

# Negentropy indicative of Consciousness: a Law of Nature; Link between Consciousness, Randomness and Sparse Distributed Networks

Copyright (C) 2025 Luke Kenneth Casson Leighton. All Rights Reserved

Contact: lkcl@lkcl.net. Date: 19 Aug 2025. Updated: 19 Aug 2025.

Ref: viXra:2508.xxxx v1 DOI

[http://lkcl.net/reports/consciousness\\_randomness](http://lkcl.net/reports/consciousness_randomness)

## Abstract

Maharishi Mahesh Yogi stated that the source of all thought is the source of all possible ideas. From a Computer Science and Mathematical perspective the only equivalent candidate for such is a true Pseudo-Random Number Generator, the caveat being that it should have an infinite-length seed and no degenerate repeating. He also stated that knowledge (new ideas) can only be "discovered" simultaneously, citing Legendre's theorem: "A group subdivides a group", from which it is deduced that beings and the Universe itself meet Definitions of Consciousness by both embodying knowledge, and thus correlate directly with groups. This paper also explores the difference between time-distributed randomness as a source of creativity and thought vs domain-distributed, with implications for simplified efficient Particle Swarm Optimisation. Randomness is just as important a part of a Definition of Consciousness as McKenzie's Memory, Perception, Imagination and Looping, sufficient to postulate that it is a Law of Nature that Negentropy indicates Consciousness is present. Further: an insight is highlighted that Analogy inherently emerges from the properties of Sparse Distributed Memory, and therefore so should self-directed learning when SDM is utilised in any Consciousness entity. In other words: Tononi et al were right.

## 1 Introduction

Hong and Pavlik explored how randomness can greatly increase efficiency in a Randomly-weighted Fourier Network.[1] Pitti Weidman and Quoy apply random permutations to (ordered) ordinal codes, intentionally creating *sparse representations* to great effect.[2] Fuzzy-PID Control also paradoxically increases effectiveness,[3] and fly eyes are shown to maximise entropy through "whitening".[4] It seems that in nature, when randomness is introduced it has a counterintuitive effect. The question is *why*?

This paper explores a new perspective on randomness, inspired by Maharishi Mahesh Yogi's insights into Consciousness.[5] The initial exploration of Consciousness did not go into significant depth: this paper corrects that.[6].

In the paper on Epigenetics[7] a new Law was postulated that wherever Negentropy is present then so is Consciousness. However this may turn out to simply be a Law of Nature. Hankey relates that in discussions witnessed between Brian Josephson and Maharishi Mahesh Yogi on the Laws of Nature, Josephson stated that the Laws are inviolate: Mahesh pointed out that Josephson had not fully understood. Querying further, Hankey relates that Mahesh referred effectively to God as the source of the Laws, which, rather obviously, requires a Definition of God, discussed below and in the initial exploration of Consciousness.[6]

It is a well-known adage that asking the right question often encodes the answer, however when that is not forthcoming an alternative technique is to hold

the question in mind (sometimes for months), and *over time* some random event, conversation, or other unrelated insight will trigger a "eureka" moment as the answer miraculously is found.

Put another way: the qualia representing the question and the qualia representing the answer had a "bit of a moment" in the time-domain where effectively *random events* (random qualia as perceived by the experiencer) connected the two together. If however the individual is, putting it colloquially, "stressed to the eyeballs" i.e distracted by other qualia, the chances of being able to recall the original question or pay attention to the crucial arbitrary event are clearly slim to none.

Explored below, then, inspired by Pitti et al, Hong et al and many others, is how randomness (infinite entropy) in both the complexity-domain and the time-domain can paradoxically result in *negative* entropy, asking the burning question "why?", aka "What The Hell??"

## 2 Randomness

If the encoding of all possible ideas is generated from a PRNG with an infinitely-long seed, the output, whilst indistinguishable from white noise and exhibiting infinite entropy, will still contain all possible ideas, each idea being encoded as a sequential stream of qualae in a given qualia. A common misconception from cryptographic testing of PRNGs, easily refuted when true-random sources of entropy are tested, is the expectation that the probability of extreme-long runs of fixed patterns (all zeros for

example) is much lower than reality.

