Improved Sensing and Positioning via 5G and mmWave radar for Airport Surveillance

Single or multiple 5G eNodeBs deployed in airport areas for optimal Line of Sight (LOS) coverage. Subspace methods for AOA estimates and correlation methods for TOA estimates with 5G positioning signals (SRS in uplink and PRS & CSI in downlink). 5G signal-based imaging and mmWave radar detection are fused to enhance surveillance at airport.

AOA Angle Of Arrival
CSI Channel Status Information
LOS Line Of Sight
PRS Positioning Reference Signal
SDR Software Defined Radio
SRS Sounding Reference Signal
TOA Time Of Arrival

Improve Sensing and Positioning via 5G and mmWave radar for

Airport Surveillance

UE – User equipment
5G equipped Cooperative targets

5G Network eNodeB

Direction finding AOA, TOA

Tracking Data fusion

ASTERIX

3D Vector Antenna

SDR Rx board

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mmWave Radar

Range, Velocity and Angle detection

Targets classification using AI

Non-cooperative targets

76-81GHz

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3D Vector Antenna
- Wide angular coverage in 3-D
- Compact size, wideband coverage
- Good polarization discrimination

5G Reference Signal
- Uplink SRS, downlink PRS, CSI-RS
- Direct transmission $\rightarrow$ Subspace-based, EM-based angle-time estimation
- Echoes $\rightarrow$ imaging

mmWave Radar
- Range, velocity, angle detection
- Targets characterization
- Targets classification using AI

SAR Imaging and AI-enabled mmWave sensing
- Adapt tracing to integrate mmWave detections
- Adapt tracing with simulated 5G positions
- Adapt data fusion algorithms
- Test with A-SMGCS prototype

Antenna simulation
- Reference signal based angle and delay estimation algorithm
- Enhanced angle estimation method with 3D-VA
- Verification with SDR

Example 5G SRS signal

SRS based AoA estimation with 3D VA array

SRS based SAR simulation

Measurement of reflection (port 1 & 8) and isolation coefficients

Gain(dB) in Co (red) and Cross (green) polarization for the equivalent electric dipoles

Gain(dB) in Co (green) and Cross (red) polarization for the equivalent magnetic dipoles

Theoretical topology and example of 8 port 3D-VA

Gain(dB) in Co (red) and Cross (green) polarization for the equivalent dipole antennas

Range-Doppler information

mmWave processing flow

mmWave range detection

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