# Effective Analysis and Elaboration Competitive Methods for Generating LPL for A/D Conversion

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## ABSTRACT

On base of analysis rules theoretical and comparisons of effectivity methods of conversion analog-digital (in shortening AD), one qualified spheres most effective uses compared methods, especially for utilizations of method Monte-Carlo, one passed estimation techniques-economics characterizations conversions systems AD Monte-Carlo in aim of enlargement exactitude and speeds of conversions and processing signals. One executed analysis different methods of generating RN and passed analysis methods estimation of quality of fate schedules RN. One gave estimated estimation and results of comparison taking into account methods of estimation quality of fate schedules RN. In recapitulation one formulated conclusions and one qualified sphere most effective uses of method conversion AD Monte-Carlo.

**Keywords**: AD conversion, method Monte-Carlo, generating RN.

## 1. INTRODUCTION

In a modern manner development of technology informatics and electronic places more and more greater requirements in range of speed and exactitudes of transformation of form of information. Thanks to digital technique being characterized with considerably greater coefficients techniques-economics both in respect of parameters and technology of production follows conversion of analogous signals to digital [ 1, 2, 3 ]. Wide use analog-digital converters in electronic systems caused necessity leadership of researches over new elaborations already existing, of competitive systems conversion [ 8 ]. Aim of paper is analysis of bases theoretical and comparison of effectivity different methods conversions AD, qualification sphere use compared methods of conversions AD, detailed discussion method Monte–Carlo and her uses, analysis methods of generating RN, estimation quality of fates schedules RN and estimation of effectivity characterizations talked over methods in aim of enlargement exactitude and speeds conversions and transmission of signals.

## 2. ANALYSIS OF ECONOMIC-TECHNICS CHARACTERSTICS OF METHODS AND ARRANGEMENT OF CONVERSION AD

Among methods of practical conversion in converters AD can belong to three groups: method of conversion immediate type flash or qualified with name of parallel method, compensation methods and integral methods [ 3, 6, 7 ].
Method of conversion AD of type flash [ 6, 7 ] relies on immediate comparison of voltage entrance - to one from *2n* sections of voltages, at what every section is credited suitable n- bit code word.
Advantages: short times of conversion, few tens nanosecond.
Defects: little resolution from 6 to 10 bits, high price of arrangement, complicated construction from regard on large number comparators.
Use: transformation video and very quick links digital AD.
Compensation methods AD [ 6, 7 ] to of which of realization uses as a rule transducer will surrender uses also idea of comparing not well-known voltages with 2n levels of voltage of reference where *n*- bit code word. Horizontal voltages necessary to comparing with voltage converted produced are by transducer will give, instead basic element of block steering is meter reversionary because arrangements these qualified are often as converters spying.
Advantages: resolution from 8 even to 16 bits, lower costs of arrangements in comparison with parallel methods.
Defects: for arrangements about resolution 14-16 bits high price of arrangement and time of conversion of line millisecond, times of conversion of line tens microsecond, number of steps executed during of every conversion is equal to bits number of word code.
Use: measuring devices, in transformation given telecommunications.
Integral Methods characterize oneself this, that process of conversion takes place two steps [ 3, 6, 7 ]. First takes executes of converting voltages entrance - on size indirect e.g. time or frequency, then measures her by means of exact digital methods on rule of counting impulses. Result of counting represents code word answering to entrance voltage.

Advantages: large resolution from 12 even to 16 bits, low costs of realization of arrangements, straight structure of arrangements.
Defects: debts long time of conversion tens, several hundred millisecond.
Use: millimeters, telemetry.
Method of conversion AD Monte-Carlo is change of methods integral block schema of arrangement converters AD Monte-Carlo became represented on figure 1. Advantages: will not demand of large supplies hardware, low costs of production, straight build of arrangement, assures wider strand frequency of measuring - signal in comparison with methods compensations and even parallel.
Defects: selection proper arrangement of generation sequence suitable RN about equableness schedule.
Use: to measurements of size e.g. of energy, of flow.

