COMPUTER VISUALIZATION OF LOW FREQUENCY MAGNETIC SIGNALS IN SYSTEMS FOR MAGNETOTHERAPY WITH VARIABLE PARAMETERS

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Abstract

The systems for magneto-therapy often are with variable parameters. In this case both temporal parameters and space parameters of low frequency magnetic signals are variable. Therefore the space-temporal configuration of these magnetic signals is very complicated. In the same time the system for magneto- therapy can to provide many different programs for therapy of different diseases taking in account the specific status of every patient. One important requirement in the process of application of these systems is optimization of space-temporal parameters of magnetic signals for every procedure for therapy. Therefore the visualization of space configuration of magnetic signals is would be very useful for physicians.

One investigation on visualization of space configuration of the field of magnetic induction of one flexible system for magneto-therapy with variable parameters is described in the present paper.

The result of computer visualization of space configuration of the field of magnetic induction of one flexible system for magneto-therapy with variable parameters is done in the paper.

1. CONFIGURATION OF SYSTEM FOR MAGNETO-THERAPY AND TASK DESCRIPTION

A new flexible multifunctional system for magneto-therapy with variable space-temporal parameters of the field of magnetic induction in the patient's area has been designed (Fig. 1). The basic unites of this system are bed, mobile carriage, microprocessor unit and unit for providing of movement of the carriage. The coils for excitement of low frequency magnetic field are situated on the bed and on the mobile carriage. During the therapy, the human body is on coils of the bed and under the coils of the carriage. The changes of space-temporal parameters of low frequency magnetic signals in the patient's area can be provided by microprocessor's unit using special software. These changes can be provided not only by movement of carriage , but by switching of different coils of both bed and carriage, also. A cross-section of carriage of the flexible multifunctional system for magneto-therapy with variable space-temporal parameters can be seen on Fig. 2.

The scheme of the cross-section contains 6 equal coils:A1, A2, B1, B2, C1 and C2. The centers OA1 and OA2 of the coils A1 and A2 are on the small base of trapezium. The distance between their axes is 232mm. The centers OC1 and OC2 of coils C1 and C2 are on the big base of trapezium. The coils A1 and C1 ands and coils A2 and C2 have common axis. On the plane the sizes of trapezium are shown. The centers of the coils B1 and B2 are situated on the middles of the trapezium edges. The axes of coils B1 and B2 are perpendicular to the edges of the trapezium. The angles between axes of coils B1, B2 and the big base of the trapezium is α. This angle can be easy calculated using the sizes of trapezium. The trapezium is in the plane XOY. The origin O of 3D coordinate system is the bottom left angle of trapezium. The plane of the coil in two projections and the sizes of coil can be seen at the upper right angle of the plan.

3D coordinates (in mm) of centers of all the coils in the coordinate system X,Y,Z are:

OA1 (184, 500,0); OA2(416,500,0); OB1(50,250, 0); OB2(550, 250,0);

OC1(184,0,0); OC2(416,0,0).

The task of present investigation is to be calculated and visualized magnetic fields created by the following pairs of coils:

1. A1 and C1.
2. A1 and C2.
3. B1 and C1.
4. A1 and B1.
5. B1 and B2.

Fig.1 multifunctional system for magneto-therapy with variable space-temporal parameters

