1) General radar system design

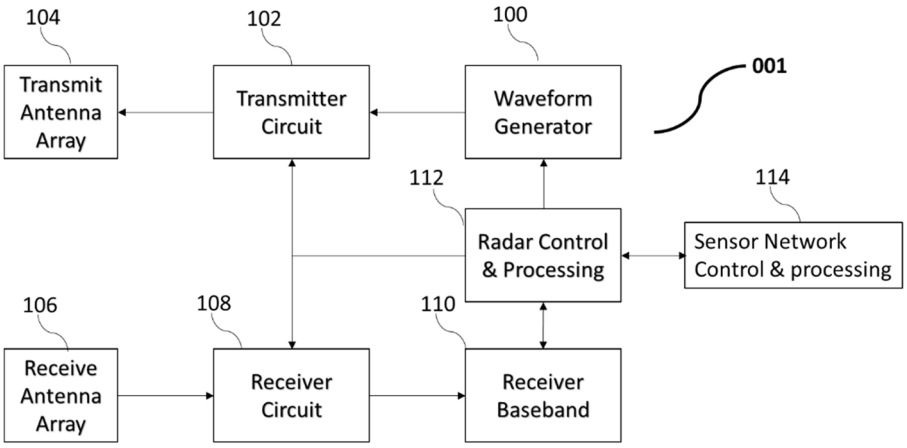
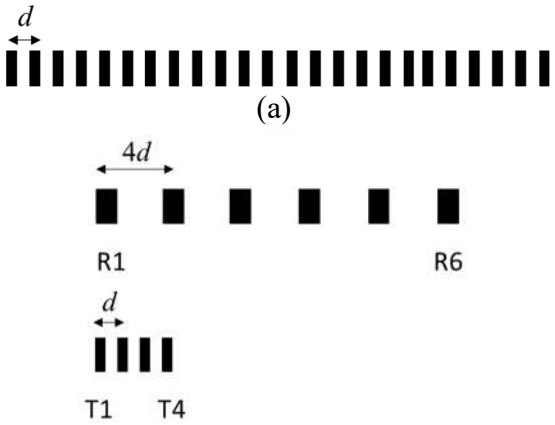


Figure-1: Radar system architecture

2) Dense ULA and its MIMO array configuration with four transmit (Tx) antennas and six receive (Rx) antennas.

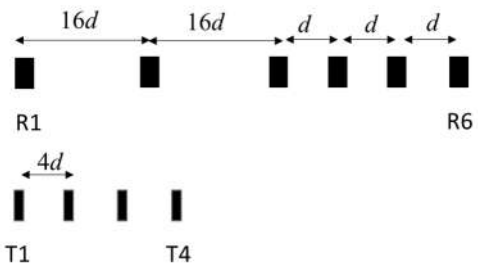


(a)

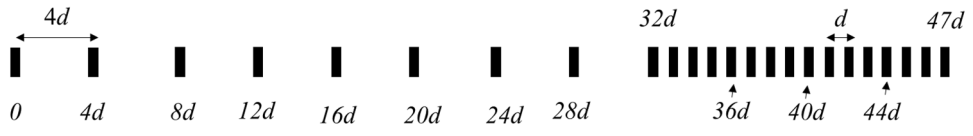
(b)

Figure-2: (a) ULA of half wavelength spacing with 24 elements, *d* is half wavelength; (b) MIMO radar that achieves equivalent 24-element ULA with four transmitters and six receivers.

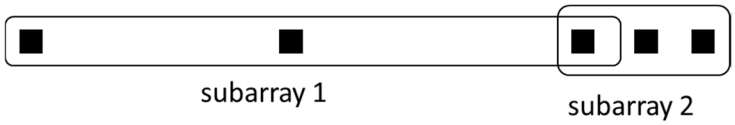
3) Hybrid array design with MIMO configuration, four Tx antennas and six Rx antennas



(a)



(b)



(c)

Figure-3 (a) MIMO radar with 4 Tx antennas and 6 Rx antennas; (b) the virtual MIMO array of (a); (c) General configuration of array in (b).

