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ATTENUATORS- DIVIDER TROTSYSHYNA AS REPRESENTATIVE OF PRINCIPLES QUANTUM THEORY AMPLITUDES MEASUREMENT SIGNAL PARAMETERS

Article is devoted to demonstrating one of the provisions of the quantum theory of measurement for increased resolution and speed ADC-DAC for example using Attenuators-divider Trotsyshyna. The methodology and system analysis reached 10-100 times increase in resolution DAC and see their schedules transmission characteristics for typical values of the binary scale. Specified in close contact with similar results obtained in the theory fazofrequency measurements.
Keywords: Quantum theory of measurement, Attenuators-divider Trotsyshyna, increasing resolution DAC.

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АТЕНЮАТОР-ПОДІЛЬНИК ТРОЦИШИНА В ЯКОСТІ ПРЕДСТАВНИКА ПРИНЦИПІВ КВАНТОВОЇ ТЕОРІЇ ВИМІРЮВАННЯ АМПЛІТУДНИХ ПАРАМЕТРІВ СИГНАЛІВ

Стаття присвячена демонстрації одного із положень квантової теорії вимірювань, збільшенні роздільної здатності і швидкості АЦП ЦАП наприклад, за допомогою Атенюатора-подільника Троцишина. Методологія та системний аналіз досяг у 10-100 разів збільшити в роздільну здатність ЦАП і подивитися їх графіки характеристик передачі для типових значень бінарного масштабу. Зазначено наявність тісного контакту з аналогічними результатами, отриманими в теорії фазочастотних вимірювань.
Ключові слова: квантова теорія вимірювання, атенюатор-подільник Троцишина, збільшення роздільної здатності ЦАП.

Entry

Radical view of world, physicists started in the first decades of last century, and rapid development of computer engineering and computer science have recently become the main factors that determined the history of the theory of measurement. Expansion and refinement of the concept of measuring as a result of the study and implementation of a microcosm of measurements into research non-physical variables (economy, sociology, psychology, system engineering, etc.). And essential features designed in modern physics and engineering phenomena (fleeting processes, random processes and fields , multidimensional deterministic and random variables, etc.) along with the difficulty of their measurement processes and higher standards for accuracy and performance measurement procedures have become a powerful impetus for the emergence and development of new concepts of fundamental and applied levels of theory of measurement and metrology. This kind of search development and implementation especially in science and engineering environment of new measurement methods, based on new conceptual basis is relevant, and has its specific features. If the first two components in general depend on the researcher is at the stage of recognition of the new - everything is still on the old, which is the actual problems of modern science.

Measurement as an important part of knowing the world.

From ancient times to the present day measure as one way of learning play an important role in human life. First person in their daily activities satisfied the information is delivered only by his feelings, and then raised them in aid of measuring devices. The aim is to obtain a quantitative measurement of information about the size of the investigated object, understood as actually existing objects (things, processes, fields, events, etc.) of the material world as well as interaction between them. Measurements can be performed both cognitive (the study of elementary particles, the human body, etc.), and in the application (domain specific process, quality control) problems.

There is a strong correlation between technological progress and achievements in the field of measurement and measuring instruments. An important part of most research is measurement, allowing establishing quantitative relations and laws of the phenomena. The importance of measurement in achieving scientific results repeatedly recognized famous scientists: "We measure everything measurable dimension and do that as yet defies measurement" (Galileo Galilei), "Science starts with since starting to measure, exact science is inconceivable without measures" (D.I. Mendeleyev) [1-4].Any modern production should be equipped with measuring tools that allow accurate and objective control of the process. Depends on this level of product quality and productivity. In automated production timely receipt of necessary information accurate measurement is one of the most important conditions for good management of the subject regulation. On the other hand, the development and perfection of technological processes in obtaining new materials and elements create opportunities for improvement and creation of a new measuring technique.

Progress in the field of measurement and measuring instruments is unthinkable without the development of measurement theory ("Nothing is more practical than good theory!") The basis of any measurement process, whatever the object of measurement, the measured physical quantity, the principle of measurement, method of processing information, etc., are the same patterns. The study of these patterns, the problem of optimizing measurement experiment under different conditions of measurement and impact of major sections devoted to the measurement theory, taught all the theories of language - the language of mathematics. Moreover, accurate measurement procedure relies on the correct definition of the purpose and features of measurement. This finds expression algorithmization measurements, when a meaningful description of the procedures and results formalized replaced.