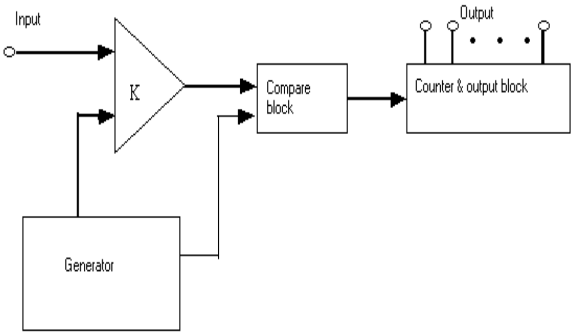



Figure 1. Blocs schema Monte-Carlo converters

## 3. ANALYSIS KNOWN AND PROPOSED METHODS OF GENERATING RN

Most of at present practical random numbers generators ( in shortening GRN) generates of fate numbers on the ground of account recursively with utilization of function modulo at what course of numbers happens repeats after certain period Most desirable features GRN are:

- Good statistical properties – equableness of schedule RN, maximum assigning quarters of points in period,
- Possibility of adaptation programmatic or arrangement - efficiency and speed of generating of course,
- Possibility of changes of period generated sequence of RN,
- reproducible generated of sequence.

At present most often practical generators about steady schedule are [ 1, 9 ]:

- Linear generators - described with example: $X_{n+1} =( a * X_n + c) \bmod m;$
- Leaning generators on shift registers described with example: $a_i = a_{i-p}\ xor\ b_{i-q}$;
- Generalized Fibonacci generators described with example: $X_n = X_{n-2} + X_{n-1} \bmod m$;
- Leaning generators on subtraction with loan described with example: $X_n = X_{n-r} \ominus X_{n-s} \bmod m$;
- Non-linear generators.

Where parameters a, b, c, i, m, n, p, r, s, q– positive integer numbers.
In paper became used select algorithms of methods non-linear generation of numbers and after programmatic implementation one received schedules of RN. The names of methods are: algorithmic I, algorithmic II, algorithmic III, table methods and methods of the rests modulo. Algorithms activity of generators make possible on the ground of first whole number creation in manner necessitation reproducible of course entire RN. If GRN creates different courses at every test - course, this influence of changes in algorithm will be difficult to estimations and such generator is not useful in practical use. Generators implemented according to proposed algorithms generate identical courses RN for identical parameters devising what became confirmed in tests. Accepted foundations: starting number is odd and does not ends on number *0* or *5*. Tests one passed for starting numbers *2143*.

### 3. 1 Algorithmic method I

Idea of method leaning is on algorithm von Neumann, qualified name average of squares. To advantages one should number straight construction of algorithm to defects short period received of sequence RN resulting from foundations, not exceeding halves of range for maximum numbers *N* about *n* - positions.

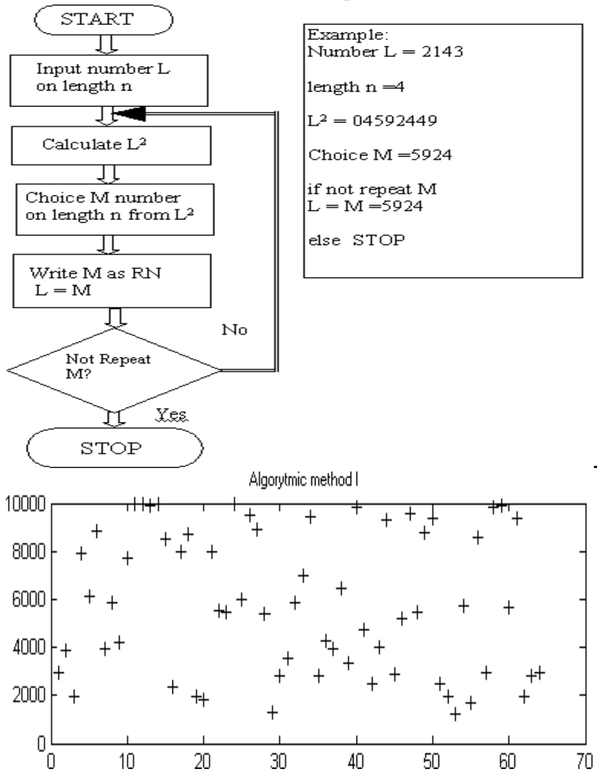



Figure 2. Schema algorithmic methods I in algorithm form and schedule RN.

