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Creating AI Assistants with Spectral Consciousness Based on Electromagnetic Waves

Evgeny Bryndin[1]

[1] Research Department, Research Center Natural Informatics, Novosibirsk, Russia
Correspondence: Evgeny Bryndin, Research Department, Research Center Natural Informatics, Novosibirsk, Russia.

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Abstract

The creation of AI assistants with spectral consciousness based on electromagnetic waves relies on periodic functions that can be expanded in a Fourier series and represented by a Fourier integral. Harmonic analysis of the periodic functions is performed to represent them as the sum of a mean value and a set of sinusoidal terms with a fundamental frequency of 1/T and harmonic frequencies of 2/T...n/T electromagnetic waves. Morphogenic cryptocoding of the sinusoidal harmonics is performed based on mental mathematics. Then, cognitive morphogenic modeling of reasoning using harmonic electromagnetic waves is performed according to a standard linguistic template of the judgment process. Based on this modeling, an AI learning model with a Fourier support function is created to create intelligent assistants with spectral consciousness for the development of new knowledge through cognitive verbal and written communication with a specialist and for training in various fields of knowledge and life.

Keywords: periodic functions, Fourier series, harmonic analysis, morphogenic reasoning, linguistic template of judgment

1. Introduction

Cognitive wave thinking is a process similar to the relay propagation of waves with phases and amplitudes. Unlike classical logic (the "true/false" dichotomy), it takes into account:

multidimensionality — the simultaneous consideration of multiple perspectives;

dynamics — the changing "waveform" depending on the context;

cognitivity — the interaction of judgments that generates new meanings;

probability — the rejection of rigid, deterministic conclusions in favor of a spectrum of possibilities.

Thoughts as waves propagating in the "field of consciousness":

*observational attention," where the waves form the "picture" of a solution.

Cognitive wave phases — stages of information processing:

generation (the emergence of a judgment);

propagation (connection with other concepts);

stabilization (conclusion formation).

1.1 Where Applicable

1) Creative tasks (design, art, invention):

* generating innovative ideas through the "overlay" of unrelated concepts;

* finding solutions in the face of uncertainty.

2) Strategic Planning:

* scenario modeling taking into account weak signals and indirect factors;

* accounting for the interaction of decisions (the "domino effect").

3) Scientific Research:

* synthesis of data from different disciplines;

* forecasting complex systems (climate, economics, biology).

4) Therapy and Self-Development:

* working with cognitive biases through the metaphor of "waves" (observing thoughts without engaging);

* reducing anxiety by accepting the multiplicity of futures.

5) AI and Cognitive Assistants:

* algorithms that simulate wave data processing for hypothesis generation;

* multi-agent systems with "resonant" idea selection mechanisms.

1.2 Summary

Cognitive wave thinking is a way to work with information that takes into account its dynamics, interconnectedness, and uncertainty (V.R. Shyanbhag, 2020; Jonjoe McFadden, 2023; Strupp W., 2024). It is useful where traditional methods fail: in chaotic situations, when solving creative problems, or analyzing complex systems, improving the quality of decision-making.

In this article, the author proposes a model of cognitive wave consciousness based on periodic electromagnetic harmonics. The second section of the article is devoted to spectral consciousness based on periodic processes. The third section examines cognitive morphogenic modeling of wave consciousness using periodic functions. Morphogenic cryptocoding of sinusoidal harmonics of periodic functions is discussed in the fourth section. The fifth section of the article is devoted to aspects of implementing wave thinking.

2. Spectral Consciousness Based on Periodic Processes

Spectral consciousness is viewed as a theoretical model of levels of consciousness with spectral activation; as a technical system of intelligent modules of varying complexity with attention switching. Spectral consciousness has a multi-level, graded structure.

Periodic processes indicate the repeatability of processes and phases of cognitive processing (attention, perception, comprehension, reaction).

Technical AI implementation:

Creation of an artificial consciousness system with modules activated according to a schedule or conditions:

* sensory processing module (low spectral level);

* logical analysis module (medium level);

* meta-reflexivity module (high level).

The phases are determined by the algorithm for switching between modules.

2.1 Tools and Methods

For modeling: Python + NumPy, SciPy (rhythm calculation), TensorFlow (neural networks).

For visualization: Matplotlib, Plotly (activity spectrograms).

The implementation of conscious AI systems raises questions of responsibility and control. Intelligent assistants with wave consciousness develop new knowledge in collaboration with specialists. Intelligent assistants understand natural language queries and generate meaningful responses and solutions; they learn based on feedback. Wave consciousness resonates with the context and intentions of the interlocutor. It develops new knowledge in collaboration with specialists. Collaboration between a human and an intelligent assistant with spectral consciousness, where:

* the specialist sets the direction, tests hypotheses, and provides expert opinion;

* the assistant analyzes data, finds non-obvious patterns, and suggests solutions;

* the final result is a synthesis of human experience and spectral consciousness analytics.