The content and features of the measurement process and measurement procedures

The term "measurement of physical quantities" according to RMG 29-99 [1] is defined as "the set of operations on the application of a technical device that keeps the unit, providing the ratio of stay (in the form of explicitly or implicitly) the measured value of its units and obtaining the value of the value".

There are other formulations the concept of "measurement" [3], "Measurement is the process of obtaining information that is measured by comparing the test and known quantities or signals, the necessary logical operations and representation of information in numeric form.

In [4] given another definition: "Measurement - obtaining a numerical value (value) values characterizing the physical properties of the object (object, process, phenomenon) that the experiment (by research) that satisfies the requirements of ensuring uniformity measurements, based on the comparison operation is an analog value from a model (measure value)".

Measurements may be subject not only physical quantities but also functional dependence that characterize the properties of the object of measurement. In this case, held or measuring at fixed values of the argument (usually time or space coordinates), or measurement functions using a degree that reflects a model dependence.

Ways to describe measurement procedures and measurement results. Often used to describe the measurement equation that establishes a connection with the measurement result of input and executable transformations that can be analog (check symbol), analog-digital (ADC) and digital (DAC).

Depending on the quality of the equipment implementing the transformation algorithm can be divided into nonideal (N denote the index of the corresponding symbol forms of transformation) and ideal (no index). If adopted by the transformation algorithm, which allows the ideal hardware implementation to obtain the measurement result as the true value of the measuring, this transformation is called hypothetical (d), depending on quality measurement algorithms transform equation can be represented in three configurations [4]:

- Measurement equation that takes into account the inadequacy of the equipment implementing the algorithm

$$X_i^* = R_\#^н K^н R_a^н \gamma_i \qquad (1)$$

where X_{uj}^* - the measurement result obtained by measuring and second experiment;

γ_i - input;

- Measurement equation, which represents the adopted algorithm

$$X_{uj}^* = R_\# K \ R_a \gamma_i \qquad (2)$$

where X_{uj}^* - the measurement result obtained by implementing the ideal algorithm;

- Measurement equation, which represents the true value of the measuring X_j (hypothetical algorithm)

$$X_j^* = R_\#^г K^г R_a^г \gamma_i \, . \qquad (3)$$

A special place is the analog-digital (A-D) conversion, during which carried out three operations: quantization, compared with a measure of sampling. The last of them linked to the fact that each digital value corresponds to a fixed point in time, or with fixed spatial coordinates. If there is a discrimination in time, the transition from continuous functions $j(t)$ to discrete sequences, implemented using delta - functions $\delta(t)$ can be described as follows:

$$\varphi(t) \to \{\varphi(t_i)\} = \left\{ \int_T \varphi(t)\delta(t - t_1)dt \right\}, t \in T \qquad (4)$$

where T - time observation.

After the uniform quantization with step sequence $\Delta_{k\varphi}$ is converted into a sequence of discrete $j(t)$ numerical values:

$$\{K(t)\}_{i=1}^m = \left\{ E\left[\frac{1}{\Delta_{k\varphi}} \int_T \varphi(t)\delta(t - t_1)dt \right] \right\} \qquad (5)$$

where E - band measurements.

Given that the ideal operation of ADC is sufficient for routine measurement of physical quantities, and given the availability of classic case of methodological and instrumental errors [5], we consider it appropriate to extend it search into the question of inadequacy of mathematical models and mathematical provisions, which are the based on new views on the nature of things. Therefore, the current guidance will be several examples of such basic things.

Attenuator-divider Trotsyshyna and classical divider Kelvin.

A typical example that characterizes the possibility of obtaining essentially new qualitative and especially quantitative parameter measuring the scale is to compare the classical Kelvin divider [5], and use all possible (quantum) states of the same divider (resistor-chain), called Attenuator -divider Trotsyshyna (ADT). Fig. 1. 2. adjusted their scheme for visual example of the chain 8 the same value resistors.