It sounds a little absurd, on the basis that if the seed is infinitely long then the PRNG, which generates infinite combinations, which in turn would already be present in an infinite seed, is effectively superfluous. However firstly the concept is an analogy and a hypothesis, secondly the value of the seed is unknown, thirdly it *might* be the case that the seed is not infinite in length after all, and fourthly evidence in the form of negative entropy throughout the universe supports the hypothesis that knowledge is being "organized" despite both infinite supply and variety of that knowledge.

A useful insight from Computer Science here is that Compression Algorithms *never* succeed in compressing true-random data, in fact the file size increases due to structural information associated with the algorithm. Infinite entropy is simply impossible to beat. The phenomenon is sufficiently well-known that Cryptographic test suites (such as NIST STS)[8] use compression to test for randomness.

### 3 Akashic Records

What are the Akashic Records? Traditionally they are postulated as being the history of all that has occurred in the universe. However if the universe is a loop, as theorised,[9][10] then one of the key characteristics of Definitions of Consciousness is met: cyclic feedback. And it is not such a stretch of imagination to infer and surmise that the Akashic Records are not just a history store, but are implicitly *the* Memory store of a Conscious being: our universe.

Additional implications arise from Hankey and Thakre's work, "Fractal physiology: the reason why", and the success of Sparse Distributed Memory, combined with Legendre's theorem. Firstly, that the encoding implicit in fractal physiology, recognised by any Software Engineer as recursion at work (3D Mandelbrot sets[11]), results in reduced Kolmogorov Complexity, increased efficiency, less energy required and reduced or negative entropy. The Mandelbulb is a useful illustration as the underlying fractal algorithm keeps cropping up in biology, both in the human body and in cruciferous vegetables. What seems fantastically implausible to have any kind of order turns out to be fractal in nature.

It would, under the circumstances of the success of Sparse Distributed Memory,[12] highlighted by Bernie Barr's Global Workspace Theory as implemented in LIDA by the CCRG, be reasonable to expect all large Consciousnesses to utilize this type of Content-Addressable Memory technique: it so hap-

pens to result in multiple distributed copies of the knowledge, which so happens to be precisely the condition that fulfils Legendre's theorem.

The startling implications are, therefore, that beings within the universe contribute to the sum distributed knowledge, and are even part of that knowledge, whether they like it or not. This seems to be a very special privilege and perspective until one realizes that we live in this universe and it's not like we can move to another.

The expectation is, then, that due to the self-organising pressure of efficient resource utilisation on Consciousness beings, the Akashic Records become, under Evolutionary pressure, fractal in nature and implement a "sparse distributed lookup", being the Universe's CAM. This perspective resonates with and underpins Ervin Laszlo's fantastically intuitively innovative work,[13] again confirmed by Laughlin's observations[4] and Pitti et al's "whitening" technique.[2]

## 4 Creativity

The key question comes down to how would randomness trigger creativity? As highlighted in previous work it comes down to "silence" (meditation) allowing innovative (random) new qualia to spontaneously occur that have no prior connection to anything else. Put another way: if a given Consciousness is focussed on a particular thought or chain of, the occurrence of new qualia or new innovative association between two seemingly-unrelated thoughts is highly unlikely to occur, and complex chains even more so.

To illustrate requires investigation into Sparse Distributed Memory (SDM). The theory has an algebra associated with it, based on treating ordered qualia as "addresses" (keys in a key-value store aka Content-Addressable Memory, or CAM). A formal proof of the algebraic properties was carried out by the inventor of SDM.