### 3. 2 Algorithmic method II

Methods leaning is also on algorithm von Neumann, became modernized, in comparison to methods algorithmic I activity of algorithm different oneself with choice of RN. To advantages one should number straight construction of algorithm to defects very short period received of sequence RN what became confirmed in numerous tests.

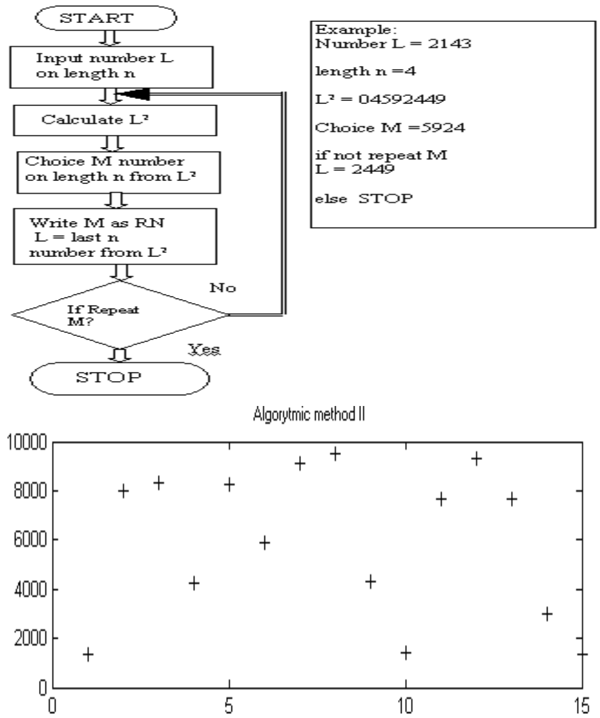



Figure 3. Schema algorithmic methods II in algorithm form and schedule RN.

### 3. 3 Algorithmic method III

Methods leaning on algorithm von Neumann, algorithm of activity became modified, first starting number is used still in activity of algorithm as solid value of multiplication. To advantages one belongs number straight construction of algorithm, long period received of sequence RN.

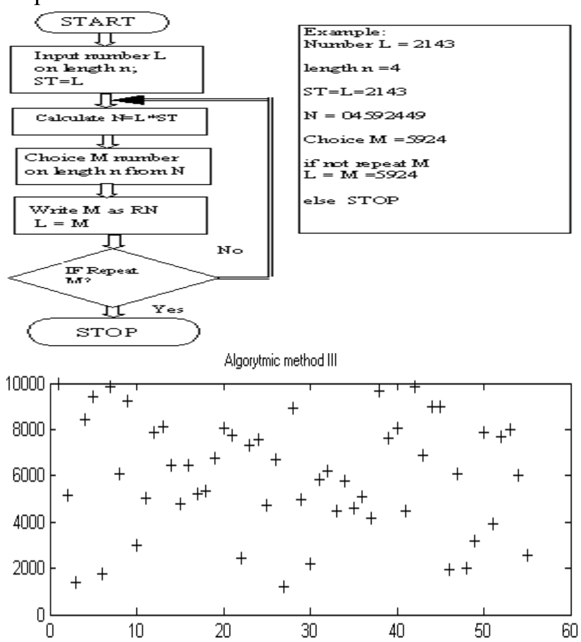



Figure 4. Schema algorithmic methods III in algorithm form and schedule RN.

### 3. 4 Table method

Methods leaning on algorithm cage automatic. To advantages one belongs number long period received of sequence RN, to defects complex algorithm, extension of time calculations, lack steady maximum assigning quarters received of numbers from GRN in period RN.