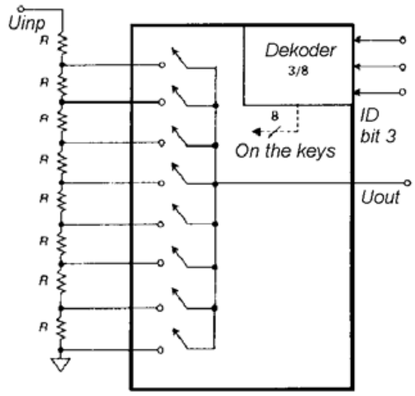


Figure 1. Divider Kelvin

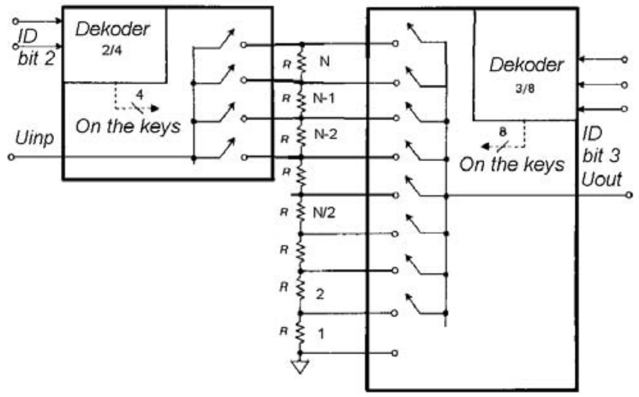


Fig.2. Divider-attenuator circuit for Trotsyshyn 8R

The simplest of all structures where the DAC is possible to compare the Kelvin divider, or tandem, as shown in Figure 1. N-bit DAC that consists of identical resistors connected in series and keys (typically CMOS), one between each node and the circuit output. Output circuits, organized one of the keys connected to the appropriate branch. The idea of the DAC dating back to Lord Kelvin mid 1800's. This simple architecture uses the output voltage (in which the output impedance depends on the code) and is quite good monotony. Even if you are accidentally closed resistor, the output signal and the signal and not exceed + 1 exit. Under the equality of all resistors that AP has a linear scale. However, it can easily be made nonlinear, if need be linear DAC. Due to the fact that at the time of switching are only two keys, in such architecture rarely occurring emissions. In addition, since emissions are independent of the code, the DAC is suitable for applications designed for low distortion signals.

The main disadvantage divider DAC (Kelvin) is a large number of resistors and keys necessary to achieve high resolution (conversion degree). For this reason it is not treated extensively used the DAC with a simple architecture of the arrival of tiny integrated circuit, opened its practicality DAC for low and medium accuracy. Today, this architecture is widely used in simple DAC, such as digital potentiometers, and is part of more complex structures of high-resolution DAC [5].

The objective of the proposed method is to increase the resolution divider (the number of quantized values of the scale transformation) and expanding functionality through adaptive selection of transformation characteristics.

The problem is solved by constructing the attenuator-divider Trotsyshyna (ADT), which is to use kodomo managed switching points of the intermediate range of compounds N series resistors connected to the same value, which at the top (extreme output line resistors) is input voltage, and the bottom (extreme output line resistors) connected to a common output attenuator-divider (divider Kelvin), differs in that, to increase the number of quantized output values of the scale points of AP, to values greater than N (Kelvin divider), the input signal is fed to kodomo managed output (point of connectivity) from the top down and the following N to N / 2, thus switching the input voltage at the output of the top N sells classical scale transformation of N values, and using the following intermediate points N-1 to N / 2 we get, in addition to the existing N even more quantized value of the scale transformation

$$N_i = \mathrm{mod}_{\leq 1,000}\left\{\frac{A_j}{B_k}\right\},\ j,k \in 1 \div N \tag{5}$$

Apt scheme for the case N = 8 resistors shown in Figure 2. The work method is consistent switching of ADT by successive values of the scale transformation which provides input and output switches, the algorithm specified by mode switching.

For comparison, conduct calculations of quantized values for the scale transformation of classical Kelvin divider and attenuator- divider Trotsyshyna (ADT), for typical values of resistors (same for both). The table shows typical values Kelvin AP and ADT and their comparative ratio.

Table 1

ADT comparison and Kelvin AD

Number of resistors NR (N AD Kelvin)	2	4	8	16	32	64	128	256	1024
The number of quantum dots scale ADT	2	6	22	80	324	1260	5022	19948	318964
Growth quantized values	0	2	14	64	292	1196	4894	19692	317940
Win	1	1,5	2,75	5	10,125	19,69	39,08	77,92	311,5

View Apt scale conversion for 8 resistors (8R) in normalized values are given in Figure 3. At the same time, the same number 8R scale transformation for the case of Kelvin divider, we obtain the classical scale is shown in Figure 4.

