

## MATHEMATICAL ASPECTS OF BIBLIOMETRICAL ANALYSIS OF NEUROPHYSIOLOGICAL INVESTIGATIONS OF ACTION OF NON-IONIZED RADIATION (MEDLINE-INTERNET)

Chizhenkova R.A.

### Introduction

Interest in neurophysiological effects of non-ionized radiation - electromagnetic (EMF), magnetic (MF), and electrical fields (EF) - has existed for many centuries [8, 9]. In the middle XX-th century biological effects of microwaves (MW) became the center of attention of researchers owing to appearance of new technological approaches. Russian researches (including the author of the present work [1-3, 5, 6]) made essential contribution to development of this problem.

Bibliometrical investigation of published material on electromagnetic biology including neurophysiology was not carried out up to now. The present work is devoted just to examination of quantitative characteristics of publications of this trend.

Information accumulated in world on electromagnetic neurophysiology during 35-year period in the later half of the XX-th century (1966-2000) was considered. The state of investigations of neurophysiological effects of non-ionized radiation was analyzed on the base of the database "Medline" accessible through Internet. Quantitative characteristics of publications on the present problem were obtained according to chosen key words. Bibliometrical data concerned investigations performed in different neurophysiological objects (the brain, the cortex, neurons, nerves) with application of non-ionized radiation were examined.

Preliminary results on this problem were partly presented in our another papers [4, 7].

### Materials and methods

Bibliometrical information on electromagnetic biology during 35-year period in the later half of the XXth century (1966-2000) was analysed. Quantitative characteristics of publications on biological effects of non-ionized radiation were considered on the base of the database "Medline" accessible through Internet. The numbers of publications on the present problem were obtained according to chosen key words. Bibliometrical data concerned investigations performed in different neurophysiological objects were studied: the brain, the cortex, neurons, nerves. Works with application of non-ionized radiation of series of kinds were examined: EMF, MW, MF and EF.

At statistical analysis of the received bibliometrical material the coefficient of correlation and Wilcoxon paired comparison test are used. Besides the comparison of the parts of the numbers of publications carried out on different neurophysiological objects in general totality and the comparison of the numbers of publications in different time periods were performed as the comparison of two selective sampling fractions of variants.

### Results

It was found, that the number of neurophysiological papers reached 1401300 in 35-years period from 1966 till 2000. In addition the numbers of papers, carried out in the brain, the cortex, neurons, nerves, were 705259, 180602, 237160, 278279 correspondingly. The number of publications of investigations with application of non-ionized radiation was 21606, including works with employment of EMF (6001), MW (6920), MF (5316) and EF (3369).

Materials concerned investigations in different neurophysiological objects under action of these penetrating physical factors were considered. Received information on the numbers of publications is presented in the tables 1, 2, 3 and the figures 1, 2.

Table 1.

General data on the number of papers carried out with non-ionized radiation in different neurophysiological objects

Objects	Characteristics of totalities		
	Total number of papers in 35 years	Average number of papers in 1 year	Sampling fraction (%)
1	3188	91.09±12.94	53.71
2	1032	29.48±5.13	17.39
3	770	22.00±3.33	12.97
4	945	27.00±4.14	15.96
5	5935	169.57±25.05	100.00

Application: 1 - the brain, 2 - the cortex, 3 - neurons, 4 - nerves, 5- sum

General quantitative data on the numbers of investigations carried out in different neurophysiological objects with employment of non-ionized radiation are presented in table 1. This table performs what investigations made on the whole brain predominate. The indicated fact is explained by increased interest of specialists of applied sciences to this neurophysiological object for investigation of biological effects of non-ionized radiation. Moreover methodical complexity of investigations on neuronal level serves restrictive circumstance.

Mathematical comparison of the numbers of papers, carried out in the brain, the cortex, neurons, and nerves during 35-years period, is presented in table 2. Positive correlation takes place between the numbers of papers made on different neurophysiological objects. However significant distinctions between analyzed consequences exist, which is shown by means of Wilcoxon paired comparison test and with the aid of the comparison of two selective sampling fractions of variants. Hence, the numbers of papers carried out in indicated objects belong to different statistical totalities.

