1 Participants

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Workshop participants:

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2 Problem Description

2.1 Problem statement

The objective was to find a model that will allow us to choose the antenna locations that maximize area coverage and image quality within a city. More specifically, the goal was to develop a model that allows us to optimize backprojection image quality (in the sense of the width of the point-spread function) and scene coverage as a function of sensor locations. Solving this problem will contribute to improving city-wide security surveillance (vehicle tracking and identification, etc) in all-weather scenarios.

2.2 Reasonable assumptions

- Single scattering is OK
- The number of antennas is fixed; assumed stationary
- Each antenna node is capable of transmission and reception of signals
A 3D model of the city is assumed known (given as a triangle mesh surface); occlusions should be considered

Assume an algorithm is available to compute line of site (LOS) angles for each pixel

Certain areas (street corners, bus stops, etc) may have more importance than others; so a weight function may be provided along with the Digital Elevation Map (DEM)

3 Summary of work on the problem

3.1 Overall strategy

1. Compute visibility maps for potential sensor configurations determined by geometry

2. For a given configuration of sensors:
   (a) Plot Fourier (k-space) components provided by sensor locations
   (b) Compute optimal weights in a resolution metric
   (c) Evaluate resolution metric

3. Update estimate and return to 2)

3.2 Accomplishments

We developed another approach to obtain optimal weights for irregular k-space plots. When this is used as part of the optimization for the sensor positions, the resulting optimization problem seems intractable. We came to the conclusion that a more promising approach is to focus instead on sensor placement that maximizes visibility while obtaining the most spread-out k-space plot.

It maybe possible to develop bounds, approximations, or inequalities for the weights that will justify the above approach.

3.3 Questions and conjectures

- When can we use the same weight for all frequencies for a given source-receiver pair? This would imply that we only need to consider monochromatic data

- Conjecture: For a larger region in k-space, there is some weight vector for which the achievable resolution is better than that of a smaller region in k-space. This would mitigates the need to estimate weights. To prove this conjecture, it is necessary to quantify the size of the k-space dataset.

- Conjecture: The best approach is to find sensor positions that maximize viewed area, and for those positions, choose the most spread-out one (maximize energy).