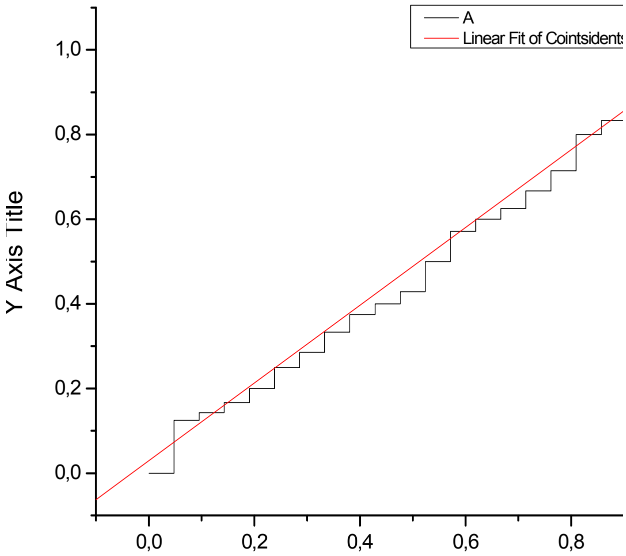


Figure 3. Quantum scale transformation ADT_8R

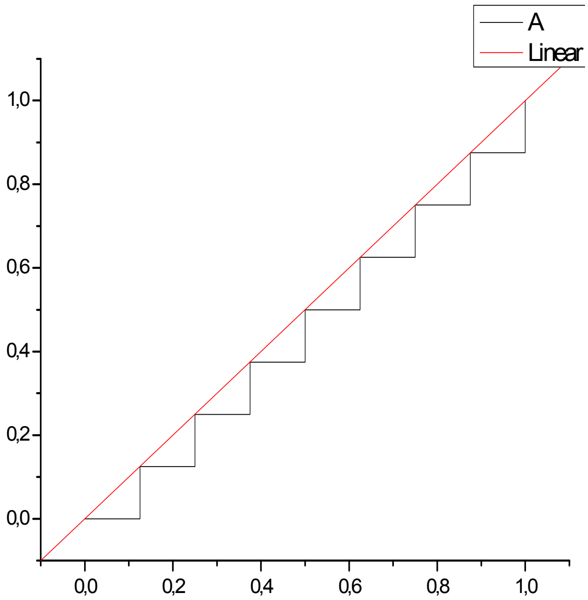


Figure 4. Quantum scale transformation Kelvina_8R AD

It is obvious substantial increase in resolution and scale transformation is winning (see Table) only 2.75 times, while already at ADT_16R, will win 5 times (80 instead of 16 divisions of the scale!), Which are shown in larger scale in Figure .5.

The equations of quantum scale transformation can be written as:

$$N_i = \mathrm{mod}_{\leq 1,000}\left\{\frac{A_j}{B_k}\right\},\ j,k \in 1 \div N \tag{6}$$

which case the AD Kelvin will look like:

$$N_i = \mathrm{mod}_{\leq 1,000}\left\{\frac{N_i}{2^n}\right\},\ i \in 1 \div N \tag{7}$$

that of a partial case AD Trotsyshyna.

Given that a small number of resistors is not a large gain, while already at 16R he is already 5 times, and Oversight t significant improvement in uniformity and linearity characteristics ADT_16, her schedule is given in figure 5.

