



# Beamformed Sensing using Dominant DoA in Cognitive mmWave Network

## Why Spectrum Sensing at mmWave?

- Helps different operators to share the resource
- Dynamic utilization of spectral resources for interference management and cognitive processing

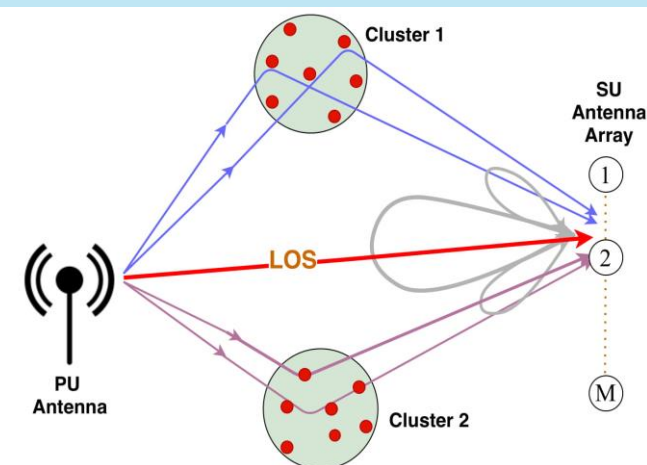
## Why Contributionsal Sensing?

- mmWave channel is sparse in angular domain
- Huge beamforming gains as large number of antennas can be accomodated in small form factor at mmWave frequencies

## Contributions

- Three spectrum sensing methods are proposed depending on the available prior.
- **BFED with Known LOS angle (BFED-KL)**: DoA of the LOS path is perfectly known.
- **BFED with Known DoAs, Estimated Dominant path angle (BFED-KDED)**: DoAs are known, Estimated Dominant path angle
- **BFED with Estimated DoAs and Estimated Dominant path angle (BFED-EDED)**: Estimated DoAs, Estimated Dominant path angle
- Detection performance is investigated

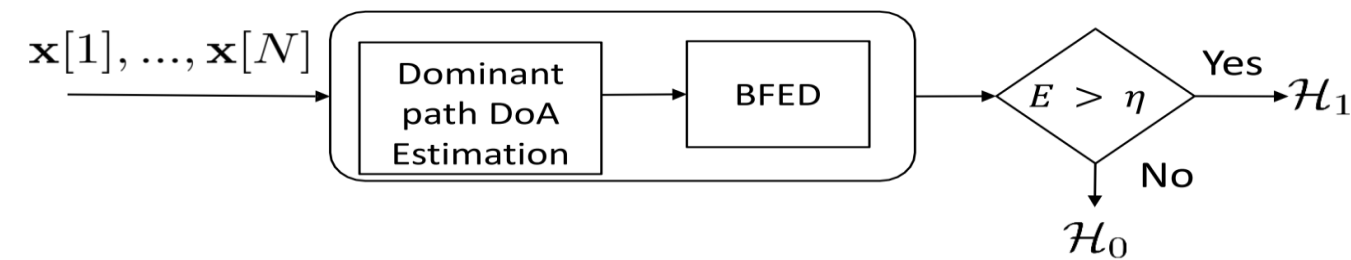
## Spatial Channel representation



- The received signal at  $n^{\text{th}}$  time instant is  $\mathbf{x}[n]=\mathbf{h}s[n]+\mathbf{w}[n]$

- The energy calculated by taking N time instances is given by  $E_s = \sum_{n=1}^N \sum_{m=1}^M |x_m[n]|^2$

