



Beamforming Design & Optimization for a MIMO System for Planes and Drones

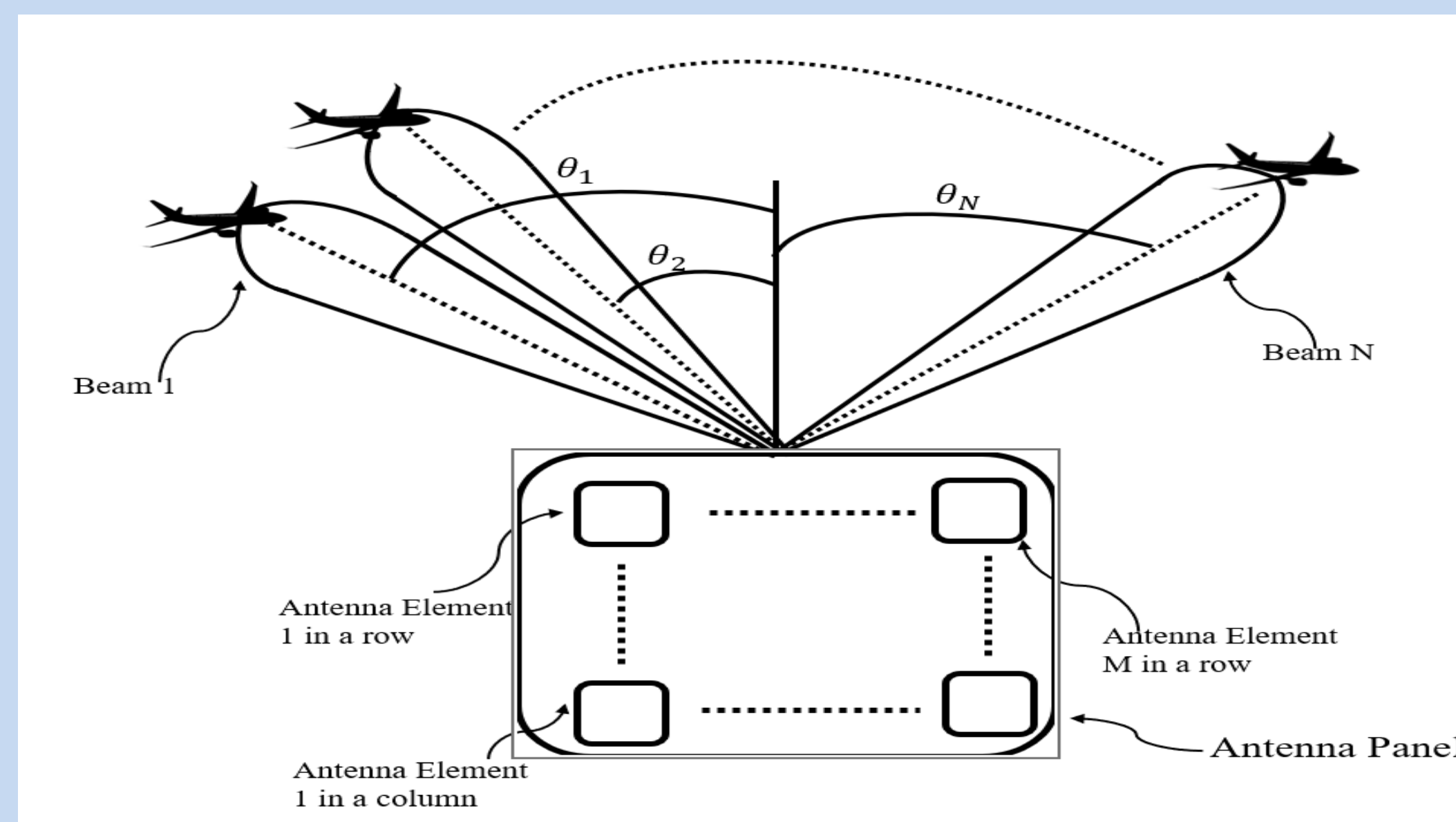
