o\right), \tag{3a,b}$$

Where $\boldsymbol{H_{brain}}(x_o)$ is the derived within the head $(\boldsymbol{x}_0)$ is called the *Helmholtz's Minimum Free Energy (MFE)* defined as the internal energy $\boldsymbol{E_{brain}}(x_o)$ in contact with a blood environment at the temperature $\boldsymbol{T_o}$. The $\boldsymbol{H_{brain}}(x_o)$ is the $\boldsymbol{E_{brain}}(x_o)$ subtracted the unusable thermal entropy energy $\boldsymbol{T_o}\ \boldsymbol{S}(\boldsymbol{x}_0)$ and the net becomes "free-to-do work" energy kept to be the minimum to be stable:

$$\text{min. } H_{brain}(x_0)\downarrow = \mathrm{E}_{brain}(x_o) - \mathrm{T}_0 S(x_0)\uparrow \tag{4}$$

Use is made of the isothermal equilibrium of brain in the warm blood reservoir at the homeostasis temperature T_o. Use is further used of the second law of conservation energy $\Delta Q_{env.} = T_o \Delta S_{env.}$ and the brain internal energy. $\Delta E_{brain} + \Delta Q_{env.} = 0$ and then we integrate the change and dropped the integration constant due to arbitrary normalization of the probability (Figure 3).

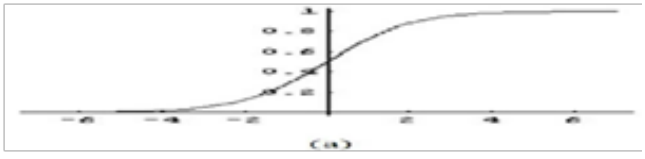

Figure 3 Standard Sigmoid Threshold Logic derived from two state normalization of Maxwell-Boltzmann distribution function Eq.(1).

We now know H_{Brain} is related to constant temperature $T_o = 37C = 310K$ thermodynamic Helmholtz Free Energy

$$H_{Brain} = E_{Brain} - T_o S$$

$$\exp\left(-\frac{H_1}{k_B T_o}\right)/\exp\left(-\frac{H_1}{k_B T_o}\right) + \exp\left(-\frac{H_2}{k_B T_o}\right) = 1/[\exp(\frac{\Delta \mathrm{H}_{1,2}}{k_B T_o}) + 1] = \sigma\left(\frac{\Delta \mathrm{H}_{1,2}}{k_B T_o}\right) = \begin{cases} 1, \frac{\Delta \mathrm{H}_{1,2}}{k_B T_o} \to \infty \\ 0, \frac{\Delta \mathrm{H}_{1,2}}{k_B T_o} \to -\infty \end{cases} \tag{5}$$

Collorary 1: Riccatti nonlinear 1st order differential equation derived from Maxwell-Boltzmann two state weighted sums and its exact solution turns out to be the sigmoid threshold function $\sigma(x)$:

$$Let = \frac{\Delta \mathrm{H}_{1,2}}{k_B T_o}, \text{ then}$$

$$\frac{d\sigma(x)}{dx} + \sigma(x) = \sigma(x)^2 \ ; \sigma(x) = \frac{1}{\exp(x)+1} \tag{6}$$

Proof:

$$\frac{\mathrm{d}\sigma(x)}{dx} = \frac{d}{dx}[\exp(x)+1]^{-1} = -1[\exp(\mathrm{x})+1]^{-2}\exp(\mathrm{x}) = -1[\exp(\mathrm{x})+1]^{-2}\{-1+(\exp(\mathrm{x})+1)\} = \sigma(\mathrm{x})^2 - \sigma(\mathrm{x})$$

Q.E.D

Collorary 2: F. Hopf (Baker) Transform: It can be linearized the first order Ricatti nonlinear differential equation to A. Einstein diffusion equation Eq(4)

