

## DDMA-MIMO observation with the MU radar

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### 1. Introduction

A phased array technique has been mainly utilized for the atmospheric radar, the wind profiling radar, and the weather radar for research objective in recent years. As an advanced usage of phased array technology, “Multiple-input multiple-output (MIMO)” technique, has been developed in the communication systems, can be applied to the radar [1]. This technique makes it possible to create the virtual antenna aperture plane beyond the actual antenna (see Figure 1), and it also possible to make the actual antenna size smaller compared to the conventional antenna with keeping the angular resolution. MIMO signal processing requires orthogonal waveforms on each transmitter to identify the transmit signals at multiple receivers, and several methods are known to realize their orthogonality [2]. To confirm the virtual antenna effect created by the MIMO technique, “Doppler Division Multiple Access (DDMA)” method is adopted to the MU radar, which can be operated as a MIMO radar with additional settings.

### 2. DDMA-MIMO observation with the MU radar

DDMA method is able to realize that transmit signals which have slightly different frequencies are radiated from each antenna, and they are separated at the Doppler velocity domain caused by the phase offsets at each receiver. Figure 2 shows a result of range-Doppler profiles observed by the MU radar with DDMA. This figure indicates that we can separate orthogonal transmit signals with using the MU radar, and this result leads to a virtual aperture generated by the MIMO processing will be effective.

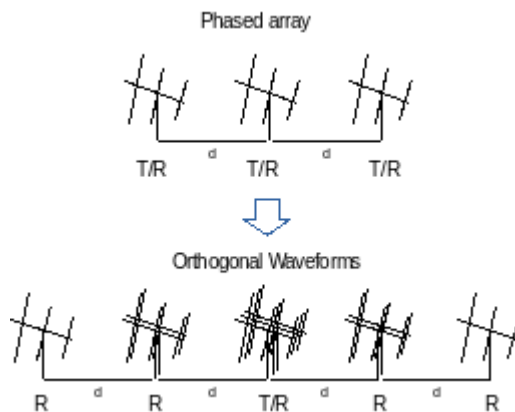


Figure 1. An image of virtual arrays corresponding to the same physical array.

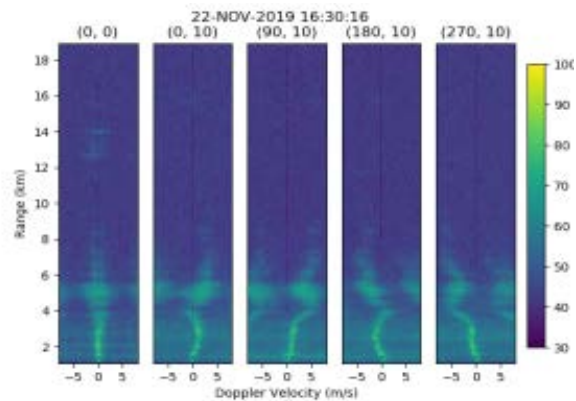


Figure 2. Range-Doppler profiles observed by the MU radar with DDMA-MIMO technique.

### References

- [1] M. S. Davis, G. A. Showman, and A. D. Lanterman, “Coherent MIMO radar: The phased array and orthogonal waveforms,” in *IEEE Aerospace and Electronic Systems Magazine*, vol. 29, no. 8, pp. 76–91, 2014.
- [2] H. Sun, F. Brigui, and M. Lesturgie, “Analysis and comparison of MIMO radar waveforms,” *Int. Radar Conf. Radar 2014*, pp. 1–6, 2014.