Информационные процессы / Information processes

Original article / Оригинальная статья
https://doi.org/10.31432/1994–2443.2025.07

Non-improvable information compression algorithms

Viktor N. Saraev ✉ **, Ekaterina A. Chudinova**

International Research Institute for Advanced Systems
9, 60-Letiya Oktyabrya Ave., Moscow, 117312, Russian Federation
✉ *glowers.saraev@mail.ru*

Abstract. This article explores the conceptualization of the Universe surrounding humans, the information it contains, and how humanity, through the perception of this information, creates images of the real, earthly, and imaginary worlds. It is shown that humanity tends to structure its knowledge of the world into specific laws that claim to explain observed phenomena and mental images. Distinguishing three main physical research paradigms in theoretical physics — o field-theoretical (dominant), geometric, and relational — the authors propose universal principles for structuring these paradigms. Particular attention is paid to the information compression algorithm as a recurring feature in various natural processes.

Key words: Natural phenomena, image, non-improvable algorithm, information compression, cognitome, observer, metrology, measurement, brand

Funding. No funding.

For citation: Saraev V.N., Chudinova E.A. Non-improvable information compression algorithms. *Information and Innovations.* 2025. https://doi.org/10.31432/1994-2443.2025.07

Неулучшаемые алгоритмы сжатия информации

В.Н. Сараев ✉ **, Е.А. Чудинова**

Международный научно-исследовательский институт проблем управления
пр-т 60-летия Октября, д. 9, г. Москва, 117312, Российская Федерация
✉ *glowers.saraev@mail.ru*

Аннотация. Статья посвящена осмыслению окружающей человека Природы, содержащейся в ней информации и тому, как человечество на основе восприятия информации создаёт Образы реального Земного и воображаемого мира. Показано, что человечеству свойственно структурировать свои знания о мире в особые законы, претендующие на объяснение наблюдаемых явлений и мыслеобразов. Выделяя три основные физические парадигмы исследований в теоретической физике — теоретико-полевую (доминирующую), геометрическую и реляционную — авторы предлагают универсальные принципы структурирования этих парадигм. Особое внимание уделено алгоритму сжатия информации как многократно повторяющемуся в различных природных процессах.

Ключевые слова: явления Природы, Образ, неулучшаемый алгоритм, сжатие информации, когнитом, наблюдатель, метрология, измерение

Финансирование. Финансирование отсутствовало.

Для цитирования: Сараев В.Н., Чудинова Е.А. Неулучшаемые алгоритмы сжатия информации. *Информация и инновации*. 2025. https://doi.org/10.31432/1994-2443.2025.07

INTRODUCTION

In recent decades, the role of intangible assets in the structure of the global market has been increasing [1]. The global value of identified intangible assets increased from 5 to 62 trillion US dollars between 1996 and 2023, according to the World Intellectual Property Organization. In his speech on 20 June 2025, at the plenary session of the XXVIII St. Petersburg International Economic Forum, the theme of which was "Common Values — the Basis for Growth in a Multipolar World," the President of Russia noted that there are already about a million active trademarks in Russia and in 2024, almost 77 thousand brands were registered, mainly for light industry goods, software, household chemicals and some other products (an increase of 12% by 2023). The President of Russia emphasized: "It is necessary to further develop the intellectual property market, namely, to expand the possibilities of lending secured by patents and trademarks. They should become a real asset for business, which helps to attract funds for the creation or expansion of production"[1]. In general, Russia occupies an important place in the global intellectual property market, and the presence of about a million active trademarks indicates high business activity and the development of branding in the country.

The catalyst for the promotion of goods and services is such an intangible asset as a brand (trademark), the foundation of which is the IMAGE — a form of compressed information.

IMAGE AS A FORM OF COMPRESSED INFORMATION

Throughout its evolution, humanity has sought to encapsulate complex, poorly understood natural phenomena into a unified form [2], structuring them into a simple, clear, and comprehensible Image. For example, collective Images of Russia include the Russian bear, birch tree, Russian troika, the Three Bogatyrs, the Kremlin, the Motherland statue, Roscongress — a space of trust, St. Petersburg International Economic Forum, Kizhi, the Church of the Intercession on the Nerl, samovar, Russian ballet, space and Gagarin, St. Basil's Cathedral, and the Bolshoi Theatre.