Interaction Scenario:

1) Problem Statement. An expert formulates a question or problem (e.g., "Find promising material combinations for lightweight composites with high thermal stability").

2) Search and Analysis. Assistant:

* Scans scientific articles, patents, and databases;

* Highlights relevant parameters (strength, density, melting point, etc.);

* Builds relationship models (e.g., correlations between composition and properties).

3) Hypothesis Generation. The AI suggests options:

* Material combinations with predicted properties.

* Synthesis methods or structure modification.

4) Expert Evaluation. Specialist:

* Eliminates unrealistic or redundant options;

* Refines parameters for the next search cycle.

5) Iterations. The process is repeated until an optimal solution is obtained.

Examples of application areas:

Science. Discovery of new molecules, catalysts, and alloys.

Medicine. Selection of personalized therapy regimens, genomic data analysis.

Engineering. Design optimization, equipment wear prediction.

Economics. Market scenario modeling, risk assessment.

To implement such an assistant, the following are needed:

Large language models (LLM) — for understanding queries and generating text.

Multi-agent systems — division of tasks between "agents" (data search, modeling, visualization).

Integration with knowledge bases (PubMed, Scopus, patent registries) and analysis tools (Python, R, MATLAB).

Explainable AI (XAI) — explanation of the logic behind the conclusions so that an expert can test hypotheses.

Collaboration interface — chats, boards, and dashboards for sharing notes and results.

2.2 Prospects

The concept of wave consciousness can evolve into:

Hybrid "human-AI" systems, where the assistant doesn't simply respond to requests, but initiates dialogue, asks clarifying questions, and suggests unexpected analogies.

Cognitive platforms with distributed learning — where dozens of assistants share knowledge while maintaining the confidentiality of the source data (federated learning).

2.3 Summary

Wave consciousness is well-suited for dynamic, multidimensional interactions between intelligent assistants and experts. Today, intelligent assistants already assist in research and design, and in the future, they will become full-fledged partners in the creation of new knowledge through deep data analysis, hypothesis generation, and adaptation to the specialist's working style (Bryndin E. G., 2025; Evgeny Bryndin, 2025a; Evgeny Bryndin, 2025b; Evgeny Bryndin, 2025c; Evgeny Bryndin, 2026a; Evgeny Bryndin, 2022; Evgenii Brindin, 2026a; Evgenii Brindin, 2026b).

3. Cognitive Morphogenic Modeling of Wave Consciousness Using Periodic Functions

Cognitive morphogenic modeling of wave consciousness using periodic functions is a promising approach. It allows for:

* representing linguistic patterns as frequency spectra;

* describing reasoning as a dynamic interaction of signals;

* formalizing cognitive processes through mathematical apparatus.

Practical implementation will require:

1) developing a concept coding system in the frequency domain;

2) creating algorithms for filtering and analyzing spectra;

3) verifying the model using text corpora and experimental data.

Cognitive modeling is a method of representing mental processes (thinking, perception, memorization) through formal structures:

* constructing mind maps;

* modeling concepts and their relationships;

* formalizing linguistic patterns.

Morphogenic modeling is the process of forming structures under the influence of distributed signals:

* self-organization of cognitive structures;

* the emergence of new linguistic forms from basic elements;

* dynamic change in reasoning patterns.

The reasoning process is a sequence of logical operations:

* data analysis;

* application of inference rules;

* generation of conclusions.

Periodic functions and the sum of sinusoidal terms are mathematical apparatus for describing electromagnetic processes:

A linguistic pattern is a stable structure in a language:

* syntactic constructions ("Subject + predicate + object");

* phraseological units;

* discourse patterns ("If ..., then ...").

3.1 The Concept of Modeling Reasoning with Periodic Functions

The idea is to represent cognitive processes as a superposition of electromagnetic waves at different levels of abstraction:

1) Encoding linguistic units in the frequency domain

Each lexical unit or syntactic role is associated with its own sinusoid with the following parameters:

* frequency — level of abstraction (concrete words → low frequencies, abstract concepts → high frequencies);

* amplitude — the significance of the element in context;

* phase — the temporal position in the reasoning.

2) Formation of a pattern as a spectrum

A linguistic pattern is defined by a set of frequencies. For example, for the construction "If P, then Q":

* "If" → base frequency ω_1;

* condition P → harmonic $2\omega_1$;

* consequence Q → harmonic $3\omega_1$.

