Enabling In-Band Coexistence of Millimeter-Wave Communication and Radar

April 30, 2020

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Outline

Problem Statement & Motivation

Contribution & Results

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Communication systems and radar systems can benefit from the wide bandwidths offered at millimeter-wave (mmWave) frequencies.

Consider the 60 GHz industrial, scientific, and medical (ISM) band.

- IEEE 802.11ad/ay
- Consumer radar (e.g., [1])

Can these two cooperate in-band when colocated?

Initial look at how our recent work on mmWave full-duplex can extend to communication and radar cooperation.

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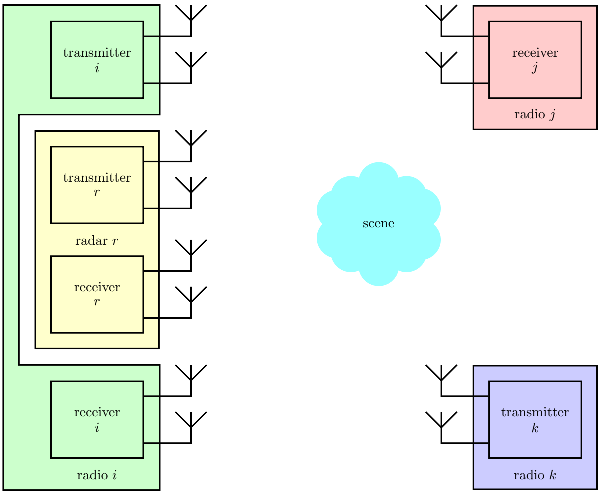

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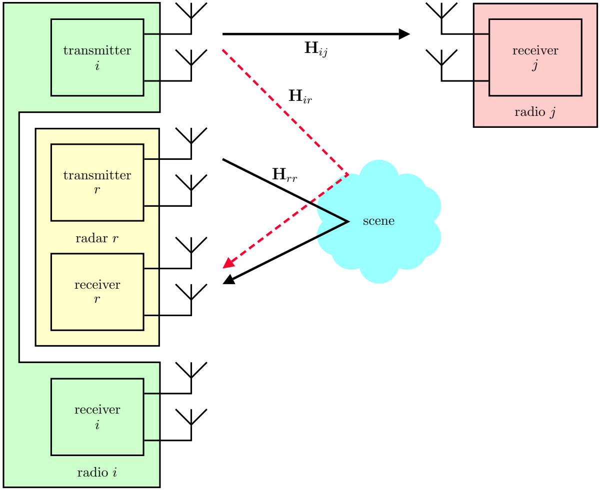

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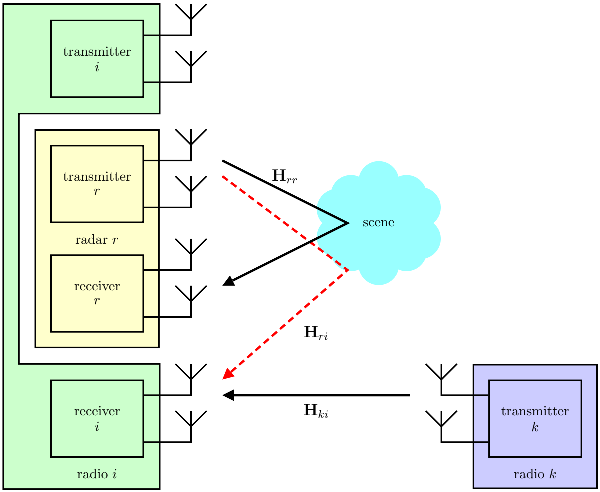

Contribution & Results

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We present two multiple-input multiple-output (MIMO) designs:

1. For transmission from i to j.
2. For reception at i from k.

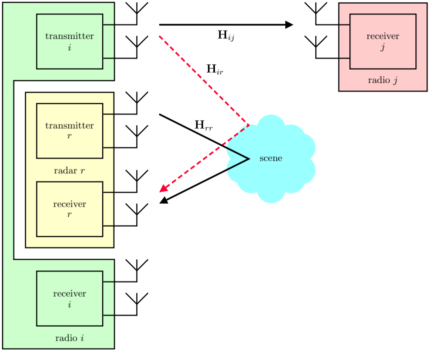
These enable half-duplex communication while the radar operates in-band.