The ancient calendar took the form of the Achinsk Rod 18000 years ago [3]. The Pythagorean theorem was formulated 4000 years ago by mathematicians of Ancient Mesopotamia. Between 1609–1619, Johannes Kepler formulated the three laws of planetary motion in the solar system. For instance, the second law states that each planet moves in a plane passing through the center of the Sun, and during equal time intervals, the radius vector connecting the Sun and the planet sweeps out equal areas. Nobel laureate in Physics A. Einstein proposed the special theory of relativity in 1905, formulating the mass-energy equivalence law $E=mc^2$ [4]. Nobel laureates in Physiology or Medicine Francis Crick and James Watson proposed the double helix structure of DNA in 1953, which stores biological information as a genetic code [5]. This list could be extended, but it should be noted that humanity has not always succeeded in describing complex natural phenomena in a simple image, such as $E=mc^2$ or DNA.

Structuring the physical universe, according to Academician of the Russian Academy of Natural Sciences (RAEN), Professor Yu. Vladimirov [6-8], should be based on a unified system of principles and regularities — using a monistic metarelational paradigm. Currently, fundamental theoretical physics research is conducted within three

[1] Plenary session of the St. Petersburg International Economic Forum. 20 June 2025. URL: http://www.kremlin.ru/events/president/news/77222 (date of access: 21.06.2025).

paradigms: field-theoretical (dominant), geometric and relational.

Structuring each paradigm can rely on three principles [7]:

1. The metaphysical principle of dualism, based on two opposites (widely manifested in existing theories).

2. The metaphysical principle of trinity, long recognized in philosophical-religious teachings of both West and East (in physics, it manifests as three types of micro-world interactions: electromagnetic, weak, strong; three generations of elementary particles; three-quark structure of hadrons, etc.; in mathematics, in the ternary nature of addition and multiplication operations).

3. The metaphysical principle of fundamental symmetry, playing an extremely important role in modern fundamental physics.

INFORMATION COMPRESSION ALGORITHMS

As demonstrated by RAS Academician K. Anokhin [9], a theory should provide a simple explanation for the diversity of complex natural facts and phenomena. The basis of this simple explanation follows the scheme[2]:

1. Understanding the world is not achieved through description. It occurs through deduction.

2. Understanding is compression.

Compressing the diversity of complex natural facts and phenomena results not only in a simple and clear Image but also in an algorithm — often a non-improvable one.

[2] Vaingauz A.M., Zvekov A.A., Novikov V.I., Saraev V.N. An unimprovable algorithm for optimizing structurally convex functionals with Boolean variables. Theory, Methodology, and Practice of Systems Research. All-Union Conf., January 29-31, 1985. Abstract of the report. Moscow: VNIISI, 1985, pp. 23-25. (In Russ.).

For example, a non-improvable information compression algorithm created in 2800 BC was realized in the cosmological architecture of Arkaim. Arkaim's spatial structure is a projection of the Sky onto Earth. Its fixed coordinate system enabled the design of the Eternal Zodiac, depicting the precession of Earth's axis around the North Ecliptic Pole as a spiral trajectory of the Celestial Pole among fixed stars. The Celestial Pole — a point on the celestial sphere around which stars appear to rotate daily due to Earth's axial rotation — completes a full cycle every 25 920 years. The Celestial Pole moves counterclockwise by 1° every 72 years. Arkaim's Eternal Zodiac remains unchanged in both its terrestrial model (meridian position is time-invariant) and celestial configuration.

The calendar problem allows describing and understanding objects of different natures — Heaven, Earth, and Humanity; Space and Time — within the unified coordinate system of the Eternal Zodiac. "Arkaim's Chronograph, a system for displaying cosmic time, is realized through three interconnected calendars: precessional, solar, and lunar. Other calendars, such as planetary calendars (e.g., the 60-year cycle of Jupiter-Saturn conjunctions), can also be based on this chronographic foundation" [10].

The effect of fixed stars is manifested in Simon Shnoll's non-improvable information compression algorithm [11], which analyzes the influence of external gravitational field energy on space. This energy alters the rate of various processes (biochemical reactions, alpha and beta decays of radioactive substances, etc.), reflected in histogram shapes characterizing different spacetime inhomogeneity regions. The fine structure of histograms mirrors the interference pattern of the space region Earth traverses during its motion.

Synchronized changes in histogram shapes across different geographical locations at the same absolute and local time are determined by the "stellar sky pattern" above the measurement site. Synchronization by local time is clearly due to Earth's rotation relative to fixed stars and exposition of the studied process. Biological reaction rates, reflected in histogram fine structures, are influenced by sunrises, sunsets, solar eclipses, new and full moon phases, etc.

This synchrony was observed by Leonid Yakovlevich Glybin[3] in analyzing 13 000 medical histories, revealing a peculiar pattern: the probability of initial symptoms of various diseases varies sharply at different hours — peaking between 0:00–3:00 AM, sharply decreasing from 4:00–6:00 AM, then rising again.