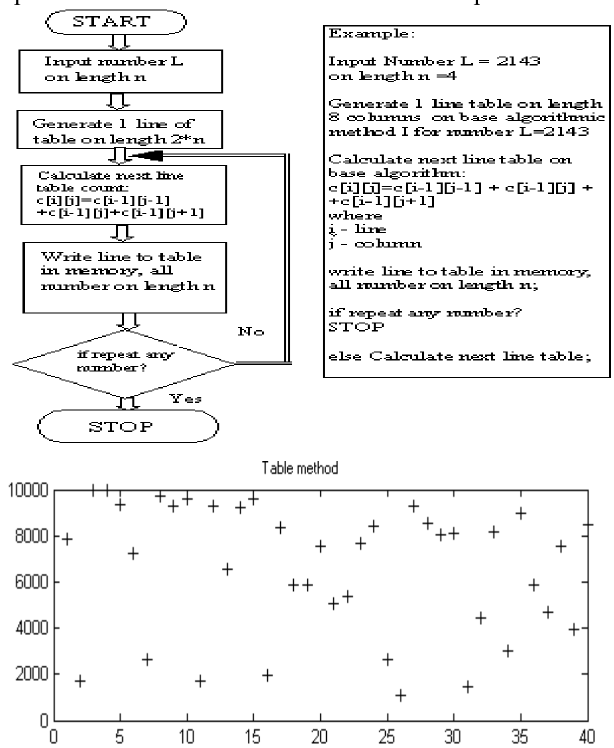



Figure 5. Schema table method in algorithm form and schedule RN.

### 3. 5 Method of the rest modulo

Methods leaning on idea of algorithm von Neumann, modification of method relies on utilization of operation modulo. To advantages belongs number generation long period received of sequence RN, good maximum assigning quarters received of numbers from generator in period RN, to defects complex algorithm, and extension of time of calculations.

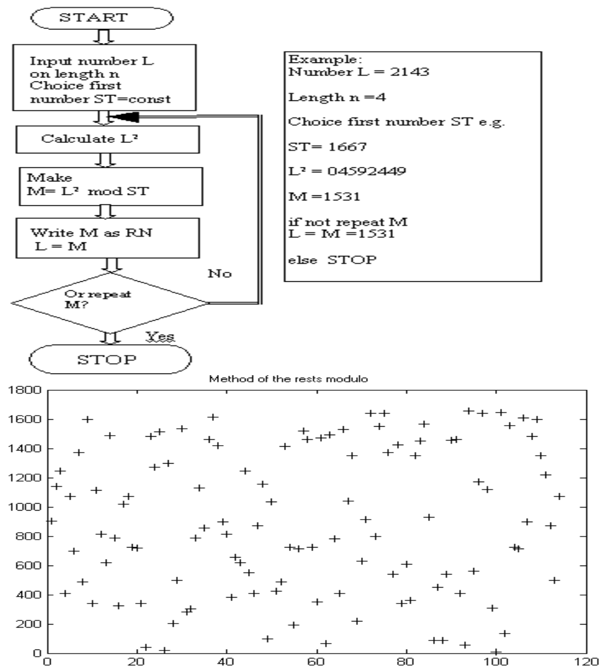



Figure 6. Schema method of the rest modulo in algorithm form and schedule RN.

**3. 6 Method max length.**

This method generates RN for bit number with sum modulo and shifts bits. Output bits are convert to digital number and period is digital number. To advantages belongs number generation long period received of sequence RN, good maximum assigning quarters received of numbers from generator in period RN. This method is simple to implement in system and allow generate maximum period for number on length *N*. Example was make for *9-bit* start vector ST=111000011.

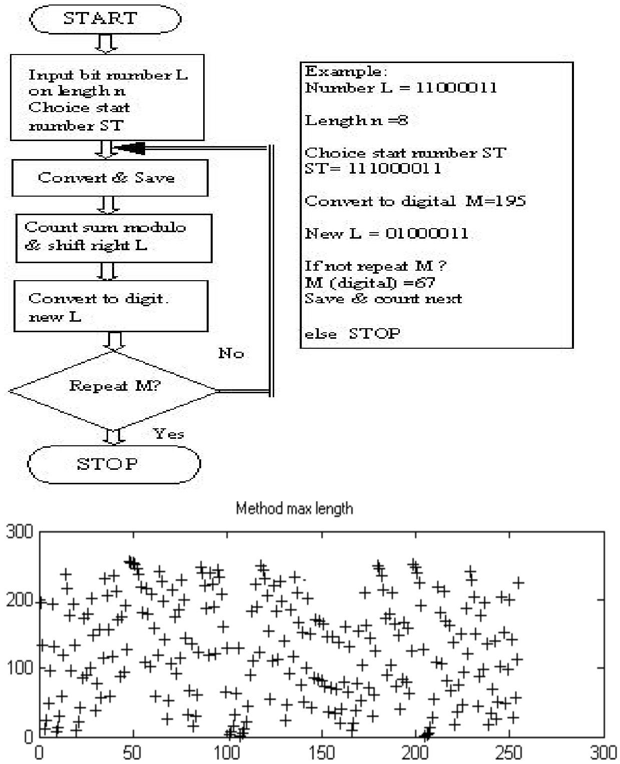



Figure 7. Schema method max length in algorithm form and schedule RN.

