**Directional 3D Channel Modeling for Millimeter Wave Small Cells:**

**A Spatial Correlation Study**

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**MOTIVATION**

- Diffuse scattering is important at mmW frequencies.
- Diffuse power increases at higher frequencies and lower ranges (attributes of mmW small cells).

**APPROACH**

- To include diffusely scattered fields an efficient surface scattering formulation is employed in a ray tracing model.
- Kirchhoff approximation is included in the ray tracing routine to compute the diffusely scattered power from rough urban surfaces.

**THEORETICAL EVALUATION**

**Assumptions:**

- Single bounce scattering
- Multiple bounce wall reflections
- Reflected components are modified by antenna gain patterns, Fresnel reflection coefficient, and Ament loss factor
- Impact of shadowing is included
- Gaussian isotropic rough surface

**Simulation Parameters:**

- 1D and 2D antenna arrays
- Walls dielectric: Concrete Road dielectric: Asphalt
  - Concrete: \( \sigma = 0.34 \text{ mm} \)
  - Asphalt: \( \sigma = 0.2 \text{ mm} \)

**Path Loss**

- In a typical multiuser scenario, an access point (AP) is simultaneously transmitting symbols to multiple users or multiple antennas of a single user.
- Access points are deployed on lampposts and transmit data to users within their coverage area.
- Access point height is 5 m, UE height is 1.5 m, and the street width is 18 m.

**CONCLUSIONS**

- This work develops a new directional 3D channel model for urban mmW small cells via Integrating Kirchhoff approximation and a ray-tracing algorithm.
- Spatial Correlation study conducted for LOS/NLOS;
- LOS availability, frequency, and surface roughness scale highly impact spatial diversity.
- In planar 2D arrays, the horizontal dimension is well-suited for spatial multiplexing to generate degrees of freedom, transmit parallel data streams and improve the spectral efficiency.
- Using antenna arrays of moderate gain at both sides of the link, even under NLOS conditions, a typical urban cell size of 200m is achievable.

**REFERENCES**