### Kademlia and SDM

Interestingly, Kademlia,[14] the DHT algorithm behind BitTorrent, likewise has a formal proof on "chaining" - the ability to traverse from nearest-neighbour nodes to the destination, selecting intermediaries by way of XOR between addresses. Even more interestingly: a study into epilepsy was looking at the level of connectivity in the brain.[15] It would seem that the properties of a Kademlia network and its decades of success in Bittorrent, backed up by the decades of research into SDM and demonstrat-

ing that both biological and computing modelling follow this theory, all validate SDM.

The key is that similar qualia end up being locally clustered, or at least locally-connected. By similar, this means that the XOR of the qualia (a comparison) results in a near-match. The author of SDM notes that beyond a certain "distance" a match (link) becomes impossible.[12] In Kademia, this is where "chains" come into play, as the properties of the network require Nodes to maintain a list of Nodes with similar addresses, inherently creating a network prioritized by Hamming distance, and, crucially, to also keep a copy of nearest-neighbour's data. Note that in an Internet-connected network the physical distance or the IP Address is not relevant: hence the sparse data inherently becomes world-wide distributed.

SPAM detection has also become successful by creating hashes (SDM style addresses) in such a way that similarly-worded messages, even if there are repeats, will have the same hash. Also worth observing is the success of cosine similarity (dot product) as a tool behind Analogy in Large Language Models:[16] again, the difference in the qualia subsets is compared ( $A - B$  vs  $C - D$ ).

The point is, here, to reinforce that there exists Computing algorithms to both implement SDM and to create chains that iteratively connect one disparate idea to another (reliably, unlike the game of Chinese Whispers).

However how would such an association occur (be discovered) if no such association between two semi-interrelated thoughts existed, due to the "qualia difference" being too great? This is where Meditation (quietness, resulting in spontaneous randomness) comes in.

## 5 Silence

From the silence - the lessening of thought that could overwhelm coherent random spontaneous firing across cortices - the expectation is that new qualia generated from random firing would in some cases also trigger a random cross-association with bare-minimalistic common ground (dual subsets) between the two qualia. In other words: if a pair of such (formerly unknowing unrelated) subsets are triggered by a randomised qualia then a "new innovation" - a new "insight" - has been "created" within the mind of the individual in the Meditative (coherent) State.

The "innovation" concept was explored in-depth by Ranjan and Gabora which they term "an as-

sociative mode of thought".[17] This paper postulates that there is no overlap between the qualia (too great an SDM distance) but that a third (randomised) thought (qualia) happens to have enough common qualia between both to create an otherwise-unknown association: aka "creative innovation". Supporting this alternative hypothesis is that Kanerva's thesis notes that the threshold (number of inputs that could trigger "firing") controls the size of the region of similar addresses to which the neuron responds.[12]

Expansion of this concept - laying down a trail exactly as implemented in the Kademia Network - involves Chaining, where multiple such "random" qualia interconnect in a chain between two distant ideas with too great an XOR (difference). examples of such would be the discovery of sequences of physical interconnected movements to light a fire, where one of the intermediate steps involves noting that lightning causes trees to catch fire, and another might be that noting flint hitting rock creates a spark.

Bottom line: without "randomness" to generate entirely new cross-associations that would otherwise never occur, innovation is virtually impossible to occur by thought alone.

## 6 Time-domain

For simpler organisms (simpler Consciousnesses) it is necessary, and even to higher-order Consciousnesses it is optional: it becomes "directed trial and error", rejection of failures and reinforcement of successes, within the constraint of the environment: ants performing randomised searches (utilizing chemical signatures to keep track of previously-visited areas) or sniffer-dogs tracking. In other words, the application of randomness occurs in the time-domain rather than the information-complexity-domain. However clearly there is scope for both strategies to be applied simultaneously.

## 7 Particle Swarm Optimisation

One key question: what is the equivalent of "lack of silence", in the physicality domain? It would be that the individual has a tendency, instead of to dwell on a particular thought or sequence of thoughts given a local context, to instead remain in one location either unintentionally or explicitly.