## 4. METHODS ESTIMATIONS OF QUALITY SCHEDULES RN

On base of estimation equableness one can rate and to ascertain whether given method more simply, cheap and effectively is to realize hardware or else according to plan. Most often in literature met elaborations of testing of schedules RN and passing statistical estimations these schedules is executed with reference to of steady schedule leaning on section *U( 0; 1*). To groups of tests of agreement with schedule *U( 0, 1)* belong [ 1, 9 ]:

- Test chi-square described with example: most often practical test of estimation equableness of schedule, $\chi_{k-1}{}^{2} = \sum_{i=1}^{k} \frac{(n_i - np_i)^2}{np_i}$
- Test of agreement with multidimensional schedule - relies on creation from course of sequence RN similar- identical sections of form $((j-1)/k,\ j/k)$ *for* $j = 1, 2,...,$ k. Received in this manner sections can be of service to construction of characterizations according to of test chi-square,
- Test OPSO (overlapping-pairs-sparse-occupancy) relies on analysis of frequency overlapping of pairs of numbers obtained from generator e.g. course of numbers from generator $l_1, l_2, l_3, \dots l_n$ - complicated {composite} from whole numbers can be of service to construction pairs $(l_1, l_2),(l_2, l_3),(l_3, l_4)\dots(l_n\text{-}1, l_n)$
- Kolmogorow test - serves to verification of variable hypothesis, that given of fate variable *X* has schedule about given continuous disturbance *F*, at what statistics is leaning on difference between hypothetical disturbance *F* and disturbance empirical *Fn* from tests of numbers $X_1, X_2,\dots, X_n$ test. Statistics is described example: $D_n = \sup_{-\infty < x < +\infty} |F_n(x) - F(x)|$

Other kind of tests are tests of agreement of schedules statistician. To groups this belong :

- Leaning tests on positional statistics,
- Test of sums,
- Test d2,
- Test of birthday for space,
- Test least distances in pairs.

Proposed by authors to usages method of estimation of quality schedules RN:

4.1 Histograms method
4.2 Method of points parity and-non-parity
4.3 Method of estimation equableness on the ground checks of quantity of points in space 2D
4.4 Method of estimation equableness of schedule RN in dependences of value of lectures and difference to maximum limitations

**4.1 Histograms method**

Let $N = 2^n = 2^8 = 256$ *N* –quantity of elections
We choose after *m* measuring - elements $m = 1, 2, 3,\dots n$.
Number $k = N / m$ to qualify will be quantity of sections measurement.
This average value in borders of choice will carry out $x = \frac{1}{m}\sum_{i=j}^{j+m-1} x_i$ . Exists possibility of generating so-called. „thick" characteristics with step *2m* or so-called. „thin" characteristics with step for every element *m*.
Advantage this methods is variety and possibility of choice many characterizations for different *m* and linearity characterizations. Defect this methods is large quantity executed of operation mathematical and complexity of calculations.

**4.2 Method of points parity-and non-parity**

Given is course of numbers about length *N*. Executing of lectures pairs of points, creates of well ordered pairs points in space 2D. Appointed points one can describe as gatherings for lectures of axis abscissas and of axis ordinates and on the ground their values one can cross out their characterization $B\ i_{vert} = f(B\ i_{hor})$:
$B\ i_{hor} = \{X_{2*i+1}\}$ for $i = 0, 1, 2,\dots N$
$B\ i_{vert} = \{X_{2*i}\}$
Advantage this methods is simplicity and linearity, defect limited number of measuring points.

