Investigation of Focal Plane Array Antennas for Development of Reconfigurable DPCAs

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The displaced phase center antenna (DPCA) technique is extremely useful for clutter reduction in moving target indicator (MTI) radar systems positioned on a moving platform (M. I. Skolnik, *Radar Handbook*, 1990). In MTI radar systems, noise generated by the moving platform will have an adverse effect on a radar's ability to accurately discriminate between targets and clutter. This issue is even more serious when an MTI radar is attempting to track low velocity targets, as the clutter return due to the noise generated by the moving platform can be much stronger than the target return (M. I. Skolnik, *Radar Handbook*, 1990). In order to compensate for the motion of the platform in MTI radar systems, the DPCA technique has been utilized. The technique works by displacing the phase center of an antenna that is placed on a moving platform which, with respect to the target, makes the antenna appear to be stationary. By having the target perceive the antenna as stationary, the clutter return due to the motion of the platform will be mitigated. Traditionally, the DPCA technique has been performed using numerous identical electrically-large antennas or large phased arrays (C. E. Muehe and M. Labitt, *Lincoln Lab Journal*, vol. 12 no. 2, 281-296, 2000). The drawback of this method becomes clear as more elements are required; resulting in complex and expensive systems. Herein, the proposed DPCA technique will use only a single-aperture parabolic reflector antenna, which will in turn allow for greatly reduced complexity and cost for systems that employ the DPCA method.

In this paper, a novel DPCA technique is introduced which involves using a reconfigurable focal plane phased array as the primary feed for a parabolic reflector antenna. The phase center of an antenna is known to be the location from which radiation originates. Therefore, by displacing the location of the phase center of an antenna, the physical location of the antenna will appear to move as well. The focal plane phased array, which is a seven-element hexagonal array with a triangular lattice, consists of wideband microstrip patch antenna elements. A progressive phase shift is electronically applied to each element of the focal plane array. As a result, the primary radiation patterns from the feed will be adaptively steered along the surface of the parabolic reflector dish. In other words, the reflector surface will be asymmetrically illuminated with respect to its apex. As such, the peak intensities of the aperture field distribution will be shifted away from its physical center. This will then cause the effective phase center of the parabolic reflector dish to be displaced in the direction that the focal plane phased array has been steered. It is worth mentioning that while the phase center location is displaced from the reflector apex, the secondary radiation pattern will remain focused with axial beams at the far-field region. This will result in a single-aperture antenna unit that is stationary in space in addition to having multiple phase center locations. The corresponding results will be presented and discussed in the conference.