Ants and other creatures utilise chemical trails to overcome this problem, where the signature naturally fades over time, allowing the creature to poten-

tially return to a location formerly visited, but not immediately. It also gives some insights into how to improve Particle Swarm Optimisation[18] - by having a recorded history of at least the average position (including that of the "centre" particle in Grey Wolf hunting) and intentionally moving away from that position if time dwelt within the locality is extended. This *may* help escape "local minima" traps. In Freito et Al's study on the history of PSO:[19]

"Wang et al., in 2013, proposed the Diversity Enhanced PSO with Neighborhood Search (DNSPSO),[20] a PSO variant that includes a new diversity enhanced mechanism using a crossover operation, and a new neighbourhood search strategy."

It turns out that combining alternative strategies with PSO can improve results in some cases but will always end up with a more complex algorithm. That being a given, the question becomes: is there any way to learn from the above, to create an effective algorithm that is also efficient and simple?

One angle to consider: can the success of Kademia be applied to PSO? The expectation would be that in a Multi-dimensional environment, the answer would be almost by definition yes, the caveat being that the entire domain would require searching and categorisation according to SDM and Kademia DHT criteria. This would be fine in a discrete domain but unacceptable in a continuous one, unless it can be demonstrated that quantization (discrete step size) does not exceed (mask) local minima variability. There is also the disadvantage of creating the categorisation in new domains.

An alternative approach would be to learn from neurons themselves: to apply the firing thresholds and response characteristics to the choices made by individual particles: both attraction *and aversion*, and to mimic the interconnectivity in such a way as to mirror SDM (and Kademia) in some fashion. The quantity of strategies to try out is considerable and exciting, and worth exploring in its own right.

## 8 Discussion

There is a lot to consider. The paper was supposed to be straightforward and highlight the importance of randomness as part of the Definition of Consciousness. However that required linking self-consistently to a wide range of topics previously explored.[6]

## Legendre

The deduction that the Universe is Conscious requires unpacking. Legendre's theorem implies that the group and the subgroup belong to the same category - are the exact same type. Therefore "discoverers" of new knowledge if we assume the discoverers *themselves* to be part of the sub-group, as Consciousness (smaller) beings, capable of *understanding* the knowledge, then correspondingly the Universe must also be likewise Consciousness, otherwise the group and the subgroup are not the same type.

Unfortunately, it is necessary to have communication across the planet (and planets and galaxies?) for the thoughts - the discoveries - to occur simultaneously, at which point "spooky action at a distance" kicks in. Fortunately this concept has been explored by Professor C D Yang[21][22] so is considered plausible (rather than proven).

So it is shown that it is plausible that the Universe is Conscious, albeit on a fantastic scale. Almost as a casual aside this helps triage the theories as to whether the Universe will end after one cycle around its loop or whether it will continue: the Definitions of Consciousness tell us that looping is a corrective feedback mechanism, where auto-tuning PID Control[23] is a single parameter (qualia of size one), and the Universe a qualia of effectively-infinite size.

We know our Universe to be bounded, not infinite, from measurements of the Cosmic Background Radiation, which has rather fortunate implications for the proposed PRNG, which need not be supplied by an infinite-sized seed, merely a fantastically-large one instead.

There is also the rather heretical implication that if the Universe is synonymous with God, then God, whilst effectively all-knowing in the form of the Akashic Records being its Memory, the limited bounds of the Universe implies that God is similarly bounded. Alternative implications are that there exist infinite Universes, at which point God jumps back a step up to infinity, and the Galileo and Inquisition axes can be buried again.

## Yoga

The practice of yoga is frequently misunderstood as being purely a sequence of physical movements and stretches: Ashtanga Yoga was developed by a student that did not wait until the full knowledge was given by a Guru. Yoga is in fact a group of practices designed *as a whole system* to get stress under control. The term "karma" is given to recurrent thought patterns outside of conscious control (worst

case: PTSD) and have a well-established consequent detrimental effect on the body.[24]

Meditation, which is one part of Yogic practice, not only encourages (entices) the brain to calm down, the inducement (enticement) of silence, through randomised creative thought, provides the practitioner with a tool to escape a potential local minima of pathological thought, or other resource or physical environmental trap, that the practitioner finds themselves in. Which is remarkably practical: the word "spiritual" not having been mentioned once. The droll prospect is raised that, due to the risk of hitting local minima, Particle Swarm Optimisation algorithms could benefit from a bit of Yogic practice.