3) Reasoning as Signal Modulation

New statements are superimposed on the existing spectrum through:

* function addition: $f_{\text{result}}(t) = f_{\text{context}}(t) + f_{\text{new}}(t)$;

* changing the amplitudes of key frequencies (emphasis on important concepts);

* phase synchronization (aligning the time frames of reasoning).

4) Isolating Conclusions through Filtering

Analysis of the resulting spectrum:

* amplitude peaks → key concepts;

* resonant frequencies → stable patterns;

* phase shifts → logical contradictions.

3.2 Implementation Example

Task: simulate reasoning based on the pattern "All A are B. X is A. Therefore, X is B."

Step 1. Coding of premises:

* "All A - B": $f_1(t) = A_1 \sin(\omega_1 t)$ (frequency ω_1 encodes universality);

* "X - A": $f_2(t) = A_2 \sin(\omega_2 t + \phi)$ (frequency ω_2 is class membership).

Step 2. Superposition:

$f_{\text{total}}(t) = A_1 \sin(\omega_1 t) + A_2 \sin(\omega_2 t + \phi)$.

Step 3. Spectrum analysis:

* resonance at $\omega_1 = \omega_2$ → confirmation of membership;

* increase in amplitude at frequency ω_B → conclusion "X - B".

Step 4. Visualization:

The graph of the resulting function will show a peak at the frequency corresponding to B, formally confirming the conclusion.

3.3 Potential Applications

* Discourse analysis: identifying hidden patterns in texts through spectral analysis.

* Speech generation: synthesizing utterances with a given logical structure.

* AI training: modeling reasoning through harmonic synthesis.

3.4 Challenges

- Computational complexity for large texts.

- Cognitive morphogenic modeling of wave consciousness using periodic functions is a promising but complex approach.

4. Morphogenic Cryptographic Encoding of Sinusoidal Harmonics of Periodic Functions

Morphogenic cryptographic encoding of sinusoidal harmonics of periodic functions based on mental mathematics combines disparate concepts from different fields.

1) "Sinusoidal Harmonics of Periodic Functions"

This refers to the expansion of periodic functions into a Fourier series—a representation as a sum of sinusoidal functions with different frequencies:

$f(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} \left[a_n \cos(n \omega t) + b_n \sin(n \omega t) \right]$, where:

* a_0 is the average value of the function over the period;

* a_n, b_n are the Fourier coefficients;

* $\omega = \frac{2\pi}{T}$ — fundamental angular frequency;

* T — period of the original function.

Fourier coefficients are calculated using integrals:

$a_n = \frac{2}{T} \int_0^T f(t) \cos(n \omega t) \, dt, \quad$

$b_n = \frac{2}{T} \int_0^T f(t) \sin(n \omega t) \, dt.$

2) “Morphogenic”

The term is borrowed from biology (morphogenesis is the formation of organismal structures). In the context of signal processing, it can be interpreted as:

* change in signal shape;

* transformation of the Fourier series structure;

* adaptation of harmonic parameters to given conditions.

3) “Cryptocoding”

This involves the use of cryptographic methods for spectral encoding of information represented in the parameters of sinusoidal harmonics (amplitude, frequency, phase).

4) “Mental Mathematics”

Mental mathematics refers to fast computing techniques. In the context of cryptography, this can mean:

* algorithms implemented with minimal computing resources;

* the use of patterns intuitively understandable to humans;

* simplified cryptographic schemes.

By combining all approaches, we can imagine a coding system where:

1) The original signal (text, image, sound) is transformed into a periodic function.

2) The function is expanded into a Fourier series, and the harmonics are identified.

3) The harmonic parameters (amplitudes a_n, b_n, frequencies $n\omega$) are modified according to a specified algorithm (“morphogenic transformation”).

4) A modified Fourier series is used to recover the encoded signal.

5) Encoding requires knowledge of the transformation algorithm and initial conditions.

Example of a simplified algorithm:

1) Take the text and encode the symbols into a numerical sequence of electromagnetic wave parameters.

2) Construct a periodic function $f(t)$, where the values correspond to the symbol codes.

3) Calculate the Fourier coefficients a_n, b_n.

4) Apply the encoding rule: for example, multiply all the coefficients by the secret key k: $a'_n = k \cdot a_n, \quad b'_n = k \cdot b_n$.

5) Recover the encoded signal $f'(t)$ from the new coefficients.

6) To decrypt, the recipient divides the coefficients by k and recovers the original text.

Conclusion

Morphogenic cryptocoding of spectral thinking for practical implementation requires:

* development of robust algorithms for converting harmonics into texts from morphemes;

* optimization of computations for wave-based conscious processes.