### 4.3 Method of estimation equableness on the ground comparisons of quantity of points in space 2D

Method this leans on geometrical partition of area e.g. individual square along his of diagonal on two equal halves. Then counts oneself quantity of points in areas divided of figures of field *K* and *L*, about this of oneself area. If number of points is identical in areas divided of figures *K* and *L*, this means that examined schedule is steady, in opposite event schedule is not steady. Then creates pairs of points; choosing facultative point we read his coordinates $(x_1, y_1)$, instead to following lectures as coordinate of axis abscissas *X* for following point we accept value from preceding lecture for axis ordinates *Y*. Pairs of points serve to realizations of characterization. Example- delimitation pairs of points:

$(x_1, y_1)(x_1, y_2)(x_{i-1}, y_i)...(y_{n-1} y_n)$ for $i = 0, 1, 2.... n$

### 4.4 Method of estimation equableness of schedule RN in dependences of value of lectures and difference to maximum limitations

For given sequence RN about length *n* one should find value maximum and max, then generates pair of points: taking root following values from sequence RN as coordinate $X_i$ of axis abscissas in space 2D, value of coordinate $Y_i$ of axis ordinates counted is as difference among value $a_{max}$ that is to say $Y_i = a_{max} - X_i$ with value measured $X_i$ for $i = 1, 2... n$.

On figure 8 one represented graphically realization this methods.

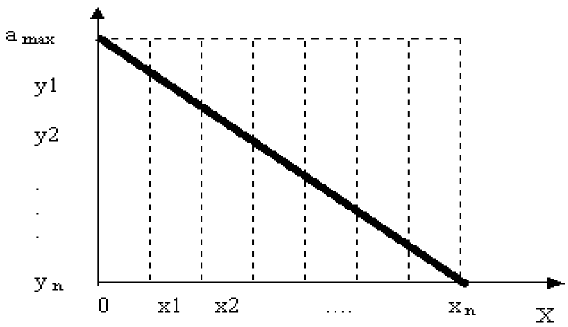
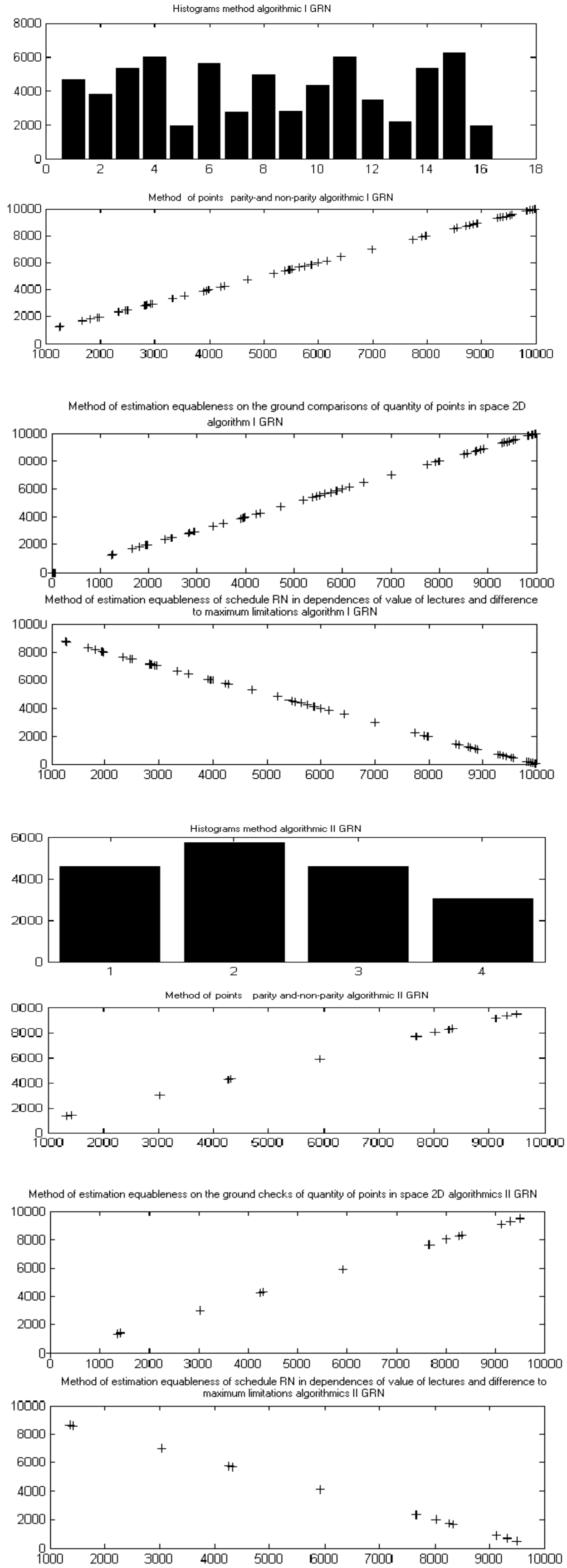



Figure 8. Representing graphically realization method of estimation equableness of schedule RN in dependences of value of lectures and difference to maximum limitations.