Proof:

$$\sigma(x) = -\frac{\varphi(x)'}{\varphi(x)} \tag{7}$$

$$LHS = \frac{d\sigma(x)}{dx} = -\frac{\varphi''}{\varphi} + \frac{(\varphi')^2}{\varphi^2} = RHS = \frac{(\varphi')^2}{\varphi^2} + \frac{\varphi(x)'}{\varphi(x)}$$

$$\varphi' = -\varphi''$$

At the wave front, the streaming term is set zero

$$\varphi_t + \varphi' = 0; \varphi' \cong -\varphi_t$$

We have derived the diffusion equation of Albert Einstein's Brownian motions:

$$\varphi_t = \varphi'' \tag{8}$$

Q.E.D.

Remarks

Applications

Figure 4 why driverless autonomous vehicle (DAV) takes dozen years (according to Science Magazine (V. 358, pp.1370-1375, Dec 15, 2018)? This might be due to that recently Volvo Uber's DAV has killed a pedestrian in Tampa Arizona. When can Human Experience Expert Systems be coded as the 3rd Wave AI including logical and emotional brains that can understand and co-exist with Human. We notice that a major difference between machines versus human is that digital closed set table of look up versus analog open set agenda. For example," a traffic rule of red light is made to be sensibly broken"; "Thy shall not do any harm to the patients"(as Physician oath)

Figure 4 Both NASA and DARPA have invested on Driverless Autonomous Vehicles (DAV). Nevertheless, in no-man land, the scientists & technologists have not taken into account of other human driver and pedestrian behaviors. Applying AI to Sensors Suites is both all-weather W band Radar and optical LIDAR, as well as the Video Motion Detection Optical Flow Imaging Processing are adopted for collision avoidance situation awareness.

i. Statistical Ergodicity principle allows us to replace the limited temporal average with massively parallel spatial averages to accommodate all possible initial boundary conditions,

ii. Biological Natural Intelligence base on aforementioned homeostasis principle, we have derived the Biological Neural Nets sigmoid logic from which we have reproduced Walter Freeman diffusion and Lotfi Zadeh fuzzy logic membership function.

iii. Human psychology & fuzzy thinking about the traffic rules. We shall code the fuzzy logic into machine's Control Command and Communication Intelligence(C4I), but FMF's are sharpen after Boolean Logic (U, ∩) at load time. Model & Simulate (M&S) each dynamics including (1) Hebb Learning (2) road-friction Langevin-Einstein, (3) Satellites-GPU, (4) Computer Sensing (Radar, Lidar, Video, Sound, Tactile, Smell, Sensors).

Multiple Layer Supervised Learning known Deep Learning:[4,9]

i. To increase probability of detection of A & minimize False Alarm Rate B we need Multiple **Li**near classifier needs multiple layers Deep Learning for multiple cuts This is the key reason why AI Deep Learning become so popular in all application worldwide (Figure 5).

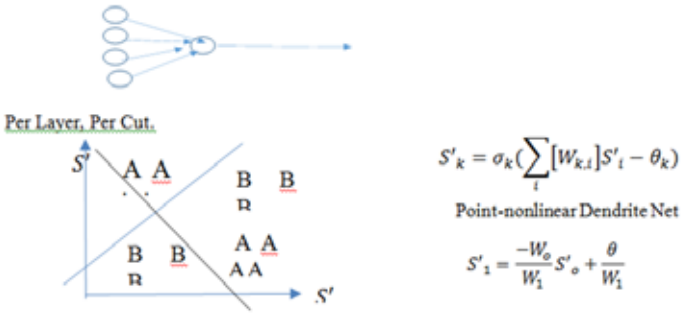

Figure 5 Artificial Neural Networks (ANN) needs supervised learning in multiple layers known as "Deep Learning"[8,9] (a) Left panel shows that while a single layer of Artificial Neural Network can simply be a linear classifier, the right panel shows the dendrite net giving rise to the linear classifier equation after the sigmoid threshold.