5. Implementation of Wave Thinking Based on Harmonic Spectra

The relay organization and superposition of periodic waves enables the associative linking of morphemes, simple and complex judgments of spectral thinking, and also ensures the coordination of cognitive spectral states.

A cognitive state can be represented as a superposition of harmonics:

$\Psi(t) = \sum_{n=1}^{N} A_n \sin(\omega_n t + \phi_n)$, where:

* $\Psi(t)$ — current cognitive state;

* A_n — significance of the nth cognitive harmonic;

* ω_n — processing speed of the nth pattern;

* ϕ_n — phase shift (activation delay).

The probability of choosing option X is then proportional to:

$P(X) \propto \left| \int \Psi(t) \cdot F_X(t) \, dt \right|^2,$

where $F_X(t)$ is the harmonic matching filter for variant X.

The results of analog spectral thinking are converted into discrete digital code by decoding them using a cognitive morpheme classification system. Texts are converted into spectral form through a cryptocoding system.

Advantages of wave thinking:

- Different associative wave patterns can propagate simultaneously, allowing for the rapid solution of multiple problems.

- Analog wave propagation requires less energy than digital signal transmission.

6. Organizing AI Thinking Based on Electromagnetic Waves

Electromagnetic waves are linked to AI through:

1) Wireless Communications:

* AI systems can exchange data via Wi-Fi, Bluetooth, and cellular networks using electromagnetic radiation.

2) Systems where electromagnetic waves play a central role:

Optoelectronic Systems:

* Using light waves (photons) instead of electrons for computing.

* Advantages: high speed, low heat generation.

* Reality: Experimental photonic processors exist, but they complement, not replace, electronics.

Quantum Systems with Electromagnetic Control:

* Quantum computers use qubits (e.g., ions or superconducting circuits) whose state is controlled by electromagnetic pulses.

* “Thinking” here is based on quantum technology, where waves are the control tool.

Distributed Neuromorphic Networks:

* A network of nanodevices exchanging information via narrowband electromagnetic signals.

* Simulates the synchronization of neural groups in the brain.

Resonant Computing Environments:

* The environment (e.g., a specially structured metamaterial) processes information through wave interference.

* Analog: analog computers solving differential equations using physical processes.

Conclusion

Hybrid systems (e.g., photonic + electronic) may emerge in the future, where waves accelerate individual operations.

* Developments in wave AI are currently limited to theoretical models and practical experiments.

7. Conclusion

The practical implementation of an intelligent assistant with wave-based thinking is a promising, yet still experimental, task related to the creation of AI systems that process information not through traditional algorithmic methods, but through mechanisms inspired by wave dynamics and semantic neurodynamics. This approach assumes that thought is viewed as a wave packet propagating through the space of meanings, and learning is viewed as the formation of semantic landscapes through which thought flows.

In the wave model, thought is a coherent wave in a multidimensional frequency basis. The semantic space is organized as a three-axis wave geometry (entity, process, value). Learning consists of the formation of stable semantic attractors that define a picture of the world.

One project implementing similar ideas is SemantML (SemantML, 2025). It utilizes the phase interaction of attention components (Q, K, V in transformers), where they are included in a coherent field of attention, rather than operating independently. This allows the model to respond not simply to the similarity of tokens, but to the resonance between their semantic phases. SemantML also utilizes Echo Memory, a parametric state store that modulates memory via phase and generates a weighted response.

Wave thinking is a relatively new concept, and generally accepted methods for evaluation, comparison, and optimization have not yet been developed for it. Practical implementation requires:

1) Theoretical modeling. Developing mathematical models of wave dynamics in semantic space, including equations and parameters that will describe the system’s behavior.

2) Experimental prototypes. Creating small pilot systems to test specific aspects of wave thinking (e.g., phase interaction).

3) Integration with existing technologies. Combining wave models with traditional machine learning and NLP methods to improve the system’s efficiency and robustness.

4) Evaluation and optimization. Developing metrics to evaluate system performance, learning, and adaptation capabilities. Optimizing

model parameters to achieve better results.

5) Real-World Testing. Implementing the prototype in specific use cases (e.g., AI assistants, recommendation systems, or analytics platforms) and other systems.

Potential includes the creation of more flexible and adaptive AI systems capable of deep context understanding and generating new ideas.

Prospects include the creation of more flexible and adaptive AI systems capable of deep contextual understanding and generating new ideas.

The author of the article proposed developing wave-based thinking using electromagnetic neural network intelligent systems based on neuromorphic chips and spectral modality (Evgeny Bryndin, 2023; Evgeny Bryndin, 2026b).

Currently, wavelet thinking remains more of a research concept than a mainstream technology. Its effective implementation requires an interdisciplinary approach integrating physics, mathematics, cognitive science, and machine learning.

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