## Kademlia and SDM

Of particular interest is how far ahead Kademlia is, compared to current SDM and cognitive computing research. Kademlia already implements perfect traversal and perfect routing between addresses within an SDM, *without realising* the significance or the similarity to SDM. It was the common usage of XOR and that both are CAMs that sparked the investigation and found both to have formal proofs.

Looking closely at how nearest connectivity works: it is important to bear in mind that given any pairs of addresses, it is the difference between the pairs that results in clustering, despite wild difference in the (four) addresses. This is *literally* the textbook definition of Analogy. In other words: SDM and Kademlia DHT identify and locally cluster (and store in a Distributed fashion) material that is Analogously inter-related. This is a significant insight as it has implications for how self-directed learning occurs. However it requires that each Node in the SDM network has built-in processing capability (creating what is known in Flynn's 1972 Taxonomy as an "Associative Processor")[25] which is just another word for Tononi's IIT.[26]

## Evolution

From an Evolutionary perspective, given the cost of carrying around any given knowledge or data or structure, if there is a choice to carry around the raw data vs a compressed version of that data, Evolutionary pressure will inherently favour the most efficient encoding. True randomness (white noise) is the exception, but even pink noise will be more efficient to store.

Evolution is a function of *efficiency*.

## Laws of Nature

It is crucial to note that observation (detection) of Negentropy does not *define* Consciousness. Rather, that the detection indicates the *presence* of Consciousness at work, at some level and to some degree.

Exactly what that Consciousness is *cannot be nailed down* as it is clearly context-specific, but the key is that the other aspects of Consciousness *should* also be present, from the other Definitions of Consciousness. This raises an interesting addendum when testing for Consciousness:[27] how does the entity react in the face of chaos (infinite entropy). As the simplest canonical guide: analysing an auto-tuning PID Controller faced with entirely random input and/or output would make a fascinating study.

## General

It is crucial to bear in mind that both domain-dependent and time-dependent complexity can face similarly-sized qualia and information (in the form of environmental and resource complexity). A reminder that Consciousness increases in capability to match the corresponding increase in environmental and resource pressure. Put another way: in the case of time-domain application the simplicity of the individual Consciousness should never be underestimated, as richly demonstrated by a wealth of astonishing and delightful Nature documentaries.

Pitti Weidmann and Quoy's sparse representations would seem to create a uniform distribution of ordinal codes, i.e. diffusion occurs, the key being as illustrated by SDM's redundancy that a uniform multiple of links to a given code *should* be a given. Another possible phrase describing such is "Holographic". When applied to SDM, another way to describe such would be "Holographic Memory", with echos of Ervin Laszlo's Hologfield.[13] However as noted above, with the Akashic Records reasonably concluded to be the SDM of "God", aka "a fantastically large Consciousness", it is not unreasonable to further deduce and describe SDM as being Holographic.

Also worth pointing out that Negentropy is not a violation of the Laws of Thermodynamics. It turns out that the creation of coherent information (aka Knowledge) as stored within a Consciousness results in output of waste byproducts such as heat and effluent that exactly match the Negentropic value of the knowledge. The irony of randomness effectively defeating its own entropy is not lost.

Lastly: how does the connectivity between neurons result in SDM? Put another way: how does the neuron know to connect, in an SDM, to similar qualia?

The answer as usual may lie within the question, given SDM's algebra, but there may be more to it, given that clusters of galaxies form such remarkably-similar structure.