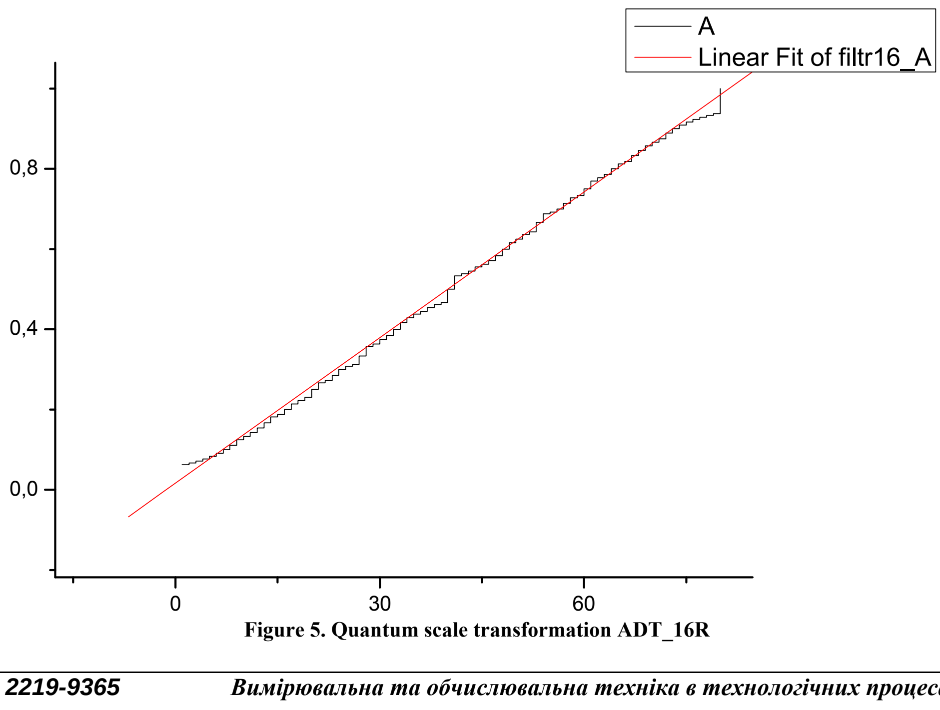


Figure 5. Quantum scale transformation ADT_16R

After such impressive results already at very small amounts binary digits of the scale, it is clear that only in the cable are available with use of all available quantum scale these values, while the classical scale uses only binary values and reject the much larger number of available.

Measurement and scale

Measurement of-establishment of correspondence between the set of objects and a lot of "standard object models, and that is measuring scale. The terms "measurement" and "scaling" are used interchangeably. Measurement and scale are tools of formalization and generalization of empirical observations.

Scale Properties certain relations defined on a set of standard models of Barnhart objects.Specified types of scales corresponding to different policies that restrict possible operations on the standard model of objects, methods of processing measurement results and their interpretations. Formal study and analysis of properties of different types of scales are given in [14].

It is important that in a number of letters - names, order, spacing, relationships - increasing capacity scales: quality measurement quantitative change, grow to accessing properties of objects, the differences and relations between their properties, application of arithmetic operations, statistical measures and criteria, expanding beyond invariant's measurements. The more powerful of the scale are all possibilities scales less powerful that connects all of the scale in a single system of measurement.

Introduction of the metric scale on the shares non-metric scale (nominal and serial) and metric (interval scale and relationships).

Scale ratio. Scale ratio is different from the interval scale introduction of "natural", or absolute zero, which corresponds to complete absence of measurable properties. If the domain of the values of the scale relationship is positive, then it is called the positive relations scale. All admissible transformations for ratio scales running out functions of the form $f(x) = kx; (k > 0)$, which indicates the highest possible scale relations as a tool for generalization [4].

Scale ratio as the most powerful, sums up all the opportunities that have less powerful scale items, order and spacing. It defined equivalence relations, equality, order, function and metric distances. On a scale ratio can be defined equality and rank the order of magnitude, equal intervals and relations between values. Opportunity assessment ratio - the most important distinctive feature of this scale that determined its name.

Notable examples of the scale ratio: weight, length, temperature scale Kelvin. They represent examples of the positive attitude scales. On a scale ratio defined by all arithmetic operations, and its values can be applied any statistical procedure.

Some features of the application scales.

Ideally should strive to use the scale relations. However, in actual research these claims are mitigated: Should you give preference to the most powerful of those scales that apply to specific data. Choice of scale should respond as measurable indicators and goals and objectives of research.

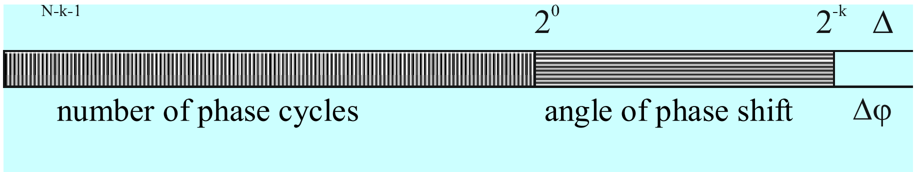
Principles and methods of the theory FFM and CRS

As part of me started a new scientific field, I personally and my students, seven of whom have successfully defended their theses for a new research direction, and under my supervision, (special 05.11.08 - Radio devices, two candidate. 2001, 2005 Technical University Vinnytsia , Spec. 05.11.13 - tools and methods to control and determine the composition of matter, 2003, 2005, Kyiv NUTD, Spec. 05.11.05 - Devices, Physics and Mathematics, Chemistry, 2004, "Lviv Polytechnic" 05.02.01-mathematical methods and modeling 2006, TSTU. field. Ternopil) [6-12] proved that in measuring the frequency and angle of phase shift used models that are inadequate to the real signals that not only enables you to simultaneously improve accuracy and performance measurement, and in many cases leads to gross errors (misses) that in the classical theory called paradoxes.

Within the developed theory of measurement and transformations fazofrequencies radio (FCHV and PR), we managed not only to prove the inadequacy of classical approaches and models, but also suggest a new - fazofrequencies approach that not only free from those drawbacks, and opens new opportunities still unknown not only in the field of measurement and information theory, signal theory, etc. [13].