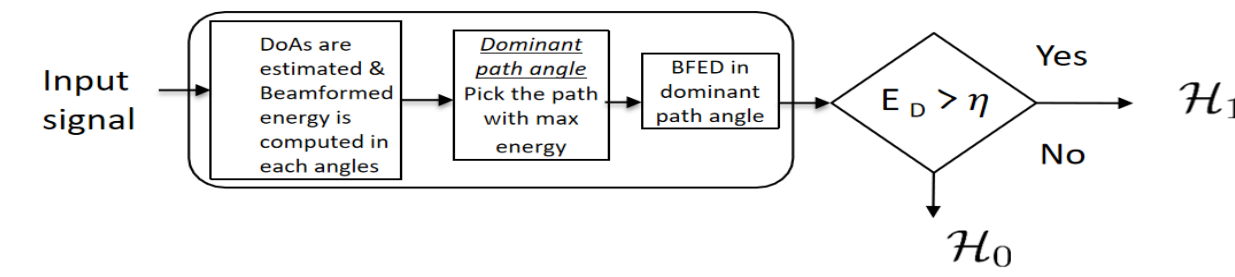
## Beamformed Energy Detector



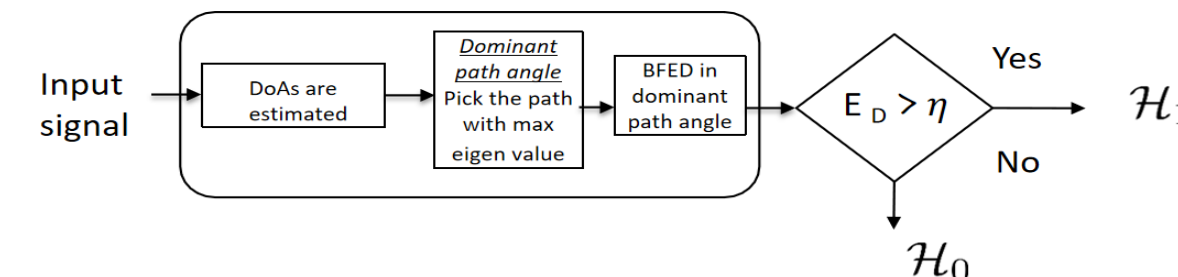
- The received signal at  $n^{\text{th}}$  time instant is  $z[n]=\mathbf{a}^H[\theta]\mathbf{x}[n]$  and the energy is calculated as  $E = \sum_{n=1}^N |z[n]|^2$