Brain-style unsupervised learning review

We wish to improve the supervised deep learning with LMS cost to become self-organization "follow the leader" as Unsupervised Deep Learning with thermodynamic equilibrium at constant temperature T_o at Minimum Free Energy (MFE). The automation solves NP Complete path finding problem by means of loss-less divide and conquer (ANN TSP, Foo & Szu, 1997). Supervised cost function is taken the LMS $min \| \vec{A} - \vec{B} \| = min \| \vec{A} - \vec{C} + \vec{C} - \vec{B} \| = min \| \vec{A} - \vec{C} \| + min \| \vec{C} - \vec{B} \| iff \perp$, the cost of search for $\vec{C}$ city is linear at boundary. We now review thermodynamics NI to answer why keep our blood temperature is kept at constant 37^{0}C. This is due to the optimum elasticity of red blood cells Hemoglobin to squeezing through the capillaries supplying the essential glucose and oxygen for human brain. Also, the thermodynamic equilibrium temperature keeps the chemical diffusion rate constant for all our nervous system to accumulate the experience over generations. This is the basis of human Natural Intelligence (NI) on two necessary conditions a constant temperature brain and power of sensory pairs.

The supervised learning is using the Least Mean Squares (LMS) Error Energy,

$$min.E = | (desired \, \textbf{\textit{O}}utput \, \vec{S}_{pairs} - actural \, \textbf{\textit{Out}}put \, \hat{S}_{pairs}(t) |^2 \tag{9}$$

(i) Sensory Inputs: "While agreed, the signal; disagreed, the noises"

$$\vec{X}_{pairs}(t) = \left[A_{ij}(t) \right] \vec{S}_{pairs}(t) \tag{10}$$

The agreed signals is because the power of pair input energy is above the thermal noise level of brain, Then the vector pair time series $\vec{X}_{pairs}(t)$ may be represented with the thermodynamic degree of uniformity of all sensory neuron firing rate $\vec{S}_{pairs}(t)$ described

with Ludwig Boltzmann entropy with unknown space-variant impulse response functions mixing matrix $\left[A_{ij}\right]$ and the inverse by learning synaptic weight matrix.

The inverse is Convolution Neural Networks:

$$\hat{S}_{pairs}(t)=\left[W_{ji}(t)\right]\bar{X}_{pairs}(t) \tag{11}$$

$$\left[W_{ji}(t)\right]\left[A_{ij}(t)\right]\cong[I] \tag{12}$$

Unsupervised learning is based on Helmholtz free energy namely, energy has been subtracted the un-usable thermal noise energy T_oS

$$\downarrow H=E-T_oS\uparrow\geq 0 \tag{13}$$

$$\frac{d[W]}{dt}=-\frac{\partial H}{\partial[W]} \tag{14}$$

Control steering wheel Lyaponov convergence of Learning of

$$\frac{dH}{dt}=\frac{\partial H}{\partial[W]}\frac{d[W]}{dt}=\frac{\partial H}{\partial[W]}\left(-\frac{\partial H}{\partial[W]}\right)=-\left(\frac{\partial H}{\partial[W]}\right)^2\leq 0 \tag{15}$$

Since dendrite input free component "i" to neurons may be denoted as synaptic summation in terms of repeated Greek letters " α " (Einstein notation)

$$D_i=[W_{i\alpha}]S_\alpha \tag{16}$$

$$\Delta H_{brain}\equiv\frac{\Delta H_{brain}}{\Delta D_\beta}(-\Delta D_\beta)=g_\beta([W_{\beta\alpha}]S_{0\alpha}-[W_{\beta\alpha}]S_\alpha)$$

If we define the change of input firing rates $\Delta S_j\equiv S_{oj}-S_j$, then it follows consistently what Donald Hebb has observed 5 decades ago "linked together fired together" cooperation among neurons

$$g_i\equiv-\frac{\Delta H_{brain}}{\Delta D_i} \tag{17}$$

$$\frac{\Delta[W_{ij}]}{\Delta t}=-\frac{\Delta H_{brain}}{\Delta[W_{ij}]}=g_i\Delta S_j \tag{18}$$

Albert Einstein said well that "Science has nothing to do the truth, but the consistency" (For general information, the truth is an arena of philosophy (Figure 6).