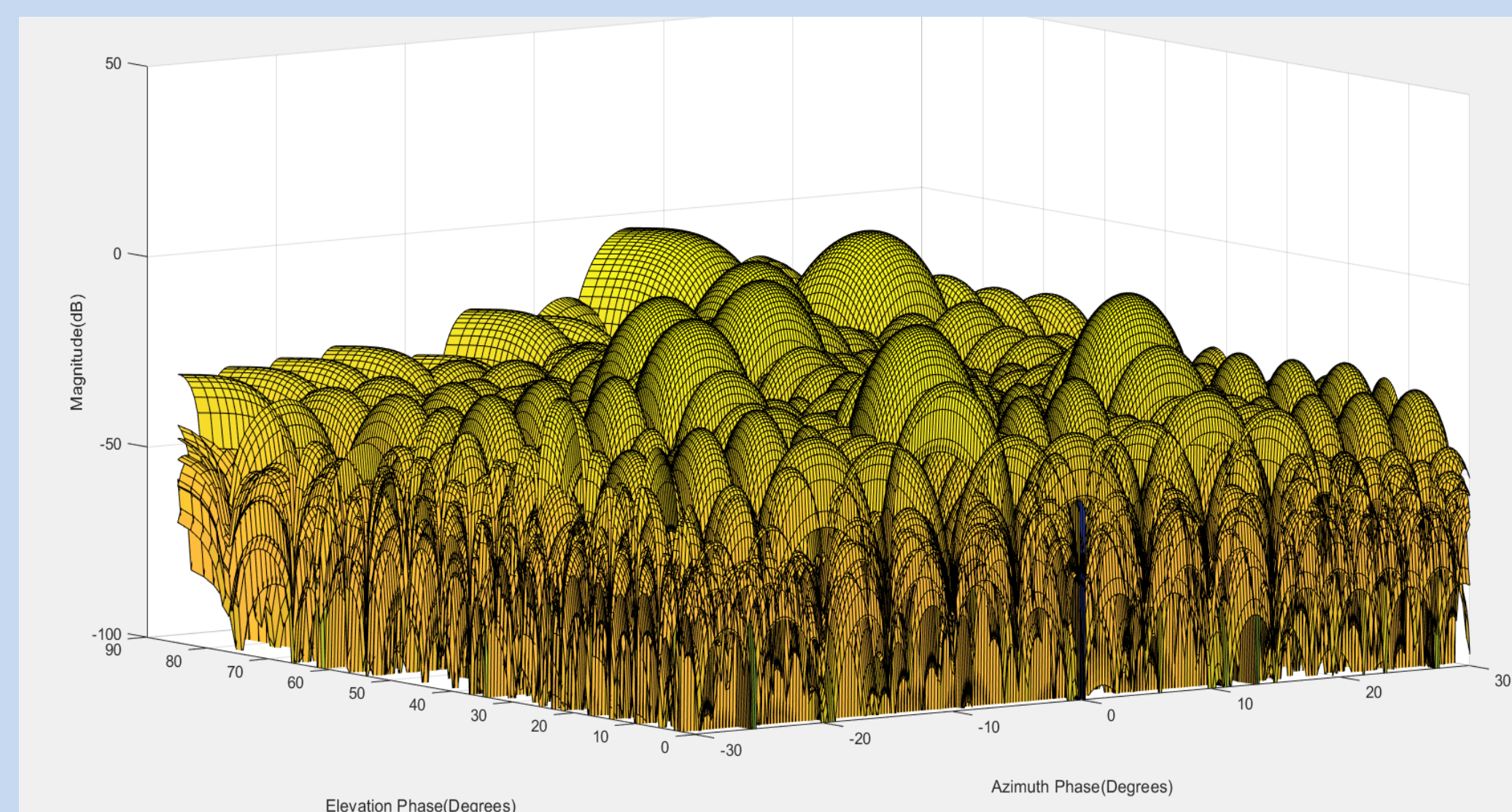
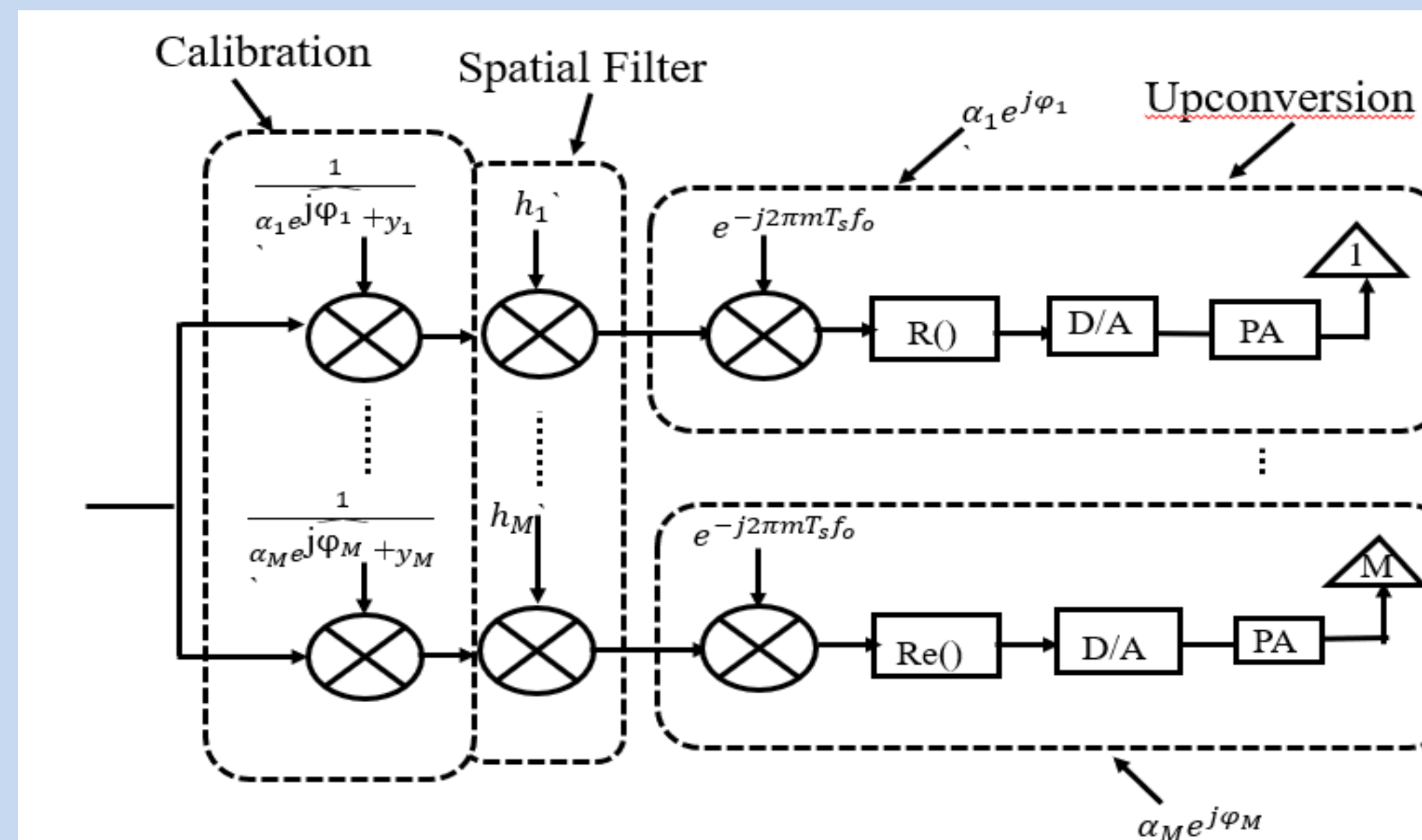
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Background