The 20th century saw attempts to construct non-improvable algorithms by M.A. Kronrod, A.N. Antamoshkin, and his students. A non-improvable sorting algorithm [12] was developed in 1967 for the Soviet chess program *Kaissa* on the BESM-6 computer, which became the world's first computer chess champion. In 1967, this program defeated a program developed by Stanford University group (led by J. McCarthy) 3–1 in a four-game match.

Non-improvable algorithms were developed for certain classes of unconditional pseudo-Boolean optimization problems [13-14]. For example, the algorithm found the exact minimum of special pseudo-Boolean function classes in (n+1) computations, where n is the optimization space dimension.

[3] Glybin L.Ya. Intra-diurnal cyclicity of the manifestation of some pathological processes: Abstract of the dissertation... Doctor of Medical Sciences. Irkutsk: East Siberian Branch of the Siberian Branch of the Russian Academy of Medical Sciences,1993. 20 p. (In Russ.).

The idea that information compression is not only an Image but also an algorithm — often non-improvable — was demonstrated by RAS Academician K. Anokhin[4] using Charles Darwin's theory of natural selection [15]. Some researchers argue that Darwin's discovery revealed life's algorithmic origin, formalized as an algorithm [16-18]:

1. If organisms exhibit variability.
2. If some variants survive and reproduce better than others.
3. If this advantage is a heritable trait passed from parents to offspring.
4. Then the population composition will change.

Repeated application of this natural selection algorithm yields descriptions of diverse complex algorithms.

Acknowledging the power of Darwin's algorithm, Academician K. Anokhin proposed the algorithm of cognitive progression — the cognitome algorithm[5]:

1. If organisms possess self-replicating functional systems.
2. If this replication occurs within a deep neural network.
3. If nodes of this network exhibit long-term plasticity.
4. Then the organism will necessarily form a neuronal hypernetwork and develop cognitiveness — psyche or intelligence.

Repeated application of this cognitome algorithm yields descriptions of diverse complex minds [9].

By analogy with Darwin's evolutionary algorithm and Anokhin's cognitome-neuronal hypernetwork algorithm, V. Saraev and I. Fe-

[4] Anokhin K. Cognite: A Hypernetwork Theory of the Brain. *Presentation* at the St. Petersburg Seminar on Cognitive Research. December 20, 2022, St. Petersburg University, Institute for Cognitive Research, St. Petersburg, Russia. (In Russ.).

[5] Там же.

dorov [19] formulated the active observer algorithm:

1. If there exists an active observer who changes during observation due to the observed natural process.
2. If the active observer studies this natural process.
3. If the active observer possesses the apparatus of mathematical logic.
4. Then the active observer can construct a model of this process to the extent they change under its influence and according to their interest in the model.

Repeated application of this algorithm across natural processes forms a complex picture of Nature, revealing the observer effect.

The fruitful idea — that information compression is not only an Image but also an algorithm (often non-improvable) — can be extended to measurement algorithms. Humans can only measure length directly; all other measurements are indirect computations. Measurement is comparison to a known quantity. For example, a thermometer measures not temperature but the height of a liquid column in a capillary, requiring computation to determine the temperature value. Measurements can be direct, indirect, joint (simultaneous measurement of heterogeneous quantities to find relationships), or aggregate (multiple measurements of homogeneous quantities). The measurement process establishes equivalence. In antiquity, this was esoteric knowledge transmitted orally [20].

The first measurement system is believed to have appeared among the Sumerians in the early 3rd millennium BC. The Babylonian term bēru (Sumerian danna) denoted both path length and the time taken to traverse it. "Within the 'length-time' system, one bēru corresponded to 2 modern hours, marked by the Sun's apparent movement of 30 modern angular degrees across the sky and a distance of 10 km. The ancient Mesopotamian system organically unified linear, temporal, and angular measures" [20].

The Algorithm for Measuring Nature:

1. Perception (e.g., very cold, cold, warm, hot, very hot).
2. Observation.
3. Measurement.
4. Computation.
5. Perception refinement (e.g., –50°C, –30°C, +20°C, +30°C, +50°C).

Images, as a form of compressed information, are also formed in the modern world, for example, brands, trademarks or digital platforms. The digital platform "VITALITY-SCOPE — Vitality. Preservation of vital forces" for a long life is an Image of the condensation of space-time-life, the analogue of which in the quantum world is the "quantum dot", which is located on the border of two worlds — these are no longer atoms, but not yet macroscopic bodies.