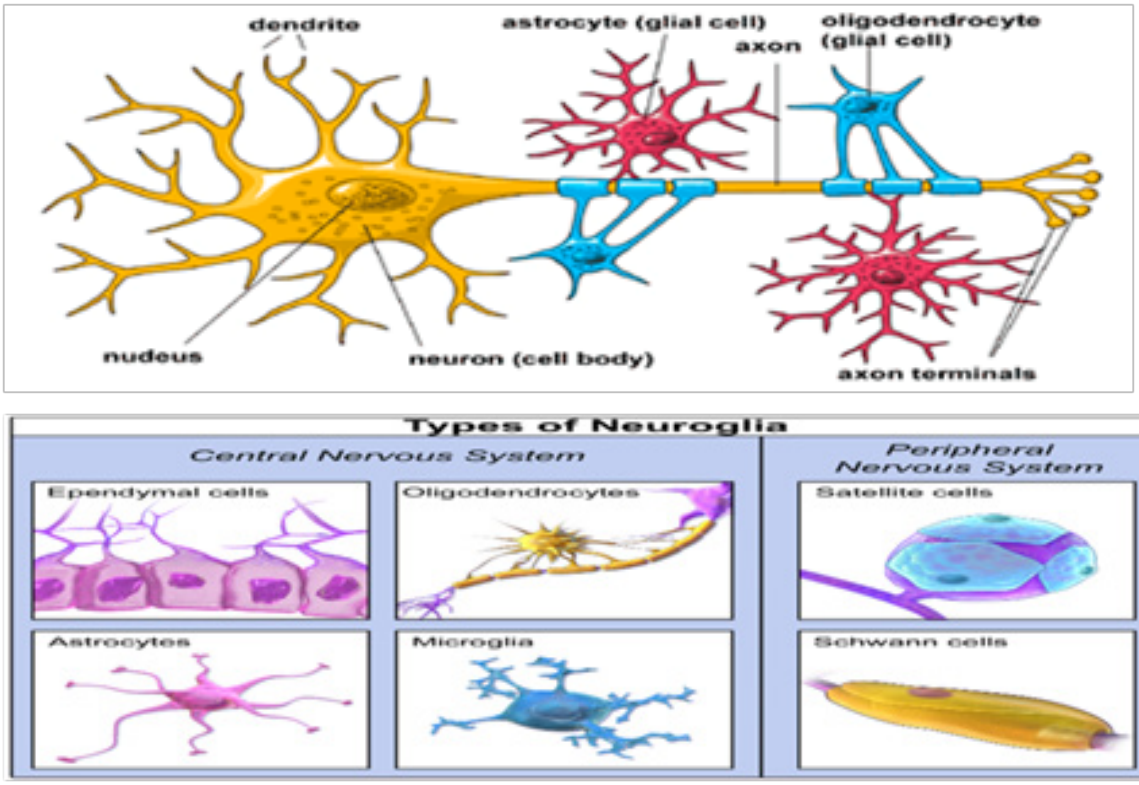

Figure 6 Glial cells: (a) functionality of neuroglial; (b) There are 4 kinds in the Central Nervous System, and 2 kinds in Peripheral Nervous Systems.

