New Coil Designs for Deep Brain Transcranial Magnetic Stimulation using Halo Coil Configurations

Rachana Kaul, Bridget N. Hogan, Ravi L. Hadimani, Lawrence J. Crowther, and David C. Jiles, *Fellow*, *IEEE*

TRANSCRANIAL magnetic stimulation (TMS) is a non-invasive therapeutic technique for stimulating the brain. This technique is widely investigated for the treatment of various neurological disorders such as Parkinson's disease, traumatic brain injury and posttraumatic stress disorder by many groups. In this work we have investigated methods to increase the depth of penetration of magnetic field for a given field intensity at the surface of the head. The standard circular coil combined with the standard Halo coil is one of the solutions to the problem of non-invasive deep brain stimulation [1]. We have taken this forward and combined the standard Halo coil with existing coil designs such as the Hesed coil [2] and the standard figure of eight coil, to decrease the rate of decay of magnetic field as we go deeper into the brain from the cortical region. The magnetic and electric fields were calculated using a low frequency solver based on a quasi-static model with the simulation package SEMCAD X with a sinusoidal magnetic flux density of 2.5 kHz and a current of 5 kA in the coil [3].

Figure 1(d) shows that the Halo coil combined with the Hesed coil gives the best depth of penetration with lesser cortical stimulation for a given current pulse into the coil. The figure of eight coil gives highest cortical stimulation for a given current pulse into the coil but the field strength decay is the highest. Circular coil with the Halo coil gives intermediate cortical stimulation and intermediate field strength decay.

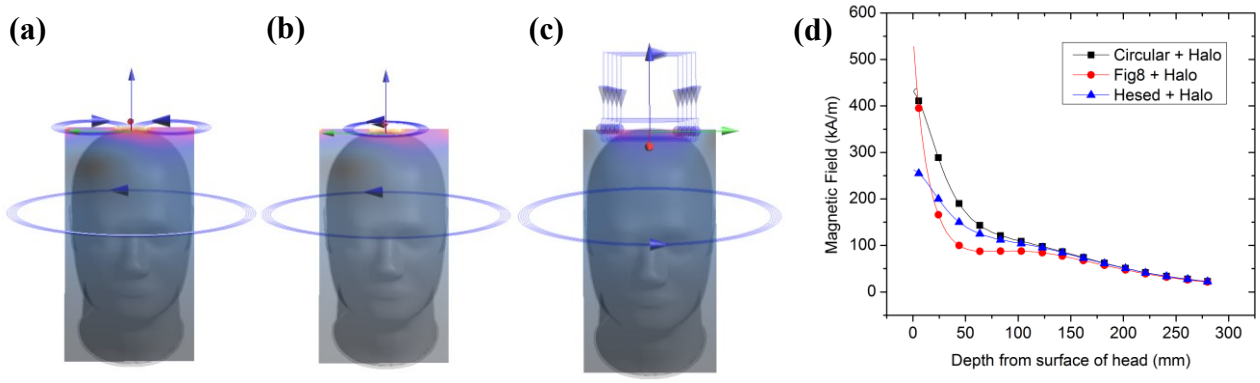

Figure 1. Different Halo coil combinations studied; (a) figure of eight coil with Halo coil (b) circular coil with Halo coil (c) Hesed coil with Halo coil and (d) comparison of magnetic field strength decay of different Halo coil configurations.

REFERENCES

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R. Kaul is with the Dept. of Electrical and Computer Engineering, Iowa State University, Ames, IA 50011 USA (e-mail: rkaul@iastate.edu).

R. L. Hadimani is with the Dept. of Electrical and Computer Engineering, Iowa State University, Ames, IA 50011 USA (e-mail: hadimani@iastate.edu).

L. J. Crowther is with the Dept. of Electrical and Computer Engineering, Iowa State University, Ames, IA 50011 USA (e-mail: crowther@iastate.edu).

D. C. Jiles is with the Dept. of Electrical and Computer Engineering, Iowa State University, Ames, IA 50011 USA (e-mail: dcjiles@iastate.edu).