VITALITYSCOPE is the first device that allows studying the collective health and consciousness of humanity. Newton invented the telescope, Leeuwenhoek — the microscope. We came up with VITALITYSCOPE as a distributed spatial scanner that synchronizes human life systems with cosmic and natural processes.

CONCLUSION

Development of information compression algorithms is one of the tools for developing a global fair market. Brands are a market form of IMAGES of perception of the world by different continents, civilizations, countries and nationalities. Exchange of brands allows to understand the cultural characteristics of different peoples, which ensures the conjugation of national interests in the construction of a multipolar world.

CONTRIBUTION OF THE AUTHORS

Viktor N. Saraev — conceptualization, methodology.
Ekaterina A. Chudinova — research implementation, supervision.

ВКЛАД АВТОРОВ

В.Н. Сараев — концептуализация, методология.
Е.А. Чудинова — проведение исследования, курирование.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

КОНФЛИКТ ИНТЕРЕСОВ

Авторы заявляет об отсутствии конфликта интересов.

REFERENCES / СПИСОК ИСТОЧНИКОВ

1. Калинин Д. В., Помулев А.А. Анализ развития рынка нематериальных активов: российские и зарубежные реалии. *Гуманитарные, социально-экономические и общественные науки*. 2024;(4):211-214. https://doi.org/10.23672/SAE.2024.4.4.041
   Kalinin D.V., Pomulev A.A. Analysis of the Development of the Intangible Assets Market: Russian and Foreign Realities. *Humanities, Social-Economic and Social Sciences*. 2024;(4):211-214. (In Russ.). https://doi.org/10.23672/SAE.2024.4.4.041
2. Агеев А., Сараев В., Чудинова Е. Бизнес-модели технологических решений. *Экономические стратегии*. 2025;27(3):78-85. https://doi.org/10.33917/es-3.201.2025.78-85. EDN GXAVLB
   Ageev A., Saraev V., Chudinova E. Business Models of Technological Solutions. Economic Strategies. 2025;27(3):78-85. (In Russ.). https://doi.org/10.33917/es-3.201.2025.78-85
3. Ларичев В.Е. Мудрость змеи. Первобытный человек, Луна и Солнце. Новосибирск: Наука,1989. 272 с. ISBN 5—02—029182—X.
   Larichev V. E. The Wisdom of the Snake. Primitive Man, the Moon and the Sun. Novosibirsk: Nauka, 1989. 272 p. ISBN 5—02—029182—X.
4. Эйнштейн А. Теория относительности. Избранные работы. Ижевск: Научно-изд. центр «Регулярная и хаотическая динамика», 2000. 224 с.
   Einstein A. Theory of Relativity. Selected Works. Izhevsk: Scientific Publishing Center "Regular and Chaotic Dynamics", 2000. 224 p.
5. Крик Ф. Что за безумное стремление! М.: АСТ, 2020. 318 с. ISBN 978-5-17-115954-2.
   Crick F. What mad pursuit! Moscow: AST Publishers, 2020. 318 p. ISBN 978-5-17-115954-2.
6. Владимиров Ю.С. Метареляционный подход к основаниям фундаментальной физики. *Метафизика*, 2024; 1(51):10-32. https://doi.org/ 10.22363/2224-7580-2024-1-10-32
   Vladimirov Yu.S. Metarelational Approach to Foundations of Fundamental Physics. *Metaphysics*. 2024, 1(51): 10-32. (In Russ.). https://doi.org/ 10.22363/2224-7580-2024-1-10-32
7. Владимиров Ю.С. Метафизические основания физики. Монография. Москва ЛЕНАНД, 2024; 240 с. ISBN 978-5-00237-058-0.
   Vladimirov Yu.S. Metaphysical Foundations of Physics. Monograph. Moscow LENAND, 2024; 240 p. (In Russ.). ISBN 978-5-00237-058-0.