Table 2.

Comparison of quantitative indices of papers carried out with non-ionized radiation in different neurophysiological objects

Objects	Comparison of totalities		
	Coefficient of correlation	Wilcoxon paired comparison test ( $U$ )	Comparison of sampling fractions ( $U$ )
1 c 2	<u>0.95</u>	<u>5.14</u>	<u>42.70</u>
1 c 3	<u>0.91</u>	<u>5.09</u>	<u>49.40</u>
1 c 4	<u>0.96</u>	<u>5.09</u>	<u>47.77</u>
2 c 3	<u>0.84</u>	<u>2.98</u>	<u>6.69</u>
2 c 4	<u>0.93</u>	0.53	<u>2.07</u>
3 c 4	<u>0.90</u>	<u>2.31</u>	<u>4.63</u>

Application: significant values of coefficients of correlation and statistically significant distinctions between distributions are underlined ( $U > 1.96$  corresponds to  $p < 0.05$ ,  $U > 2.58$  corresponds to  $p < 0.01$ ); 1 - the brain, 2 - the cortex, 3 - neurons, 4 - nerves.

Dynamics of quantitative indices of investigations of action of non-ionized radiation on neurophysiological objects during analyzed 35-year period is demonstrated in fig. 1 and 2.

Fig. 1 shows the essential increase of the numbers of papers, carried out in neurophysiological objects with considered physical factors. The greatest increase is observed in investigations on the brain. The dependence of number of papers on analyzed time period is circumscribed by exponential function.

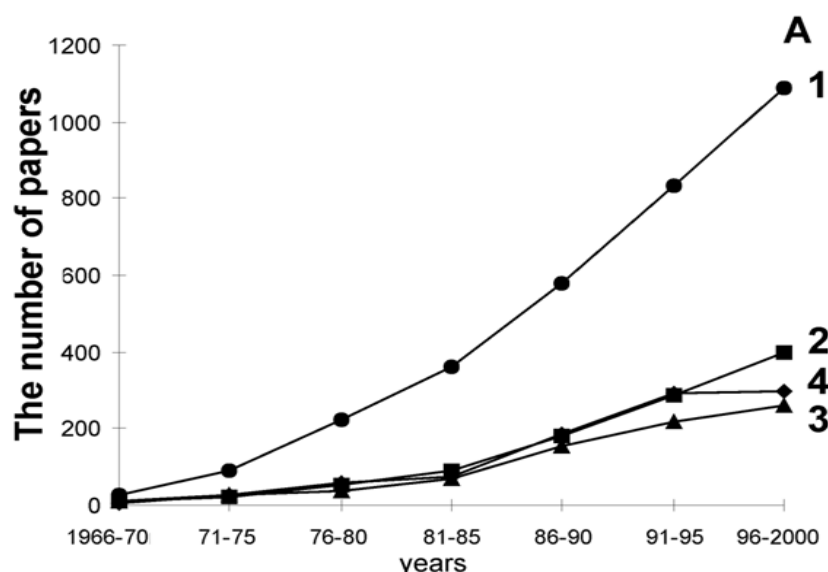


Fig. 1. Dynamics of the numbers of papers carried out on different neurophysiological objects with non-ionized radiation during 35-year time interval. 1 - the brain, 2 - the cortex, 3 - neurons, 4 - nerves.

Fig. 2 demonstrates dynamics of the parts of corresponding papers in the general totality of investigations of biological effects of the physical factors. The increase of the parts of neurophysiological papers in the general totality is observed but to the lesser extent than at the above-mentioned events.