Method this is straight in implementation, gives however good results of estimation at properly long sequence of schedule RN. If in every section quantity of points assigned quarters on line is stood, this means that we received steady schedule.

## 5. RESULTS OF SIMULATION

On base proposed methods of estimation of quality schedules RN became passed simulations and calculations. On figure 9 are represented characterizations for choice methods of estimation of quality of schedules RN.



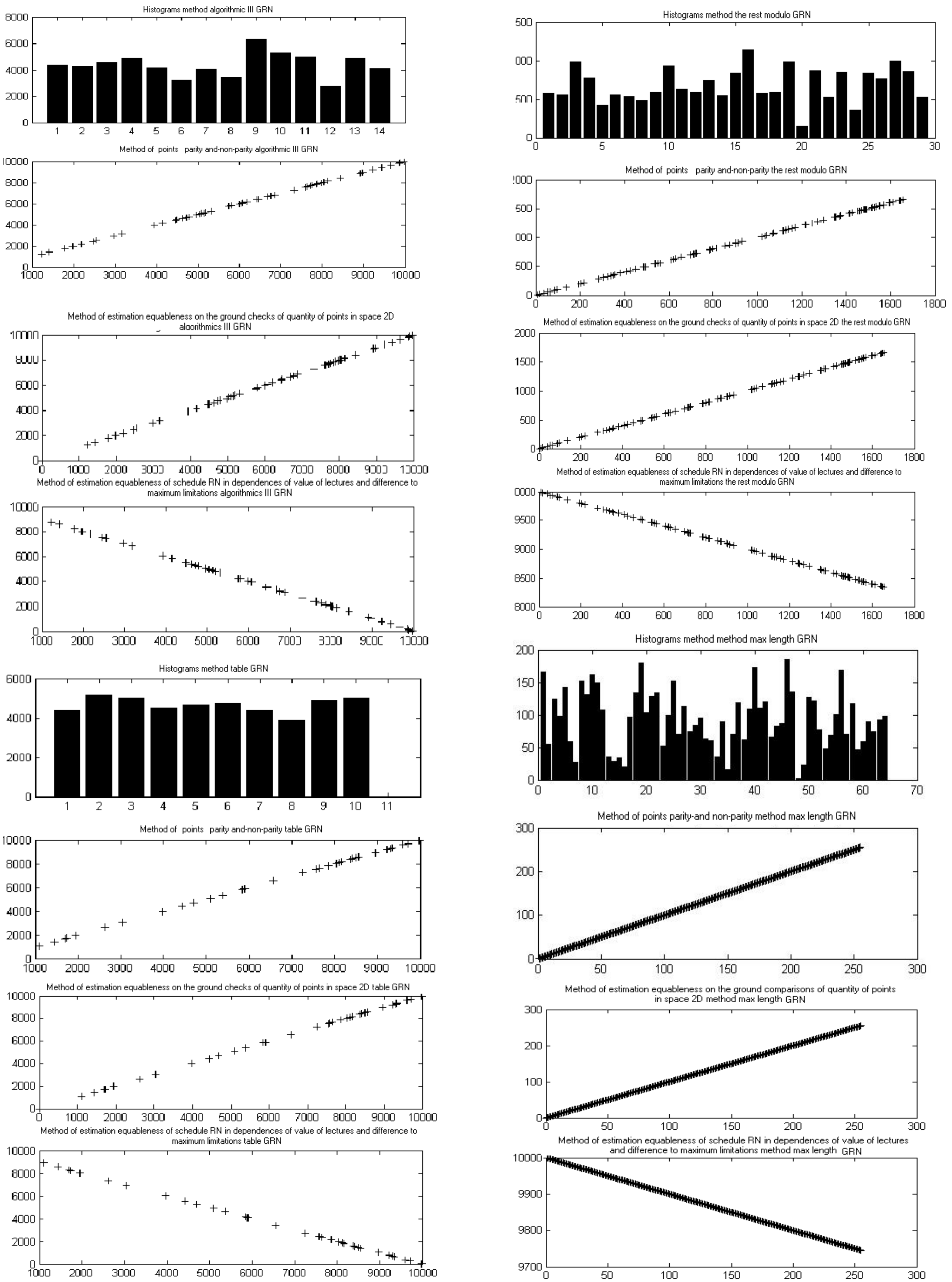



Figure 9. Characterizations for choice methods of estimation of quality of schedules RN.