4) 2D MIMO array configuration with hybrid antenna array design

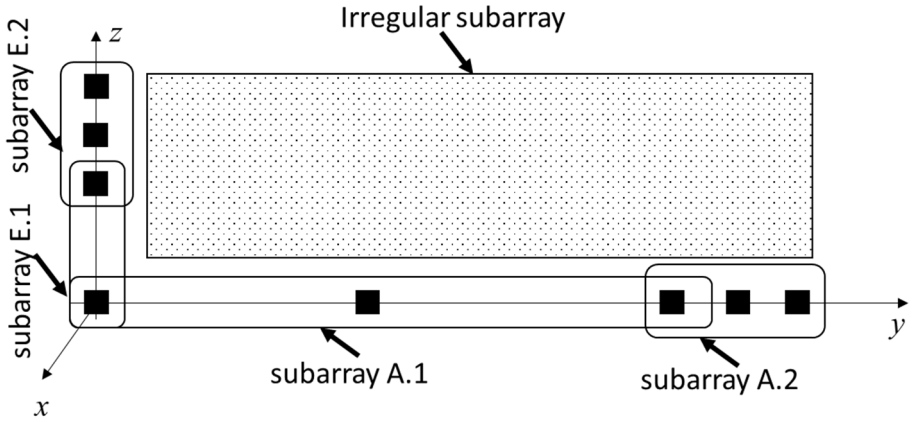


Figure-4: 2D generalization of the design in Figure-3.

5) Signal processing flowchart for radar with the hybrid array

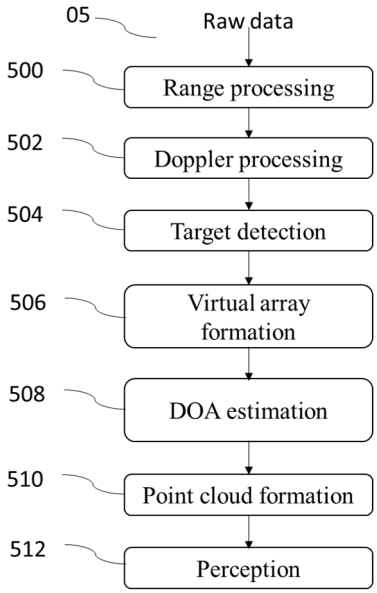


Figure-5 General signal processing flowchart

6) DOA estimation for 1D hybrid array

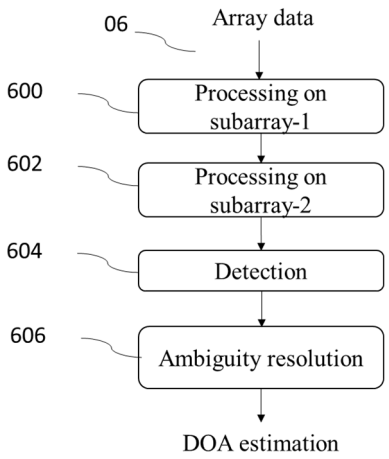


Figure-6: 1D DOA estimation

7) 2D DOA estimation for 2D hybrid array

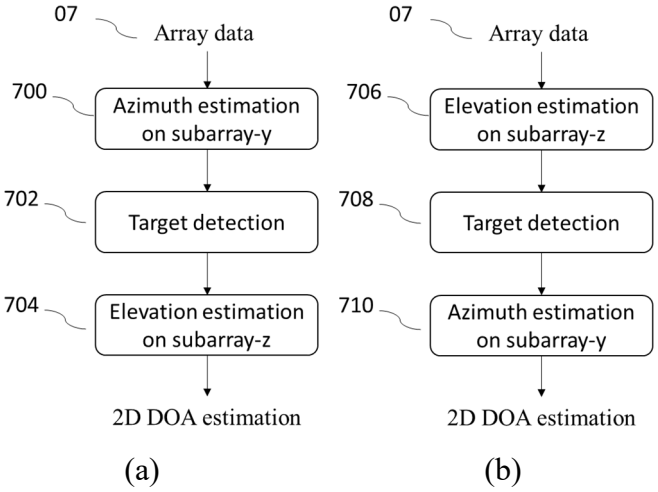


Figure-7: 2D DOA estimation