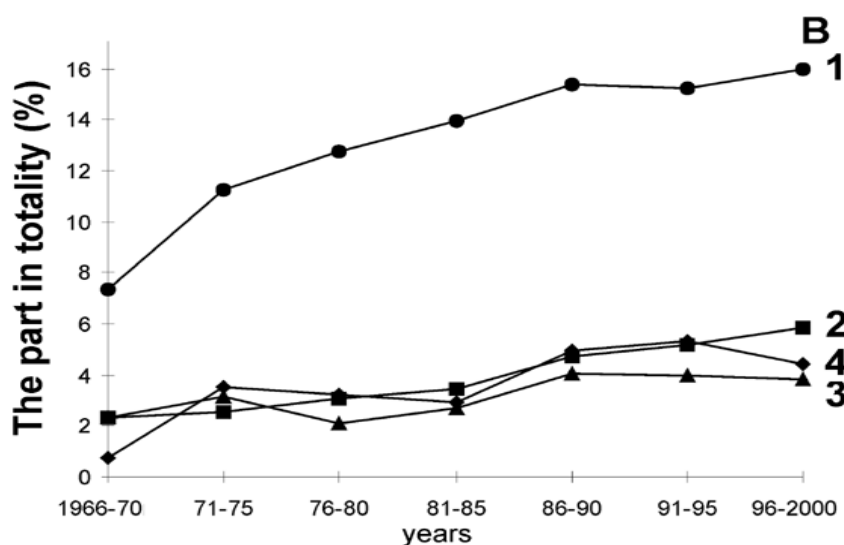


Fig. 2. Dynamics of the parts of papers carried out on different neurophysiological objects in the general totality of investigations with non-ionized radiation during 35-year time interval. 1 - the brain, 2 - neocortex, 3 - neurons, 4 - nerves.

Statistical characteristics of events were reflected in fig. 2 are presented in table 3. Statistically significant increase takes place in all cases excepting investigations on neuronal level.

### Conclusion

Performance of the present bibliometrical investigations made it possible to arrive at the following conclusion.

The number of papers on biological effects of non-ionized radiation is too big. But among them papers carried out in neurophysiological objects is little. The case of this fact is the preva-

lence of study in sphere of applied aspects of the problem - dosimetrical, hygienic, therapeutic [4, 7].

Clear dynamics of quantity of publications about biological influence of physical factors including papers carried out in neurophysiological objects exists. Besides absolute quantity of the latter papers and them parts in the general totality of investigations of biological effects of non-ionized radiation to the lesser extent increase.

On the whole fundamental investigations of activity of the brain are played no enough attention to. However, in the future they will hold a leading position in solution of the problem of biological action of these factors, since they will make it possible to uncover genesis and patterns of reactions of organism. Undoubtedly, the greatest importance will belong to investigations on neuronal level [1-3, 5, 6].

Table 3

Comparison of parts of neurophysiological papers in the general totality of investigations carried out with non-ionized radiation in different time periods

Objects	Comparison of indices for first five years with data for following five-year periods (values $U$ )					
	Second five-year-period	Third five-year-period	Fourth five-year-period	Fifth five-year-period	Sixth five-year-period	Seventh five-year-period
1	<u>2.19</u>	<u>3.24</u>	<u>3.99</u>	<u>4.83</u>	<u>4.79</u>	<u>5.24</u>
2	0.32	0.896	1.24	<u>2.51</u>	<u>2.99</u>	<u>3.51</u>
3	0.91	0.23	0.48	1.87	1.80	1.70
4	<u>3.37</u>	<u>3.32</u>	<u>3.08</u>	<u>5.21</u>	<u>5.55</u>	<u>4.78</u>

Application: statistically significant distinctions between totalities are underlined ( $U > 1.96$  corresponds to  $p < 0.05$ ,  $U > 2.58$  corresponds to  $p < 0.01$ ); 1 - the brain, 2 - the cortex, 3 - neurons, 4 - nerves.

Investigations supported by the Grant of Russian Foundation of Fundamental Investigations No. 00-04-48139.

Представлены библиометрические данные по исследованиям, выполненным на нейрофизиологических объектах (целостный мозг, кора больших полушарий, нейроны, нервы) с применением электромагнитных, магнитных и электрических полей. Рассмотрены количественные характеристики публикаций выбранных направлений за 35-летний интервал времени (1966-2000). Проанализированы числа статей указанных типов. Сделано заключение о перспективах исследований действия неионизирующей радиации на нейрофизиологических объектах.