Brain science applications

To complete the applications, we need to introduce the Langevin equation of the car momentum $\vec{P}=m\vec{V}$, with tire-road friction coefficient f , car-body aerodynamic fluctuation force $\vec{F}(t)$

$$\frac{d\vec{P}}{dt}=-f\vec{P}+\vec{F}(t) \tag{19}$$

$$\left\langle\vec{F}(t)\cdot\vec{F}(t')\right\rangle=2k_Bf\,\delta(t-t') \tag{20}$$

This possible membership concept is important to exploration of large data as which often don't have definitive membership relations when partial analysis of the data is being done without definite knowledge that classifies all the subsets of the data. For example,

"young and beautiful" is a much sharper possibility than either "the Young" or "the Beautiful". When we average over spatial cases, we obtain the average of the Experience Based Expert System in order to elucidate ***i-AI***.

$$\text{Brake FMF} \cap sensor \ \text{Awareness FMF} \cap GPS \ \text{space-time FMF=Experience} \ \sigma(stop)$$

Review of Fuzzy Membership Function, which is an open set and cannot be normalized as the probability but a possibility (Figure 7).

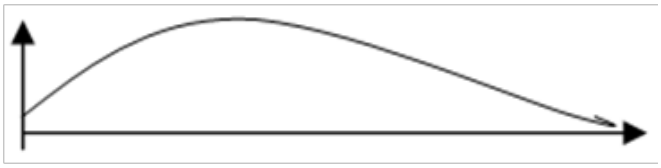

Figure 7 "Young" membership is not well defined: Young (17 to 65);

UC Berkeley Prof. Lotfi Zadeh passed away at the age of 95 years old and Walter Freeman at age 89. To them, 80 may be "young." Likewise, the "beauty" is in the eye of beholder. According to the Greek mythology of Helen of Troy, has sunk thousand ships, and Egypt Cleopatra hundred ships and Bible Eva one ship (Noah Arc) (Figure 8). Boolean logic is sharp, not fuzzy. Unfortunately, the shortened "Fuzzy (membership function) Logic" as "Fuzzy Logic" is a misnomer. Logic cannot be fuzzy, but the set can be open set as all possibilities. Szu et. al. have advocated a bifurcation of chaos (advocated first by Walter Freeman in human brains with Bob Kozma) as a learnable FMF, making the deterministic Chaos as the learnable dynamics of FMF (cf. Max Planck: ResearcGate.net). Consequently, the car will drive through slowly when the red light happens at the mid night in desert and without incoming cars. Such an ***RB*** becomes flexible as **EBES**. To show that this replacing ***RB*** with ***EBES*** is a natural improvement of *AI* in the remaining paper. This explains a driverless car that will turn the rule stopping at red light to be gliding over the red light when no incoming car at mid light in desert.

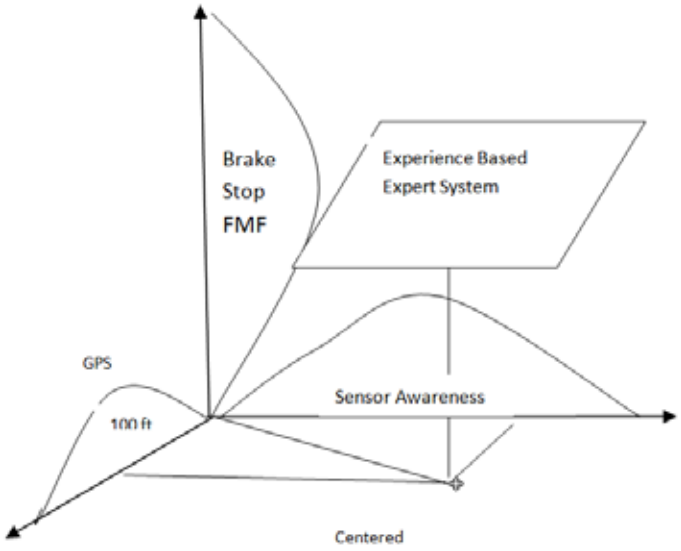

Figure 8 The utility of FMF logic is Boolean Logic of Union ∪ & Intersection ∩ of open set Fuzzy Membership Functions (FMF) which cannot be normalized as the probability.

Conclusion

In conclusion we demonstrate an application of Lotfi Zadeh fuzzy membership function of two states "beauty or not (Figure 9)."

