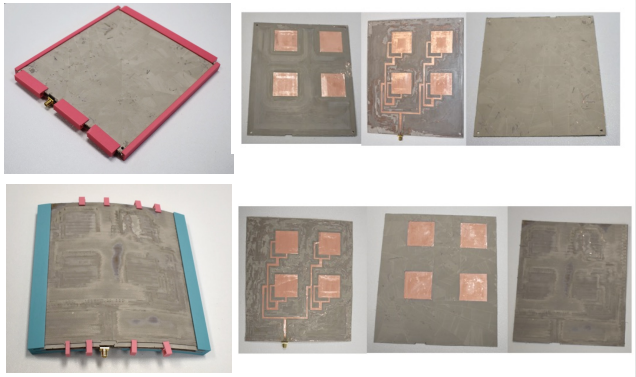
Development of a Conformal Antenna Array for Data Transmission from a Cutting Drum to the Mining Equipment in Harsh Working Conditions.

Silje Ostrem, Atef Elsherbeni, Jamal Rostami
siljeostrem@mines.edu, aelsherb@mines.edu, rostami@mines.edu
Electrical Engineering Department
Colorado School of Mines, Golden, CO 80401, USA

Introduction

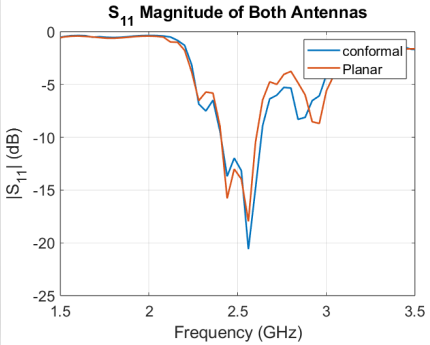
- Continuous miner machines rely on a spinning barrel covered in teeth for drilling into rock
- Monitoring the wear and tear of these bits is extremely important
- Current methods involve the operator leaving the cab and inspecting each bit
- This is time consuming and potentially dangerous for the operator
- Wired communications in this environment is nearly impossible due to the rotary nature of the drum
- We are developing a wireless communication system at 2.4 GHz to transmit this data back to the cab
    - Specifically, a small-footprint conformal antenna array

Array Configurations



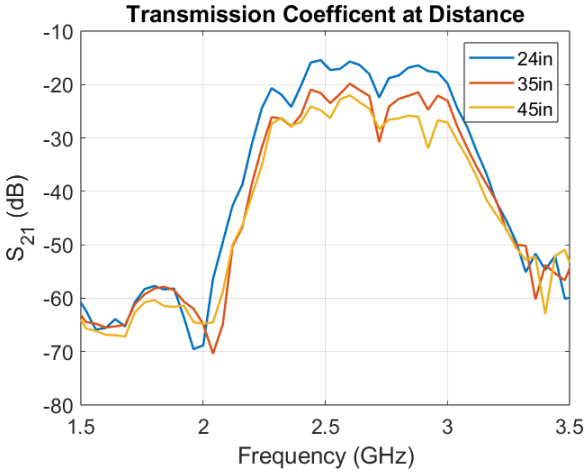
Scattering Parameters

- Resonance throughout band

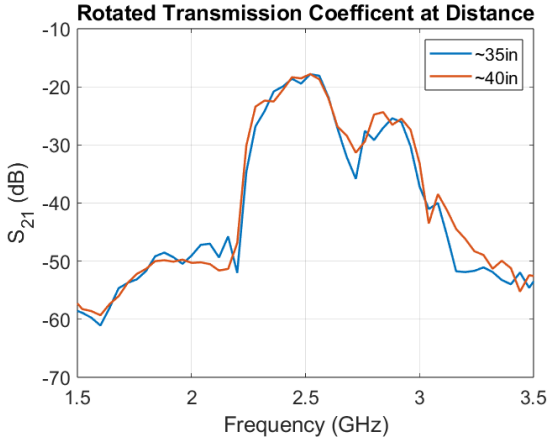


Results

- When both antennas are measured there is good transmission across the entire operating band
- Both antennas are working as expected despite significant manufacturing challenges



- The antennas were rotated to validate circular polarization
- Performance is maintained across the operating band,
- Communication will work at any setup



Conclusion and Future Work

- This antenna is showing promising measurement results
- Next steps involve thorough testing of the antennas
    - Testing on the mining drum in the EMI
- Designing a more robust housing for both antennas
- Developing a system for powering the antennas

References

[1] Y. Fan, L. Li, R. K. Arya, X. Ma, S. Kong, and J. Dong, "Outdoor Wi-Fi Dual-band Dual-polarized Base Station Antenna Design," Applied Computational Electromagnetics Society Journal (ACES), pp. 1042–1050, Dec. 2024, doi: 10.13052/2024.ACES.J.391202.

[2] K. Y. Hora, T. J. Wolf, C. Kringlen, A. Z. Elsherbeni, and J. Rostami, "Sensor Data Relay System for Underground Mine Communications," in 2024 International Applied Computational Electromagnetics Society Symposium (ACES), May 2024, pp. 1–2. Accessed: Mar. 24, 2025. [Online]. Available: https://ieeexplore.ieee.org/document/10580724

R1.3