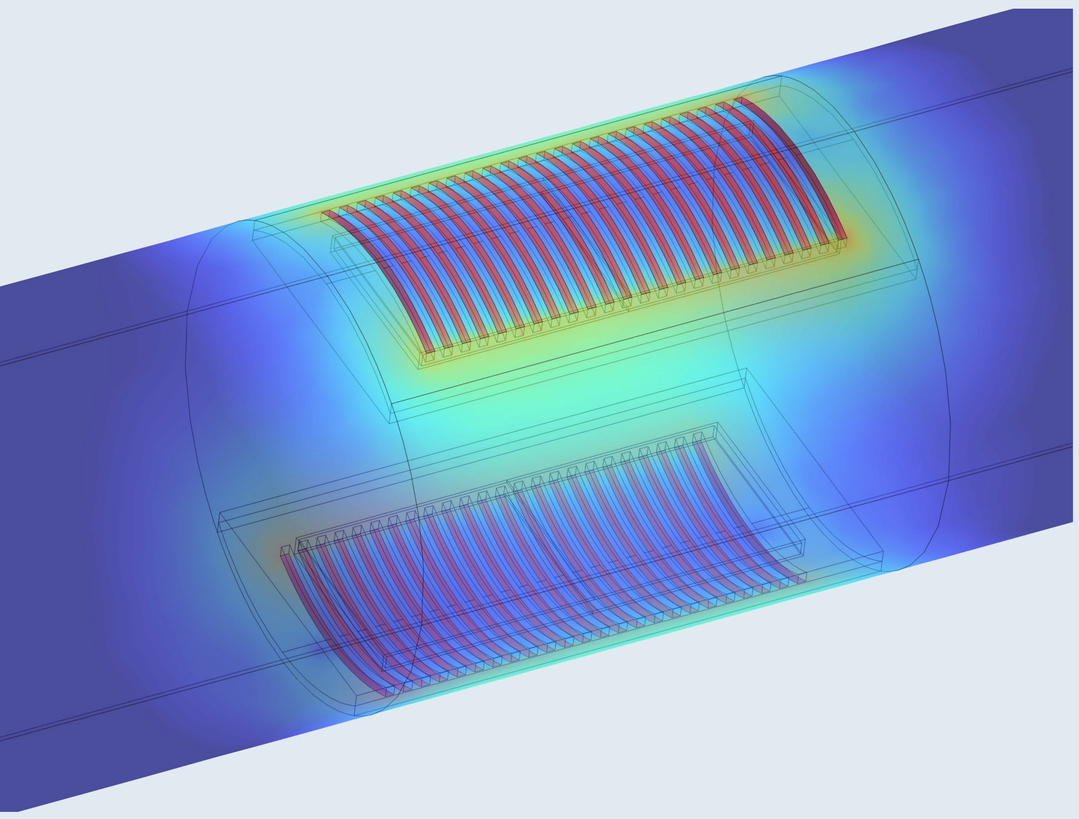

Analysis of A Metallic Shield Effects on LWD Signals Amplitude in 3D

The design of the antenna of the LWD look-ahead instrument must consider the signal strength. The metallic shield affects the transmitting efficiency. This study gives the thickness and number of grooves of a suitable metallic shield.

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Introduction & Goals

In the design and optimization of resistivity while drilling (LWD) forward-looking instruments, this study focuses on incorporating the effects of the antenna cover into the simulation calculations. These instruments are extensively used in oil and gas drilling operations for measuring formation resistivity and detecting formation boundaries ahead of the drill bit. Accurate information on formation structure and fluid distribution is crucial for optimizing drilling paths and enhancing extraction efficiency. This research aims to determine the optimal dimensions and configurations of the antenna cover, including groove width, number, and thickness, to improve the performance and reliability of the look-ahead resistivity measurements. By addressing these factors, the study seeks to contribute to more effective drilling strategies and better resource management.