1. Chizhenkova R.A. Slow potentials and spike unit activity of the cerebral cortex of rabbits exposed to microwaves. Bioelectromagnetobiology. 1988, v. 9, No. 3, pp. 337-345.
2. Chizhenkova R.A. Impulse fluxes of neuronal populations of the cerebral hemispheres on exposure to weak ultrahigh frequency electromagnetic radiation. Biophysics, 2003, v. 48, No. 3, pp. 509-515.
3. Chizhenkova R.A. Pulse flows of populations of cortical neurons under microwave exposure of different intensity. Bioelectrochemistry, 2004, v. 63, No. 1-2, pp. 343-346.
4. Chizhenkova R.A. Bibliometrical review of neurophysiological investigation of action of non-ionized radiation in second half of the XXth century. Biophysics, 2005, v. 50, supplement No. 1, pp. 163-172.

5. Chizhenkova R.A., Safroshkina A.A. Effect of low-intensity microwaves on the behavior of cortical neurons. *Bioelectrochemistry and Bioenergetics*, 1993, v. 30, No. 1, pp. 287-391.
6. Chizhenkova R.A., Safroshkina A.A. Electrical reactions of the brain to microwave irradiation. *Electro- and Magnetobiology*, 1996, v. 15, No. 3, pp. 253-258.
7. Chizhenkova R.A., Safroshkina A.A., Slashcheva N.A., Chernukhin V.Yu. Bibliometrical analysis of neurophysiological aspects of action of non-ionized radiation. *Uspekhi sovremennoy biologii*, 2004, v. 124, No. 5, pp. 472-479.
8. Kholodov Yu.A. Influence of electromagnetic fields on central nervous system. Moscow: Nauka, 1966. 283 p.
9. Kholodov Yu.A. Reactions of nervous system on electromagnetic fields. Moscow: Nauka, 1975. 207 p.

УДК 681.63, 519.872

## ИМИТАЦИОННАЯ МОДЕЛЬ ВЗАИМОДЕЙСТВИЯ GRID-УЗЛОВ С ОЧЕРЕДЬЮ ДОСТУПА К ОБЩЕЙ ПАМЯТИ<sup>1</sup>

Шелестов А.Ю

### **Введение**

В настоящее время усложнение инфраструктуры распределенных информационных систем привело к необходимости развития подходов к их моделированию. Системный подход к решению этой задачи предложен в [1], а более детально его применение описано в [2]. Одной из наиболее перспективных технологий построения распределенных систем является Grid-технология, которая обеспечивает решение вычислительно сложных задач с использованием распределенных хранилищ данных и вычислительных ресурсов [3]. Для моделирования подобных систем могут использоваться различные подходы, каждый из которых не позволяет провести комплексное исследование. Достаточно полный обзор существующих моделей содержится в [4, 5].

В данной работе для моделирования динамики Grid-систем предлагается использовать сети Петри [6], поскольку такие системы представляют собой набор взаимодействующих друг с другом компонентов (узлов различного типа), которые могут функционировать параллельно и работа которых должна быть синхронизована. Именно при исследовании Grid-систем наблюдения Земли все эти вопросы являются очень актуальными.

### **Постановка задачи**

Основным элементом структурной модели Grid-системы наблюдения Земли [2] является вычислительный узел, выполняющий вычислительные задачи или задачи доступа к данным хранилища (информационный узел) по запросу пользователя или в режиме операционного сервиса. Поскольку узел может содержать несколько различных физических вычислительных устройств (процессоров или многопроцессорных компьютеров), которые используют общую память, то работа отдельных устройств координируется управляющими узлами. Поэтому вычислительные, информационные и управляющие узлы (планировщики) следует рассматривать как базовые элементы распределенной системы доступа и обработки данных. Задача состоит в построении Grid-системы, обеспечивающей прозрач-

---

<sup>1</sup> Работа выполнена в рамках темы НАНУ «Интеллект», а также при поддержке гранта INTAS-CNES-NSAU “Data Fusion Grid Infrastructure” (Ref. Nr 06-1000024-9154).