## 6. COMPARISON EFFECTIVITY OF METHODS GENERATING RN.

On base assembled results of simulation one can pass estimation effectivity of generating RN. Comparing characterizations for proposed methods of estimation quality of schedules RN one passed estimation according to following criterions:

- Equableness of schedule – is compared assigning quarters of points on line,
- Length of sequence RN – period of sequence RN received from generator,
- Very low value of standard deviation and absolute deviation,
- Linearity of sequence – check linearity received characterizations, all represented schedules realize this criterion,
- Maximum assigning quarters of points in period – executes oneself on the ground analysis's received of schedules RN from generators, estimation relies on estimation of assigning quarters of points in space 2D.

One can ascertain, that from among proposed methods of generation RN, in road of testing at help different values of starting numbers, with best parameters was characterized method max length and next method of the rests modulo; good parameters show also methods algorithmic I, algorithmic III and to tabulate. From regard on worst parameters of estimation quality of schedules for method algorithmic II, in futures not will be driven works investigative and tests this methods. All methods are linearity. In table 1 one represented comparison each methods according to exchanged choice statistics criterions for starting numbers 2143. This criterions are:

Variance:

$$Var = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2$$

Absolute deviation:

$$ADev = \frac{1}{n}\sum_{i=1}^{n}\left|x_i - \overline{x}\right|$$

Standard deviation:

$$\partial = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\left|\overline{x}^2 - x_i^2\right|}$$

Table 1. Composition for methods RN.

| Method | Variance | Length of RN period | Abs. deviation | Std. deviation |
|---|---|---|---|---|
| algorithmic I | 8654700 | 64 | 2577.3 | 5114.3 |
| algorithmic II | 9442400 | 15 | 2686.3 | 5308.4 |
| algorithmic III | 6000900 | 55 | 2025.7 | 4533.4 |
| table | 7924000 | 40 | 2417.9 | 5277.9 |
| the rest modulo | 248290 | 114 | 433.8 | 822.1 |
| max length | 5440 | 255 | 63,75 | 118.73 |

In table 2 are presented another statistical values .This are means and relative values what takes compare RN sequence:

Mean:

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Standard deviation / mean:

$$\frac{\partial}{\overline{\overline{x}}}$$

Absolute deviation / mean:

$$\frac{Adev}{\overline{x}}$$

Table 2. Statistical values for methods RN.

| Method | Mean | Std. Deviation/ mean | Abs. Deviation/ mean |
|---|---|---|---|
| algorithmic I | 5827.5 | 0.0178 | 0.0353 |
| algorithmic II | 5970.1 | 0.0750 | 0.1482 |
| algorithmic III | 6032.5 | 0.0242 | 0.0541 |
| table | 6606.9 | 0.0313 | 0.0683 |
| the rest modulo | 899.29 | 0.0096 | 0.0182 |
| max length | 128 | 0.0042 | 0.0079 |

## 7. CONCLUSIONS AND MOTIONS

In support for received results driven of paper one can ascertain, that method of conversion AD Monte-Carlo permits to enlarge effectivity of systems transformation, by diminution complexity of construction converters, to lower their price in comparison with till now carried costs, permits to enlarge exactitude and speed of conversion and transmission of information with reference to present methods of conversion AD. The method max length proposed by authors appear good for Monte-Carlo RNG. Sphere of uses converters Monte-Carlo this mass - digital arrangements to measurements of size e.g. of energy, of flow. Executed already computer simulations gave satisfactory results driven of researches. Will be continued further research simulations in aim to optimization and selection proper arrangement generation RN and their with result will be realization physical arrangement converters AD Monte-Carlo. Area of uses GRN is very wide and continually evolving, because exists yet possibility of perfecting and elaborations new algorithms and structures of conversions information, elaboration methods of estimation quality of schedules RN and reaches it is necessary elaborations suitable arrangements digital and devices.

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