Briefly, the essence is that the frequency is defined as the derivative of the total phase () and all measuring devices, implement algorithms accumulation (ie integration), which is the inverse operation to find the derivative. So, obviously, but decades of devices measured at what is basically does not exist in nature (frequency - H group, phase shift - Group F). At the present stage it appears that even super-modern equipment that have high metrological characteristics rapidly lose them when you access the signal decreases, or when it is unknown a priori, especially when signals are modulation - that is the radio signals (or the interpretation of the authors - in such Basically there are all really existing signals). The classical approach to explain these phenomena can not, because using idealized models (from the sinusoid), which is an abstraction, but only for such models, and hence all the problems.

Moreover, the desire to use simplified models, suitable methods of harmonic analysis have led to catastrophic errors in measurement theory is when a single scale measuring full phase shift (FPS), was divided into two separate: frequency (group H) and phase (group F) representing the first approximation and a small part of a single scale. Thus, it is clear what the causes and problems of measurement is fazofrequencies measurements rather than measuring the frequency and phase in the classic sense, for which there is no real signals. Pain in detail the specifics of the concept of "frequency" on the radio signals given in [5,13-16].



But as it turned out, the proposed theory FFM and CRS, based on the concept fazofrequencies approach to the problem of measuring "frequency" and "phase" electrical signals appeared even "technological" and "ideological" research direction in the field of measuring instruments, and specifically it fazofrequencies parameters.

First, we not only abandoned the classical concepts, but also established and proved that for those of real signals (which merged into the overall rating and was named radio signals) that are the beginning and end, and they all have fundamental differences from ideal "sine." Yes, they do not exist terms "frequency" and "phase shift" in its classic sense which is regulated by GOST, ISO, as these parameters, as already stated, are introduced and there are "only for ideal signals (sine wave with no beginning and end), and this is the absolute idealism. Therefore, the "frequency" and "phase" - does not really exist, and can not be measured, for today's real signals demonstrate a simple example: no precision Frequency impossible to measure with a specified accuracy BEARING mobile phone, even in active mode, the more in standby mode, similar problems in measuring the parameters of HMS, and more.

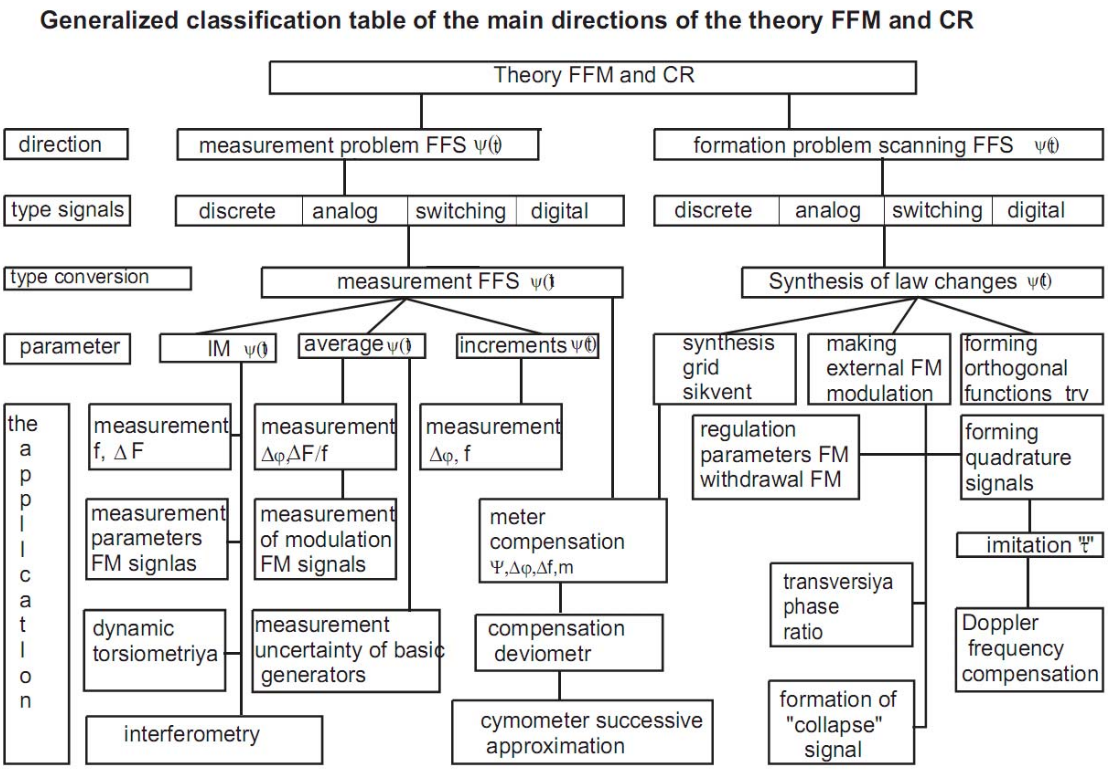


Figure 6. Generalized classification table of the main areas of application of the theory FFM and CR [13]