Transmit Stage

Transmitting from i to j:

1. Leave radar as is.
2. Beamtraining from i to j.
3. Set baseband receiver at j.
4. Set baseband transmitter at i.

We assume $\mathbf{H}_{ir}$ can be learned from $\mathbf{H}_{rr}$, given the close proximity of the arrays of i and the radar.

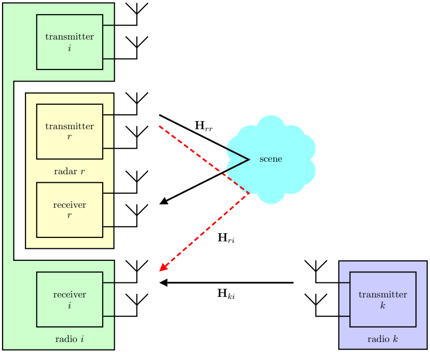


Receive Stage

Receiving at i from k:

1. Leave radar as is.
2. Beamtraining from k to i.
3. Set baseband transmitter at k.
4. Set baseband receiver at i.

We assume $\mathbf{H}_{ri}$ can be learned from $\mathbf{H}_{rr}$, given the close proximity of the arrays of i and the radar.



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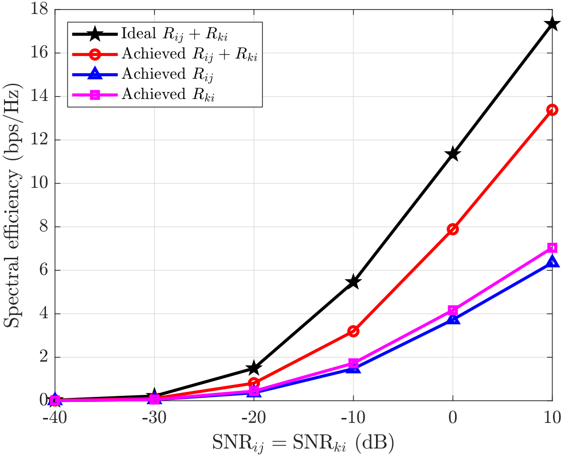

Figure 1: Spectral efficiency as a function of the desired link SNRs; shown are our achieved link spectral efficiencies and their sum (red) versus the sum spectral efficiency had the radar not been present (black).

Contribution & Results

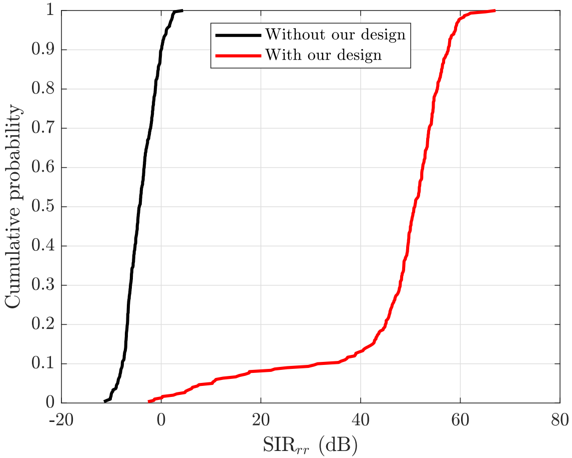

Figure 2: CDF of the SIR of the radar's desired receive signal when using our design (red) as compared to without (black).

Contribution & Results

Key takeaways from this work:

- Can sacrifice spatial dimensions to enable simultaneous in-band operation of the radios and radar.
- This can lead to appreciable performance even when hybrid beamforming is used.
- Our first look at how a radar's channel estimate can be leveraged to enable simultaneous in-band operation.

Thank you. Feel free to email us with any questions or feedback.

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References

[1] *Single-chip 60-GHz to 64-GHz intelligent mmWave sensor integrating processing capability*, Texas Instruments. [Online]. Available: http://www.ti.com/product/IWR6843