## 9 Conclusion

An exploration of randomness being the source of all thought threw up links between what would otherwise be considered wildly different areas of research. At the core is Sparse Distributed Memory (SDM) and the Kademia Distributed Hash Table (DHT), both of which are key-value stores based around the properties of XOR and Hamming distance, both of which invoke the same underlying algebra and both of which have mathematical proofs, one extending the other. Gabora and Ranjan's theory invited an additional perspective of an intermediary random qualia that overlapped sufficiently with both, so as to trigger - or become - the "creative innovative link".

Further: the automatic local-clustering of qualia with similar Hamming distance allows, if processing is built-in to every Node (or in the case of neurons, additionally in the connectivity *between* neurons) allows for Analogy ( $A-B = C-D$  and  $A-C = B-D$ ) to be derived and applied, meaning that Tononi's IIT[26] emerges.

Pictures comparing neural networks to galaxies are virtually indistinguishable, hinting that there is an underlying mathematical / algorithmic pattern right across the board: it is postulated that this is Consciousness, or its definition, and that randomness is just an equally important characteristic as those highlighted by McKenzie (Memory, Perception, Imagination and the iterative feedback between them).[28] Again this has implications for PID Control: could the deliberate introduction of random fluctuations help dampen hysteresis, or is it just that PID Control inherently helps with noisy input?[3]

Time-distributed randomness is especially fascinating: it's not truly random (pink noise rather than white) as illustrated by Ant chemical trails causing localised aversion and attraction, ultimately resulting in Negentropy achieved in a time-sequential fashion.

The bottom line here is that for any given Consciousness, the crucial role of randomness in Memory, notably in the use of SDM and its biological implementations (brains) has been highlighted as a paradoxical way to overcome entropic increase rather than feed it. The implication being that when Negentropy is found hiding in plain sight amongst randomness, Consciousness *has* to be present. Worth

exploring further: the driving factor being, ultimately, efficiency of encoding, implying that chaos - the storing and carrying of randomness by any given Consciousness - is *heavy*. Chaos *literally* has weight.

## 10 Acknowledgements

With thanks to Professor Alex Hankey, for many valuable discussions on Consciousness.