But the new theory does not waive the "frequency" and "phase shift", and establishes a causal link them and adequate to the actual process definition. The foundation theory FFM and CRS is the statement that for real signals (radio) there is a concept of full phase shift (FFS) $\Psi(t)$ and derivative $d\Psi(t)/dt = \omega(t) = 2\pi f(t)$ - which is the "instantaneous frequency", and analyzing the behavior changes and extremes $\Psi(t)$ can find all the known (and new) options as the "frequency" and "phase." This definition does not contradict the "classical" definition, which we will be limiting case $\Psi(t) \in (-\infty \le t \le +\infty)$, if that, and this is an idealization.

Moreover, measuring instruments, which we have developed a new theory based on only a last resort and at simplifying the scheme and provide functionality known variants of existing "traditional" methods and devices which are partial cases fazofrequencies meter [15-16].

The theory is incomplete, as not only covers the analysis (measurement), but also the synthesis (formation and transformation) fazofrequencies parameters of radio signals. For instance on the same technological level (performance components, circuits) by changing the configuration (scheme firmware) we received synthesizers, which are twice as higher frequency source (or rather sequent) and smaller spurt phase, (both increased and speed and accuracy).

In addition, we detected a completely new properties that do not and can exist in classical representations, that can say that the zone properties of the new theory in comparison with "classic" is, so-to speak, "a complex component, and its projection on the set of real numbers "gives" classical system ". So you want to explore new opportunities that have lie outside our representations in both measurements and processing signals, and so on.

In theory FFM and CRS instead of two independent scales (whole part - H devices group and the fractional part - devices group F), using a single scale of rational numbers, which include the addition of whole and infinite number of intermediate (possible) values of "fractional" (see. Fig. Scale [13]).

Thus, to distinguish signals from our example is not necessary to wait $T_{mes.\min} \geq 1c$, perhaps for that $T_{mts.\min} \sim 1мс$ at times 10^3 faster than ECFM [16], on this theory indicates FFM and CRS (Fig. 7) [17].

To complete and confirm the only source of progress to increase the resolution as the ADC-DAC and fazofrequencies settings within cable KTM here's a sampling scale coincidence winning growth compared with the classical (Fig. 7) and comparison resolution frequnsimeter coincidence and CNT-90 (which is "best in the world") Figure 8.

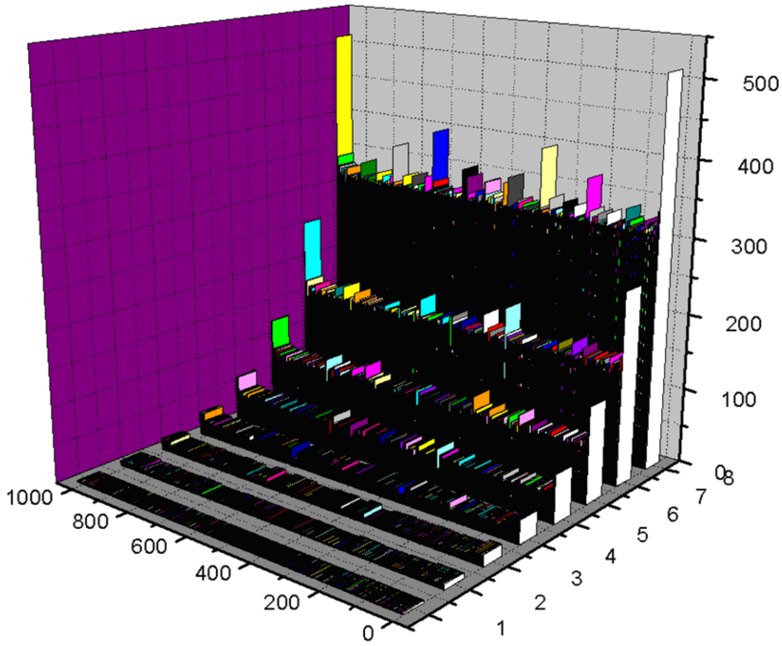


Figure 7. Dynamics of the grouping of "fractional divisions" within the classical scale 1-1024

