Coil system proposal for homogeneous LF-EMF application

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Abstract **The presented article deals with numerical simulations to design new exposure coil system employable in various biomedical experiments. The main criteria during the design of the exposure coil concerned the electromagnetic field homogeneity within the exposed volume to assure precise interpretation of observed effects.**

Keywords **Numerical simulation, electromagnetic field, magnetic flux density.**

I. INTRODUCTION

In the scientific community, there is a strong need to response the question regarding low frequency electromagnetic field (LF EMF) influence to living organisms, what documents articles, such as [1,2]. The proper investigation of this phenomenon is available only in adequate ambient conditions and under correct irradiation. For the purpose of improvement of the irradiation system described in [3] it has been decided to create new system and achieve at maximum 5% of inhomogeneity of the applied LF EMF.

II. SYSTEM PROPOSAL

The new system proposal is based on numerical modeling and simulation. The model is designed as three air coils. The role of the upper and lower side coil is to generate the electro-magnetic field (EMF) of desired strength (mean value of magnetic flux density is 2.4 mT) and to complement the centre coil, which is designed to further enhance the homogeneity of the generated EMF (max. 5% variation within the exposed volume).

Number of turns for each of the side coils has been determined experimentally to be 105, wound in 14 layers. The stabilization centre coil has been designed with 56 turns, wound in 4 layers. The results of numerical simulations, presented in *Fig.1* show, that the desired homogeneity in the exposure area has been achieved. The system has been driven by 1A excitation current of a sinusoidal shape. Minimum value of magnetic flux density in exposure area was 2.36 mT and maximum 2.47 mT.

As it is demonstrated on *Fig. 1*, the proposed coil system is of uncommon shape, so the atypical support system for its creation has to be designed.

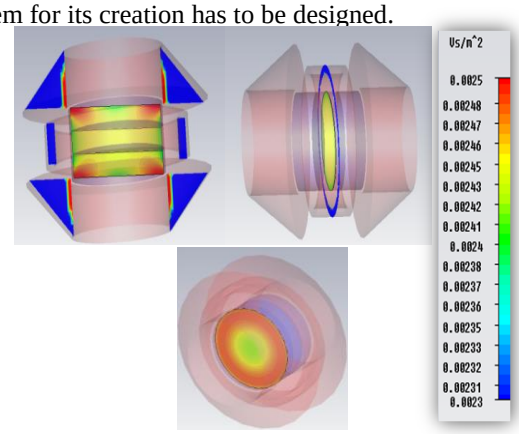

Fig.1 Proposed model of exposure coil system–simulation results of **B** field. Color range from 2.3 to 2.5 mT

This task was solved in cooperation with the Faculty of mechanical engineering, University of Zilina. Model of the coil strut has been designed in the Autodesk Inventor software, sent to a 3D printer and printed.

The final creation of the proposed coil system has been made manually using about 100 m of enamelled copper winding wire with the diameter of 1.8 mm. The three coils have been created separately and connected together in series as shown in *Fig. 2.*

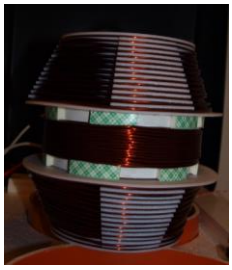

Fig. 2 The finalized exposure coil system

Inductance of the whole coil system is L = 5.346 mH, measured by an LC-meter. The B-field produced by the coil system was achieved within the range of 2.37 to 2.49 mT.

III. CONCLUSION

The magnetic flux density measurement confirmed that the constructed coil system is adequate to the simulation proposal. Due to the similar **B** with the coil used in [3] (2.0-2.3mT), future results from irradiation by proposed system could be compared with the results from previous experiments made by authors.

IV. ACKNOWLEDGEMENTS

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V. REFERENCES

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