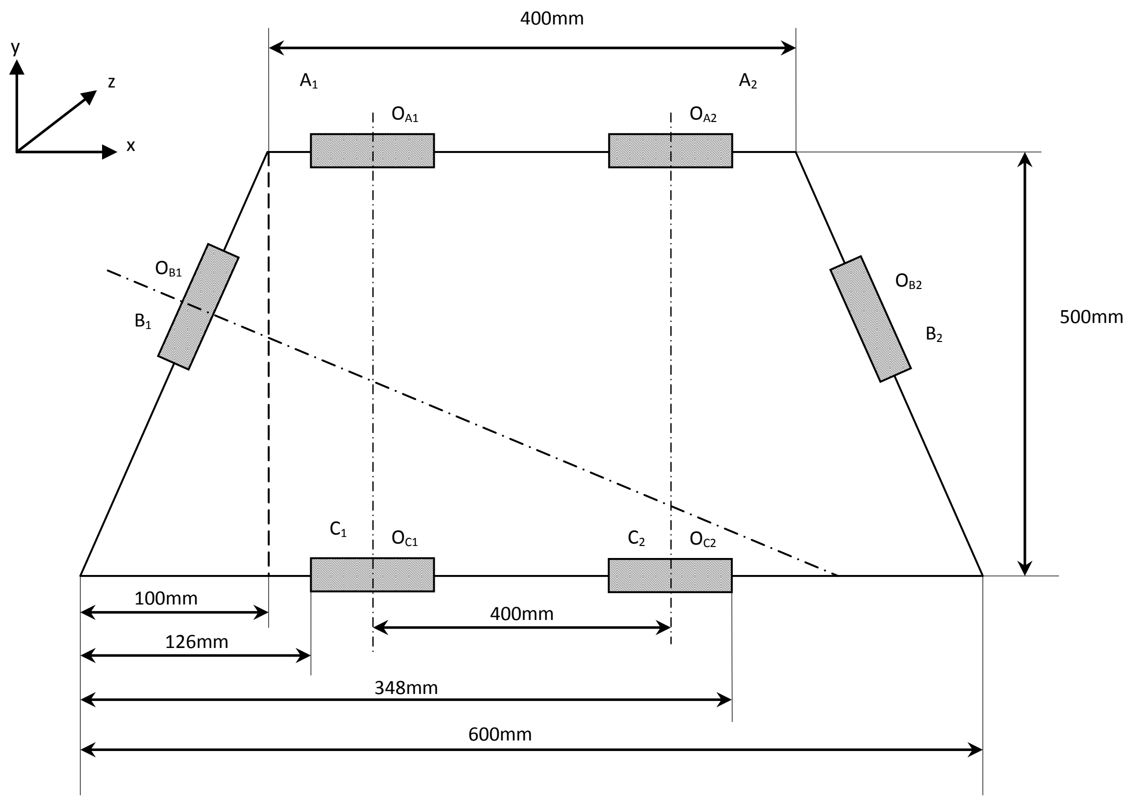

Fig. 2. A cross-section of carriage of the flexible multifunctional system for magneto-therapy

2. VISUALIZATIONS OF SPACE CONFIGURATION OF LOW FREQUENCY MAGNETIC FIELD IN THE PLANE OF CROSS-SECTION OF CARRIAGE

Usually there is an influence of low frequency magnetic field only on the part of human body during the process of therapy. Because of that often there is a movement of the mobile carriage on the bed's axis. There is an additional movement of magnetic field in the plane of cross-section of carriage of the flexible multifunctional system for magneto-therapy (Fig. 2), also. This movement of magnetic field can be provided by microprocessor's unit. In fact this is one movement (rotation) of pair of coils in the plane of cross-section of carriage around the part of human body. The basic steps of this movement of pair of coils can be provided by switching of above mentioned combinations for pairs of coils namely:

1. A1 and C1.
2. A1 and C2.
3. B1 and C1.
4. A1 and B1.
5. B1 and B2

Therefore the visualizations of space configuration of low frequency magnetic field in the plane of cross-section of carriage can be presented as separate visualizations of space configuration of low frequency magnetic field in the plane of cross-section of carriage for the above mentioned pairs of coils. These separate visualization can be obtained using appropriate mathematical methods [1] and appropriate algorithms [2]. These methods and algorithms have been used for respective combinations for pairs of coils. A computer visualization of space configuration of low frequency magnetic field of every one of above mentioned separate pair of coils A1 and C1, A1 and C2, B1 and C1, A1 and B1, B1 and B2 can be seen on the Figure 3, Figure 4,Figure5, Fugure 6 and Figure 7.

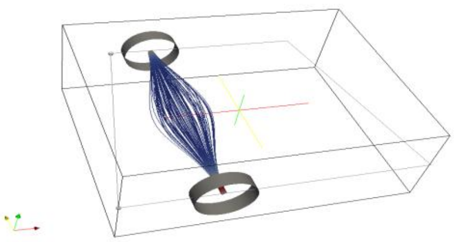

Figure 3. Space configuration of low frequency magnetic field of pair A1 and C1 in the plane of cross-section of carriage

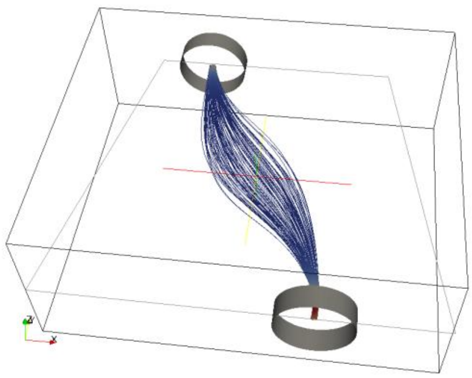

Figure 4. Space configuration of low frequency magnetic field of pair A1 and C2 in the plane of cross-section of carriage