## Dominant DoA Estimation

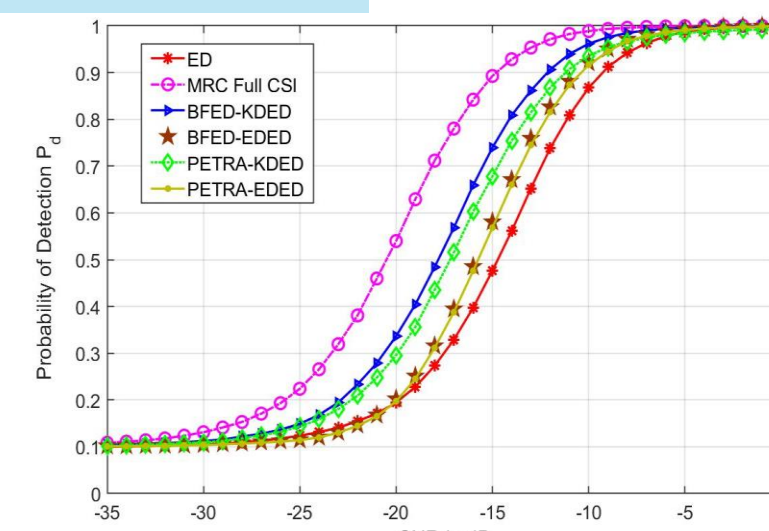
### Maximum Energy



### PETRA



## Results

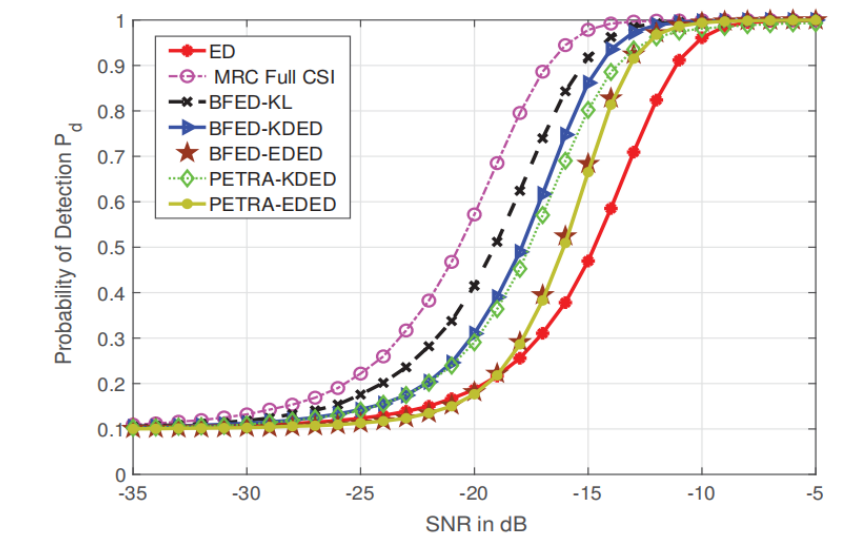


### Comparison of all methods under NLOS condition

Looking at only one dominant path angle the detection performance is still better than ED.

## Results

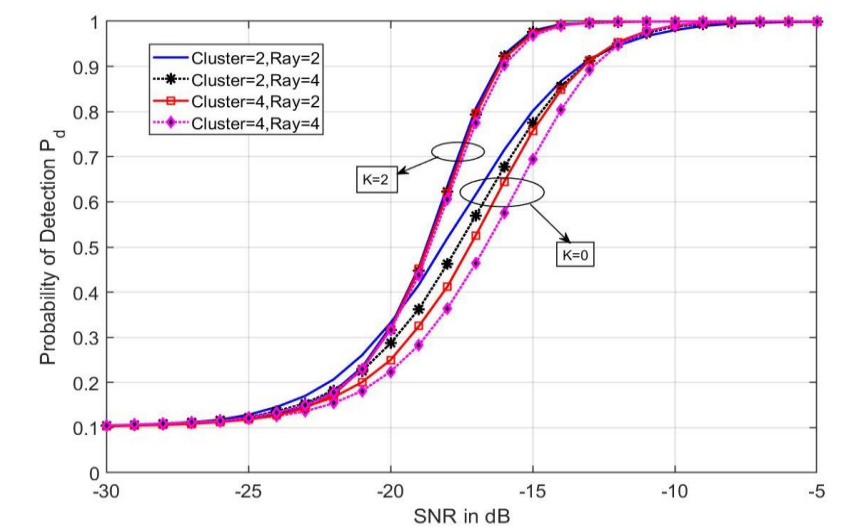
### Comparison of all methods under LOS condition



Performance of BFED-KL is close to MRC by just knowing the LOS angle

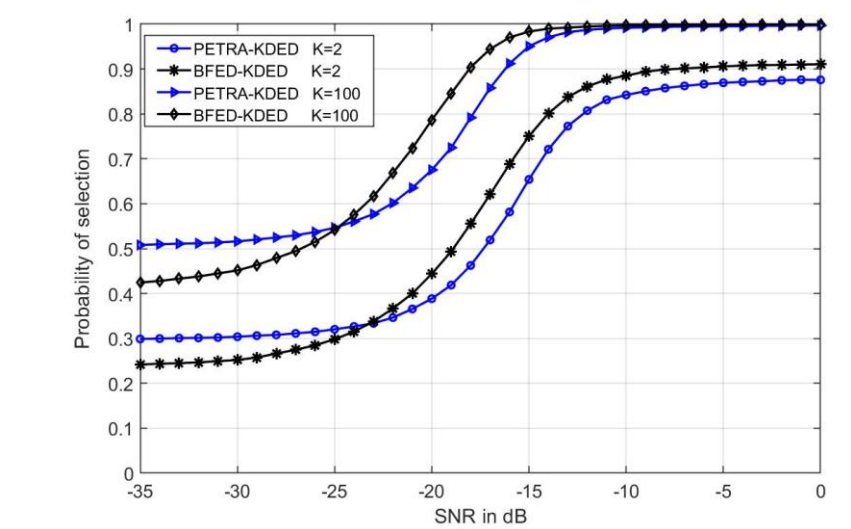
### Varying clusters & Rays

For K=2 there is almost no change in performance because of the stronger LOS component.



### Comparison between Maximum Energy & PETRA

For K=2 at higher SNRs 90 percent of the cases BFED-KDED method is able to detect the LOS component



## Publications

- M.Latha, S. Charan, S. Chaudhari, "Beamformed Sensing using Dominant DoA in Cognitive mmWave Network," in IEEE ANTS, New Delhi, India, Dec. 2020