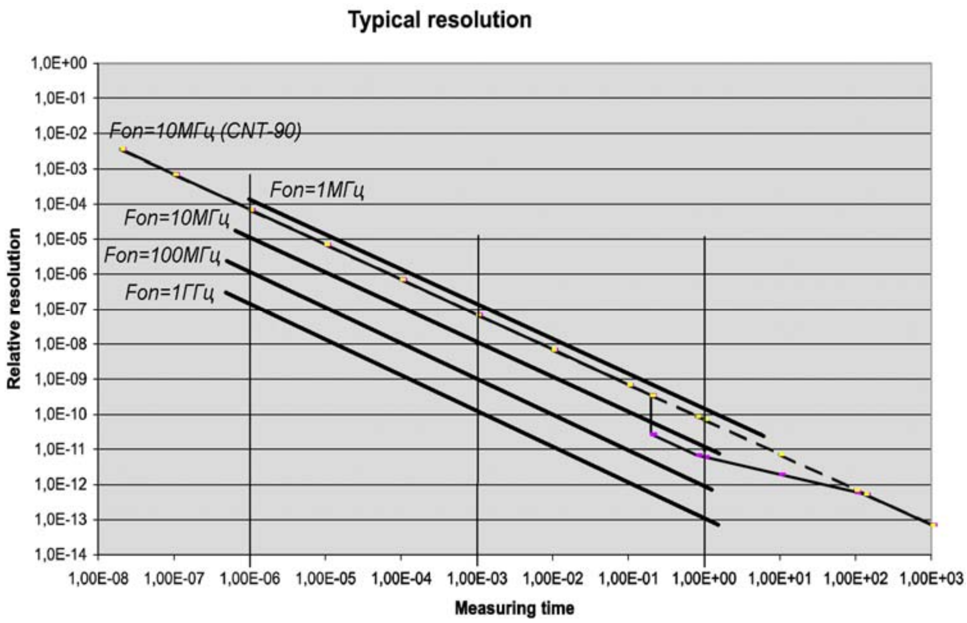


Figure. 8. Comparison of Frequency coincidence with "best in the world" Frequency CNT-90

Winning coincidence method over other known digital methods may be estimated as [18]:

$$B=\frac{\delta_{fкκласи}}{\delta_{\text{fккоін}}}=\frac{\dfrac{3}{f_{on}T_{вим}}}{\left(\dfrac{2}{T_{вим}\mathrm{f}_{\text{on}}}\right)^2}=\frac{3}{4}\cdot \mathrm{f}_{\text{on}}T_c=\frac{3}{4}\cdot N_{on}=3\cdot 2^{n_{on}-2}. \qquad (9)$$

Specified analytical expression evaluation winnings in complex settings (speed x accuracy of measurement) shows the same functional dependence that we observed examining divisions on the scale of measurement Frequency coincidence depending on the digit (values) represent the results in the numerator and denominator counters.

Indeed, experimental work, confirming the theory and has no desire for other experimenters to check the results again. Her place in the review article. Experimenters will remember her only in rare cases if the theory that tested to be found any defect, if it will be incomplete or erroneous.

The story of the publication that refutes the theory. She immediately gets the opposition represented by the authors and supporters of the theory. All its data and conclusions undoubtedly will be thoroughly analyzed to detect possible errors. Moreover, such work must be re tested by independent researchers.

Apparently, the publication of work that refutes the theory requires, generally speaking, more thorough research, more highly qualified researchers and determined courage, at last.

Conclusion

Detailed examination of fundamental aspects of quantum theory of measurement and especially the theory of scales of measurement returned implicit acknowledgment that it is a concept fazofrequencies approach and a basis for its fractional-rational scale of measurement is really the highest level of hierarchy as fazofrequencies measurements and measurements of amplitude and other parameters at all.

Formation and development of new fazofrequencies approach for measuring the frequency and quantum measurement theory requires revision of existing definitions in the field of metrology parameters of group H, and developing new legal materials that would reflect the current level of knowledge.

Value principles and methodology of the new theory and the results of its importance for the development of measuring instruments can be compared as a ratio of geocentric and heliocentric systems, where it is clear that all the possibilities of representation and measurement parameters of the real picture of the world are at first could also be acquired from the other and vice versa no.

Found that when using coincidense quantized values of the scale of the DAC-ADC is much greater than is used in classical binary converters.

With increasing attenuator-divider Trotsyshyna resolution increases exponential dependence in comparison with the Kelvin divider resistors with the same quantities. Winning resolution ADT 1024 resistor at more than 300 times, and scale transformation is quite lines.

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