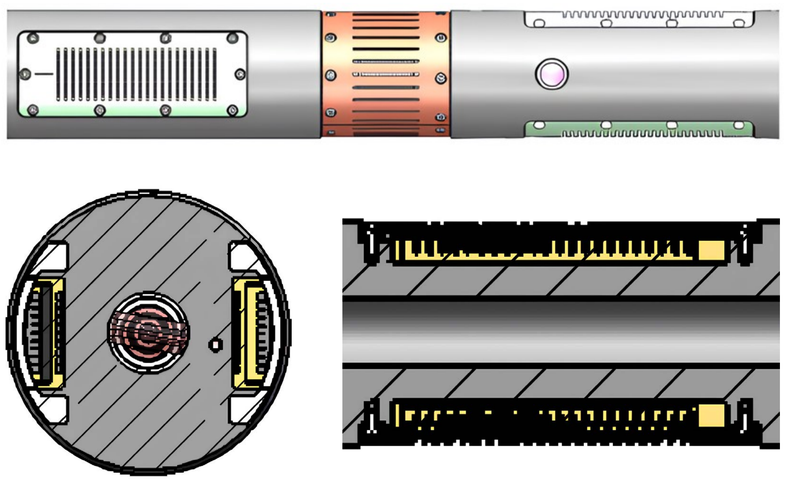

FIGURE 1. The overall structure and cross-section of the instrument antenna.

Methodology

The structure of the instrument is shown in Fig. 1, and the transceiver antennas are connected to each other by a non-magnetic drill collar. Each antenna is protected by a metallic shield. The antenna cover is made of the same material as the drill collar and has grooves of a certain width. The metallic shield is made of the same material as the drill collar, which is equivalent to an ideal electrical conductor and will inevitably lead to a reduction in the efficiency of the transmitted signal.

In the following, under the same transmitting conditions, the effect of different number of slots and size of slots on the signal amplitude of the metallic shield is calculated.

Results

With the increase of the number of slots, the reception efficiency is slightly enhanced, for the transmission frequency of 2kHz, before and after the increase of the number of slots, the reception efficiency increases from 75% to 83%, and from 18% to 28% for 96kHz. Considering the size of the metallic shield should not exceed 25cm, and the surrounding need to leave the location of the screw holes, the number of grooves between 24-28 is more appropriate, the width of the grooves is 3.2mm.

Overall the horizontal antenna seems to have a stronger signal and the individual parameters respond to a simpler pattern, making it easier to adjust in terms of circuitry and mechanics.

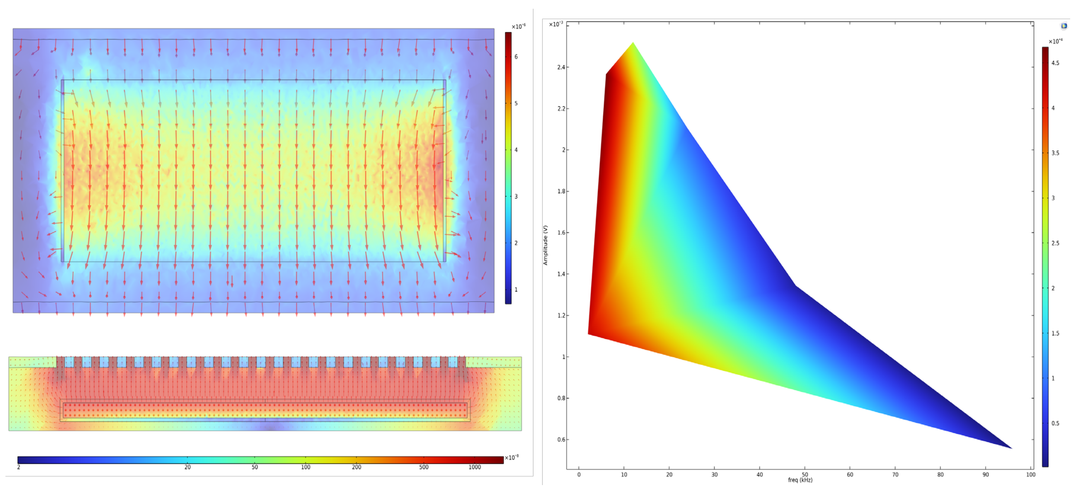

FIGURE 2. Electromagnetic field distribution and signal strength of frequency-TR combinations for a given structure.

Reference

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