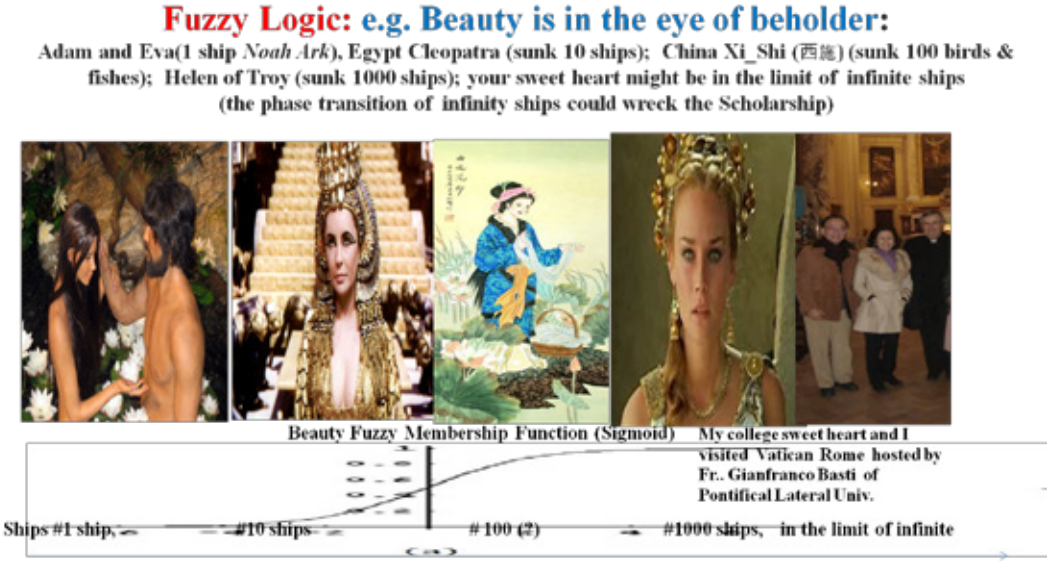

Figure 9 Beauty Fuzzy Logic Membership Function turns out to sigmoid. Since the beauty is in the eyes of beholder, then it follows two state beauty or not in terms of Maxwell-Boltzmann phase space distribution and derived the sigmoid function, Eq.(5).

In summary, Russian Mathematician **G. Cybenko** has proved "Approximation by Superposition of a Sigmoidal Functions," **Math. Control Signals Sys**. (1989)2: 303-314.[2] Similarly, **A. N. Kolmogorov** has given "On the representation of continuous functions of many variables by superposition of continuous function of one variable and addition,"**Dokl. Akad. Nauk, SSSR**, 114(1957), 953-956.[3] The

two state normalization in the Maxwell-Boltzmann phase space distributions is derived to be equivalent to a ion-current diffusion equation, as proposed first ad-hoc-ly by Walter Freeman. By means of the Hopf transform, we can be applied to the sigmoid threshold logic, which turns out to be fuzzy membership function (FMF) of beauty or not. We have illustrated the two states normalization. We cannot code by a finite lookup table of FMF into a finite state Von Neumann computer Machine which require dynamic equations development. We believe Prof. Walter Freeman of UC Berkeley has shown us how to use dynamical equation to compute the output, rather to store all computed results in computers. In conclusion, the missing half Einstein brain turned out to be the none-electrically conducting Glial cells, which are necessary integrate part of human brains.[10–15]

Review of tomography projection theorem

Radon Transform[16] & **Wikipedia**)