8. Владимиров Ю.С. Основания фундаментальной физики, принцип Маха и космология. *Метафизика*. 2025; 1(55):8-30. https://doi.org/. 10.22363/2224-7580-2025-1-8-30
Vladimirov Yu.S. Foundations of Fundamental Physics, Mach's Principle, and Cosmology. *Metaphysics*. 2025; 1(55):8-30. (In Russ.). https://doi.org/. 10.22363/2224-7580-2025-1-8-30
9. Анохин К.В. Когнитом: в поисках фундаментальной нейронаучной теории сознания. *Журнал Высшей нервной деятельности им. И.П. Павлова*. 2021; 71(1):39–71. https://doi.org/10.31857/S0044467721010032
Anokhin K.V. Cognitome: in Search of Fundamental Neuroscience Theory of Consciousness. *I.P. Pavlov Journal of Higher Nervous Activity*. 2021. 71(1):39–71. (In Russ.). https://doi.org/10.31857/S0044467721010032
10. Быструшкин К.К. Феномен Аркаима: космологическая архитектура и историческая геодезия. М.: Белые альвы, 2009. 272 с. ISBN: 5-7619-0172-2.
Bystrushkin K.K. The Arkaim Phenomenon: Cosmological Architecture and Historical Geodesy. Moscow: Belye Alvy, 2009. 272 p. ISBN: 5-7619-0172-2.
11. Шноль С.Э. Космологические факторы в случайных процессах. М.: МГУ, Swedish physics, Svenska fysikarkivet, 2009. 390 с.
Shnoll S.E. Kosmofysiska faktorer i slumpmassiga processer. Svenska fysikarkivet, Stokholm, 2009. 390 p. ISBN: 978-91-85917-06-8.
12. Кронрод М.А. Алгоритм оптимальной сортировки без операционного поля. *Доклады Академии наук СССР*. 1969;186(6):1256–1258.
Kronrod M.A. An optimal ordering algorithm without a field of operation. *Reports of the USSR Academy of Sciences.* 1969;186(6):1256–1258.
13. Антамошкин А.Н. Регулярная оптимизация псевдобулевых функций. Красноярск: Изд-во Красноярского ун-та, 1989. 159 с.
Antamoshkin A.N. Regular optimization of pseudo-Boolean functions. Krasnoyarsk: Publishing house of Krasnoyarsk University, 1989. 159 p.
14. Антамошкин А.Н., Масич И.С. Не улучшаемый алгоритм условной оптимизации монотонных псевдобулевых функций. *Исследовано в России*. 2004;(7):703-708.
Antamoshkin A.N., Masich I.S. A non-improvable algorithm for conditional optimization of monotone pseudo-Boolean functions. *Researched in Russia.* 2004;(7):703-708.
15. Дарвин Ч. Полное собрание сочинений Чарльза Дарвина. Происхождение видов путем естественного отбора или сохранение избранных пород в борьбе за жизнь. Москва; Ленинград: Гос. изд-во, 1925-1929. Москва; Гос. изд-во, 1926. 446 с.
Darwin Ch. The Complete Works of Charles Darwin. On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. Moscow; Leningrad: State Publishing House, 1925–1929. Moscow; State Publishing House, 1926. 446 p.
16. Деннет Д. Опасная идея Дарвина: эволюция и смысл жизни. М.: Новое литературное обозрение, 2020. 784 с.
Dennett D. Darwin's dangerous idea. Evolution and the meanings of life. Moscow: Nlobooks, 2020. 784 p.
17. Chaitin G. Meta Math!: The Quest for Omega. New York: Pantheon Books, 2005. 240 p.

18. Sober E. "Chapter 29. Darwin on Natural Selection: A Philosophical Perspective". *The Darwinian Heritage*, edited by David Kohn, Princeton: Princeton University Press, 1986, pp. 867-900. https://doi.org/10.1515/9781400854714.867
19. Сараев В.Н., Федоров И.Ю. О некоторых наблюдениях фундаментальных законов природы. *Экономические стратегии.* 2023;25(3):42-49.
Saraev V.N. Fedorov I.Yu. On Some Observations of the Fundamental Laws of Nature. *Economic Strategies.* 2023;25(3):42-49. (In Russ.). https://doi.org/10.33917/es-3.189.2023.42-49
20. Белобров В.А. Меры длины Средиземноморья: от Древнего Египта к средневековой Византии. М.: Сам Полиграфист, 2020. 482 с. ISBN 978-5-00166-196-2.
Belobrov V. The Length Measures of the Mediterranean. From Ancient Egypt to Medieval Byzantium. Moscow: The Polygraphist himself, 2020. 482 p. ISBN 978-5-00166-196-2.

INFORMATION ABOUT THE AUTORS

Viktor N. Saraev, Cand. Sci. (Eng.), First Deputy Director General, International Research Institute for Advanced Systems, laureate of the Russian Government Prize in Science and Technology; e-mail: glowers.saraev@mail.ru

Ekaterina A. Chudinova, independent researcher.

ИНФОРМАЦИЯ ОБ АВТОРАХ

Виктор Никифорович Сараев, к.т.н, первый заместитель генерального директора, Международный научно-исследовательский институт проблем управления, лауреат премии Правительства Российской Федерации в области науки и техники; e-mail: glowers.saraev@mail.ru

Екатерина Андреевна Чудинова, независимый исследователь.

Received / Поступила 21.06.2025
Accepted / Принята 15.07.2025