MIMO In Advance Automobile Radar System

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Multiple Input Multiple Output (MIMO) Technology has made giant strides for improving channel capacity and introducing high data rate video transmission in evolving 5G, 6G wireless communication standards [1]. Apart from mobile communication, MIMO technology has got major contribution for advance driver assistance systems (ADAS) in modern automobile systems [2],[3]. In MIMO systems, the basic advantage is that even if it employs multiple antennas, both at the receiver and the transmitter side, it does not require additional transmitted power or bandwidth with respect to a single-input-single-output (SISO) solution.

For automobile usages, MIMO radars offer higher spatial resolution in the azimuth by forming *virtual array*, higher sensitivity to detecting slowly moving targets, etc. – properties highly useful for ADAS systems. A co-located antenna system can emulate larger aperture phased array radar in the *virtual array* [4]. For example, if L_T and L_R represent the number of transmit and receive antenna elements, the phase differences caused by different transmitting antennas along with the phase differences caused by different receiving antennas can form a new *virtual array* steering vector. Considering d_T and d_R to be the transmit and receive antenna spacing, and $d_T = L_R \times d_R$, the *virtual array* in the MIMO receiver emulates a linear 1-D phased array of *virtual* aperture length as $L_T \times L_R \times d_R$. Hence, the spatial resolution for a FFT-based target imaging can be improved by the factor of L_T. With judiciously designed antenna positions, one can create a very long *virtual array* steering vector with a small number of physical transmits and receives antennas. The spatial resolution for clutter in the azimuth can be dramatically increased at a small cost of putting an array of co-located antennas. Also, the MIMO radar system is more weight, cost and in certain cases power efficient than phased array radar system.

The current Talk is a review of the state-of-the-art MIMO automobile radar systems with special emphasis on the improved spatial resolution obtained by a *virtual array* in comparison to a phased array of antennas.

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