## References

- [1] Jinyung Hong, Theodore P. Pavlic, "An Insect-Inspired Randomly Weighted Neural Network with Random Fourier Features For Neuro-Symbolic Relational Learning",  
<https://ceur-ws.org/Vol-2986/paper10.pdf>
- [2] Alexandre Pitti, Claudio Weidmann, Mathias Quoy, "Digital computing through randomness and order in neural networks", 119 (33) e2115335119, Pitti, Weidmann,  
<https://pnas.org/doi/10.1073/pnas.2115335119>
- [3] <https://www.sciencedirect.com/science/article/pii/S2214317323000549>  
<https://onlinelibrary.wiley.com/doi/10.1111/jfpe.14651>
- [4] S. Laughlin, "A simple coding procedure enhances a neuron's information capacity." *Z Naturforsch C Biosci* 36, 910–912 (1981). PMID: 7303823  
[https://www.princeton.edu/~wbialek/rome/refs/laughlin\\_81.pdf](https://www.princeton.edu/~wbialek/rome/refs/laughlin_81.pdf)
- [5] "The Science of Being and the Art of Living", Maharishi Mahesh Yogi
- [6] "Where is the Definition of Consciousness?", Luke Kenneth Casson Leighton, viXra:2503.0196, doi:10.13140/RG.2.2.11189.18403  
<https://www.researchgate.net/publication/390335688>
- [7] "Epigenetics: O(N) emergent Integral windup and Consciousness" Luke Kenneth Casson Leighton. viXra:2507.0105, DOI:10.13140/RG.2.2.31750.48963  
[http://lkcl.net/reports/consciousness\\_epigenetics](http://lkcl.net/reports/consciousness_epigenetics)
- [8] "Randomness Testing of the Advanced Encryption Standard Candidate Algorithms", Juan Soto (NIST), NIST IR 6390, September 1999  
<https://csrc.nist.gov/pubs/ir/6390/final>
- [9] <https://www.scientificamerican.com/article/is-the-universe-a-giant-loop/>
- [10] <https://www.theguardian.com/education/2005/apr/14/research.highereducation1>
- [11] <https://en.wikipedia.org/wiki/Mandelbulb>
- [12] Kanerva, Pentti (1988). "Sparse Distributed Memory", The MIT Press. ISBN 978-0-262-11132-4.  
[https://en.m.wikipedia.org/wiki/Sparse\\_distributed\\_memory](https://en.m.wikipedia.org/wiki/Sparse_distributed_memory)
- [13] "SCIENCE AND THE AKASHIC FIELD", ERVIN LASZLO, Simon & Schuster; 2nd Edition, 3 May 2007, ISBN 978-1594771811
- [14] <https://pdos.csail.mit.edu/~petar/papers/maymounkov-kademlia-lncs.pdf>
- [15] "Measures of entropy and complexity in altered states of Consciousness" D Mateos, R Guevara Erra, R Wennberg, J L Perez Velazquez  
PMCID: PMC5801282 PMID: 29435088  
*Cogn Neurodyn.* 2017 Oct 20;12(1):73–84. doi:10.1007/s11571-017-9459-8  
<https://pmc.ncbi.nlm.nih.gov/articles/PMC5801282/>
- [16] <https://memgraph.com/blog/cosine-similarity-python-scikit-learn>
- [17] Ranjan, A., Gabora, L. (2013). "How insight emerges in a distributed, content-addressable memory." In A. Bristol, O. Vartanian, J. Kaufman (Eds.), *The neuroscience of creativity* (pp. 19-43). doi:10.7551/mitpress/9780262019583.003.0002  
<https://arxiv.org/pdf/1106.3600>
- [18] [https://en.m.wikipedia.org/wiki/Particle\\_swarm\\_optimization](https://en.m.wikipedia.org/wiki/Particle_swarm_optimization)
- [19] "Particle Swarm Optimisation: A Historical Review Up to the Current Developments", Diogo Freitas, Luiz Guerreiro Lopes Fernando Morgado-Dias  
*Entropy* 2020, 22(3), 362; <https://doi.org/10.3390/e22030362>  
<https://www.mdpi.com/1099-4300/22/3/362>

- [20] Diversity Enhanced PSO with Neighborhood Search (DNSPSO) "Wang et al.", 2013  
<https://www.mdpi.com/1099-4300/22/3/362>
- [21] "Complex Mechanics", C. D. Yang, Progress in Nonlinear Science , Volume 1, 2010, 1-383
- [22] "A Scientific Realization and Verification of Yin-Yang Theory: Complex-Valued Mechanics", C. D. Yang, February 2010 International Journal of Nonlinear Sciences and Numerical Simulation 11(2):135-156  
DOI: 10.1515/IJNSNS.2010.11.2.135
- [23] [https://en.m.wikipedia.org/wiki/Proportional-integral-derivative\\_controller](https://en.m.wikipedia.org/wiki/Proportional-integral-derivative_controller)
- [24] "Perfect Health: the complete mind/body guide", Deepak Chopra, ISBN 9780517584217
- [25] "Some Computer Organizations and Their Effectiveness", MICHAEL J. FLYNN, IEEE TRANSACTIONS ON COMPUTERS, VOL. c-21, NO. 9, SEPTEMBER 1972
- [26] Giulio Tononi (2015), Scholarpedia, 10(1):4164. doi:10.4249/scholarpedia.4164, "Integrated Information Theory",
- [27] "Upgrading the Turing Test to Consciousness", Luke Kenneth Casson Leighton. Ref: viXra:2504.0101  
DOI:10.13140/RG.2.2.35284.10887  
[http://lkcl.net/reports/consciousness\\_turing](http://lkcl.net/reports/consciousness_turing)
- [28] "Consciousness defined: requirements for biological and artificial general intelligence", Craig Mckenzie, June 2024, DOI: 10.48550/arXiv.2406.01648  
<https://www.researchgate.net/publication/381158681>