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The experimental research on Magnetic Resonance Sounding underground water exploration using 2m antenna

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SUMMARY

The effective MRS signal with meter scale antenna is the key point of the application in narrow detection space, such as, underground engineering. At present, there is no public literature suggests that effective MRS signal can be received with 2m antenna. Based on the optimal parameters with 2m antenna, started with theoretical calculation, I developed the exploration antenna experimental research with different characteristic parameters. Finally, I received the effective MRS signal which SNR is above 4.5 in experimental field, which is contribute to established the foundation of expand the MRS method application scope.

Key words: MRS antenna; 2m scale antenna; characteristics parameters; underground engineering; SNR;

INTRODUCTION

The technology of MRS signal with meter-scale is the key technical of the MRS technology using in underground engineering, such as mineral and tunnel. At present, there is no public literature shows that effective signal can be received in geomagnetic field with 2m antenna. Jesús Díaz-Curiel, Spain, had elaborate measurement in shallow layer with using multi-turns octagon coils which side length is 6m or 10m(Jesús Díaz-Curiel, 2011). J.M.Greben had advanced detection of underground water contained with square coils which side length is 2m, but didn't received the MRS signal either, which is caused by the limited conditions(J.M.GREBEN, 2011).

The signal effect in MRS detection is depended on the characteristics parameter of detection antenna(Hertrich, 2005). Therefore, I focused on experimental study with 2m antenna which is based on the designation of meter scale antenna with theoretical calculation. I have done the practical experiment by changing the antenna's characteristics parameters. I analyzed the experimental results, determined to use 91turns receiving antenna which materials is annealing pure copper with 2mm diameter, fortunately, the MRS signal SNR is above 4.5. Meantime, I analyzed space electromagnetic noise intensity effect to 2m scale antenna, which contributes to confirmed when the space noise intensity is above 200nv, the time domain signal cannot be detected in the field.

METHOD AND RESULTS

I argued the theoretical design about 2m antenna in this paper, which is adopt the method of calculation and simulation:
1. The kernel function and simulation of 2m antenna with different turns.
2. The transfer coefficient calculation of receiving antenna system.
3. The practical effect discussion about the kernel function calculation results combined with antenna system.

After the procession below, I put forward the optimal design parameters about the meter scale antenna. Also, before the experiment, I improved the instrument system which is specific to unique parameters about 2m antenna. Mainly conclude:
1. Discussing the precision of the matched capacitance which will influence the antenna's performance and the signal's amplitude, I argued the improved project of capacitor which precision reached to 0.1nF.
2. I discussed the matched capacitor's influenced to the antenna system transfer coefficient, argued the optimal parameters of matched capacitor, through the test, the transfer coefficient reached to 31.5 when matched the optimal capacitor.

About the actual measurement, I experiment in the outfield using the designed antenna and the improved system. The experiment mainly conclude:
1. Using optimal parameters of antenna which is designed by theoretical in the actual measurement, I statistics the error between measurement and theoretical, and analyzed the reason lead to the error.
2. I take the theoretical designed optimal parameters as the central, increased and decreased the received antenna turns separately, and observed the changed of the detection signal's amplitude, and testified the optimal parameters.
3. I changed the impedance parameters of the received antenna, testified the optimal diameter and materials of 2m receiving antenna
4. After measured in different environment, I testified the tolerance range of noise in the actual measurement, confirmed the noise strength which can burdened is 200nV, when the electromagnetic noise above the value, the time domain MRS signal cannot be detected in the field.

Figures and Tables

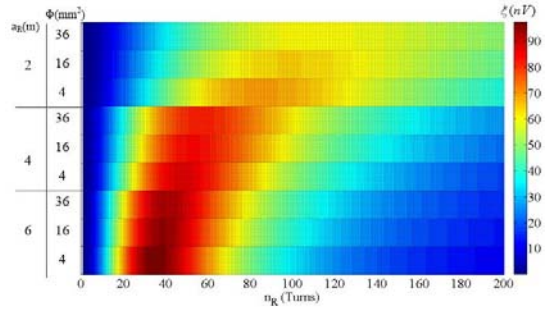


Figure 1. The MRS signal simulation of meter scale antenna with different winding way

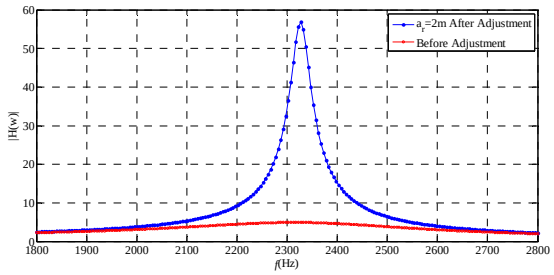
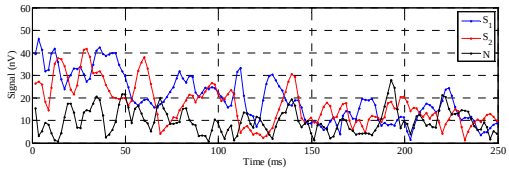
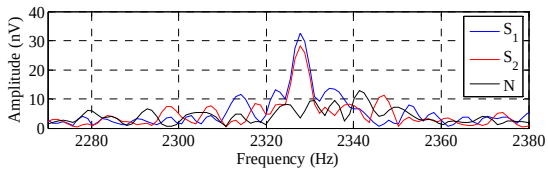


Figure 2. The calculation of 2m antenna's transfer coefficient



a.time domain curves



b.spectrum analysis

Figure 3. The measured waveform and spectrum analysis with 2m antenna.

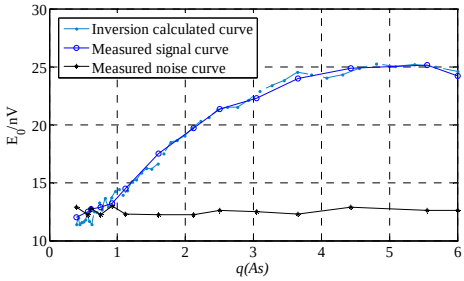


Figure 4. E0-q curves of 2m antenna in experimental.

CONCLUSIONS

I focused on the research of the MRS detection method with small scale antenna, and argued the optimal parameters and the designation method. Based on the parameters characteristics of 2m antenna I improved the instrument system. Yet I explored the underground water content structure, confirmed the optimal property of detection antenna, which is based on the optimal parameters and changed the characteristics parameters of antenna system. Finally, I obtained the MRS signal which SNR reached to 4.5 in the experimental field, which provide the theoretical support and technical surrance in underground engineering such as tunnel and mineral.

REFERENCES

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