- Currently, the cheapest method of ground-based broadband for airplanes is only able to provide a few Mb/s and is limited to when the airplane is over land.
- Ground to Air communication system is best for sending WiFi to commercial planes and drones.

Approach

- Use Beamforming to send 8 beams of WiFi under the same carrier frequency to 8 planes in a 60° sector in azimuth.
- Form 8 beams that null interference from other beams by least squares filtering.
- Performance is judged by the SINR a observes & the throughput found by Shannon-bound Criterion.
- Use calibration to adjust for error in phase and gain of the beams due to errors in hardware through estimation.
- Over the air real-time calibration scheme to account for degradation over time.
- Use MATLAB & Simulink to test, implement, and create simulation tool.



Progress & Future Work

- Finish over the air real time calibration.
- Connect components using SIMULINK to make one fluid simulation tool for system that calibrates, then transmits using our beamforming algorithm and can calibrate in real-time. Implemented Calibration scheme using estimation.
- Putting elevation components of beams.
- Begin analysis and implementation of over the air real-time calibration.

Figures

- Figure 1: Upconversion adds error in phase & gain. Also adds noise. Calibration estimates and corrects this. Spatial Filter takes care of beamforming coefficients.
- Figure 2: Beams in Elevation & Azimuth
- Figure 3: Simulated 32x32 element phased-array antenna used to form n beams to n planes in given sector

References

- [1] K. GHARAIBEH, "Communication System Models and Simulation in MATLAB®", *ieeexplore.ieee.org*, 2012. [Online]. Available: <https://ieeexplore.ieee.org/document/6542574>.
- [2] B. VAN VEEN and K. BUCKLEY, "Beamforming: A Versatile Approach to Spatial Filtering", *ieeexplore.ieee.org*, 1988. [Online]. Available: <https://ieeexplore.ieee.org/document/665>.



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