Figure 10 Hence the inverse of the Radon transform can be used to reconstruct the original density from the projection data, and thus it forms the mathematical underpinning for tomographic reconstruction. This is also known as iterative reconstruction. The Radon transform data is often called a sinogram because the Radon transform of an off-center point source is a sinusoid. Consequently, the Radon transform of a number of small objects appears graphically as a number of blurred sine waves with different amplitudes and phases. The Radon transform is useful in computed axial tomography (CAT scan), barcode scanners, electron microscopy of macromolecular assemblies like viruses and protein complexes, reflection seismology and in the solution of hyperbolic partial differential equations. Let $f(\mathbf{x}) = f(x,y)$ be a compactly supported continuous function on $\mathbf{R}^2$. The Radon transform, Rf, is a function defined on the space of straight lines L in $\mathbf{R}^2$ by the line integral along each such line: Concretely, the parametrization of any straight line L with respect to arc length z can always be written (Figure 11).[17,18]

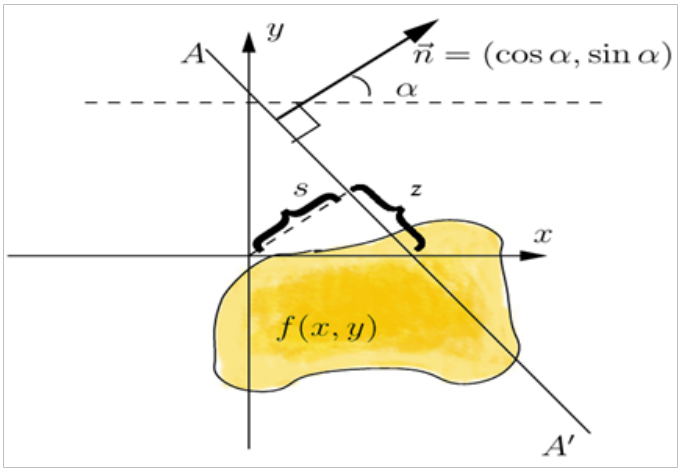

Figure 10 s is the distance of L from the origin and α is the angle the normal vector to L makes with the x-axis).Let f be a function that represents an unknown density, then the Radon transform represents the projection data obtained as the output of a tomographic scan.

Super-resolution by Band-limited 1972 Gerchburg-Saxon Theory for phase retrieval:

One takes the advantage of Fourier Transform is L2 convergence in the least mean squares (LMS) sense (Figure 12).

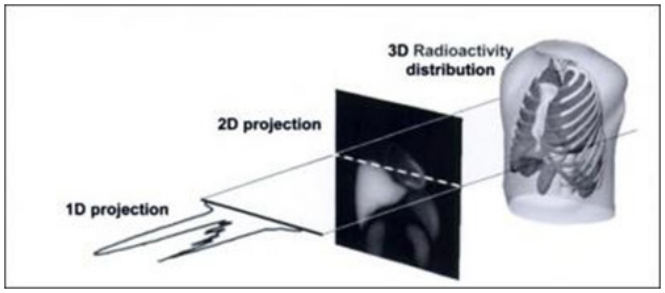

Figure 11 It follows that the quantities (α,s) can be considered as coordinates on the space of all lines in $\mathbf{R}^2$, and the Radon transform can be expressed in these coordinates by.

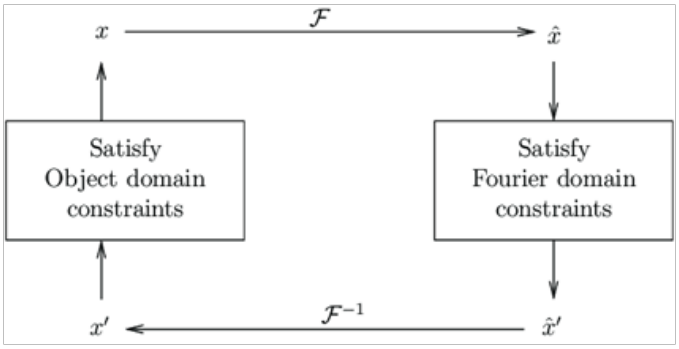

Figure 12 Usually we know a-priori a space-limited function is also its Fourier spectrum to be band-limited as well.

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Conflicts of interest

None.

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