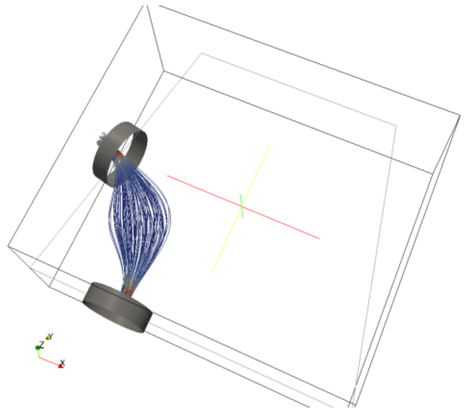

Figure 5. Space configuration of low frequency magnetic field of pair B1 and C1 in the plane of cross-section of carriage

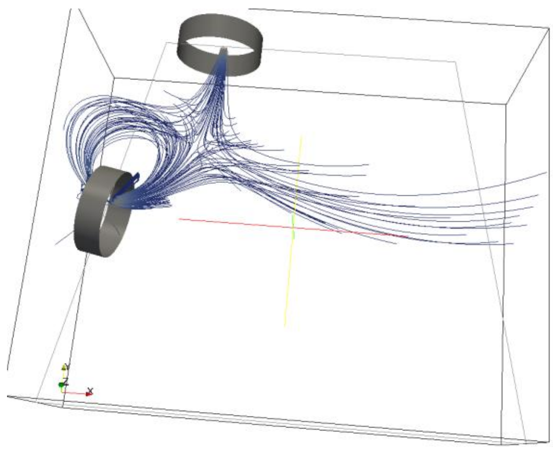

Figure 6. Space configuration of low frequency magnetic field of pair B1 and A1 in the plane of cross-section of carriage

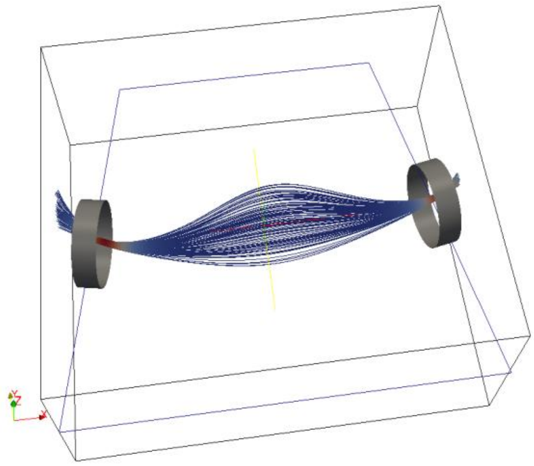

Figure 7. Space configuration of low frequency magnetic field of pair B1 and B2 in the plane of cross-section of carriage

7. CONCLUSION

One periodical change or rotation of direction of the vectors of magnetic induction in cross-section of carriage can be obtained step by step in time using switching of coils. These changes of space configuration of magnetic field can be done by appropriate software for of microprocessor's unit. Usually [3],[4] the vectors of magnetic induction and vector of blood's velocity should be orthogonal. It's clear that it would be obtained for different part of human body in cross-section of carriage by above mentioned switching of pairs of coils. This is the reason for obtaining of fast effect of therapy.

5. ACKNOWLEDGMENTS

The work was partially supported by the grant RFBR 13-01-00782

References

[1] N. B. Ampilova, D. Dimitrov, B. Kudrin, "Mathematical investigation on calculation of magnetic induction of low frequency magnetic field in systems for magnetotherapy" 6th International Confefrence "Communications, Electromagnetics and MedicalApplication" (CEMA'13), Sofia, 2013, October 17-19.

[2] B. Kudrin, A.Dimitrov, "Algorithm for visualization of low-frequency magnetic signals in systems for magnetotherapy", 6th International Confefrence "Communications, Electromagnetics and MedicalApplication" (CEMA'13), Sofia, 2013, October 17-19.

[3] Bekiarski Al., Sn. Pleshkova, Microphone Array Beamforming for Mobile Robot, The 8th WSEAS International Conference on CIRCUITS, SYSTEMS, ELECTRONICS, CONTROL &SIGNALPROCESSING, (CSECS'09), Puerto De La Cruz, Spain, 2009, pp.146-150

[4] Alexander Bekiarski, Snejana Pleshkova, Svetlin Antonov, "Real Time Processing and Database of Medical Thermal Images", 4rdINTERNATIONAL CONFERENCE on Communications, Electromagnetics and Medical Application (CEMA'11), Sofia,2011, pp.101-106