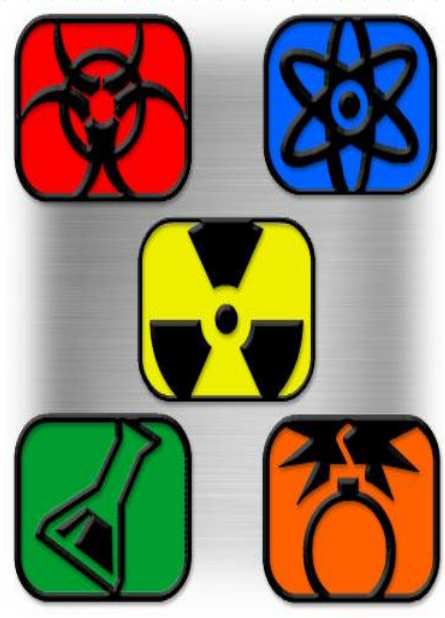
# Ubiquitous (CB)RN(E) Sensor Networks: An Analysis of Parameters Final Report



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# Agenda

- Introduction
- Problem Statement
- Scenario
- Assumptions
- Modeling
  - Sensor Generation
  - Main Loop
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- Variables
- Analysis
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  - Results
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- Closure
- Questions

# Introduction

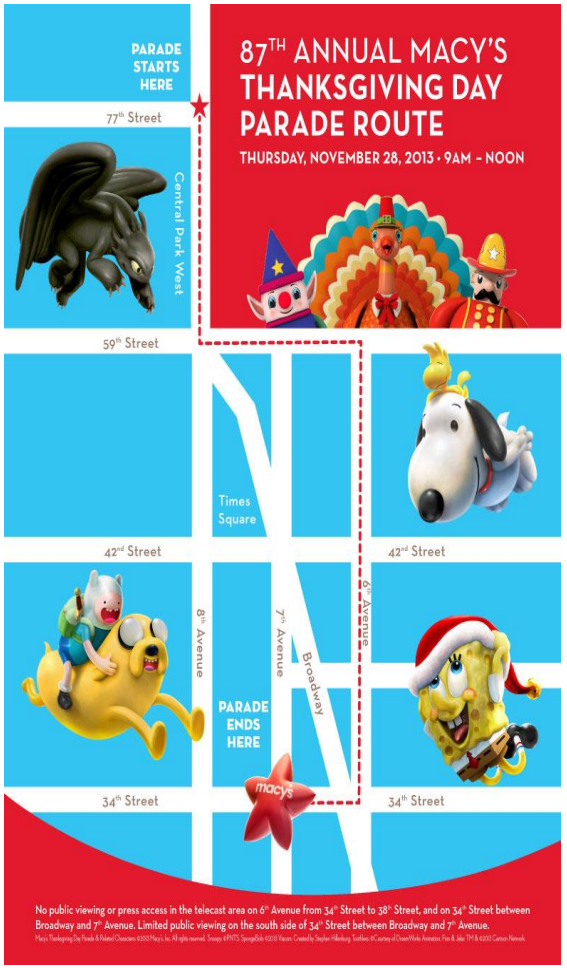
- TASC Inc.
  - Protect US from harmful materials
- CBRNE devices pose a threat to major public events across the country:
  - Recent plots: Boston Marathon Bombing, New York City Subway plot

# Problem Statement

- Determine metrics for a comparison of the effectiveness of different networks containing varying parameters.
- Determine any relationships existing between (CB)RN(E) source strength, network density, and sensor strength and subsequently, their impact on interdiction.
- Introduce a framework for a ubiquitous sensor network that localizes a (CB)RN(E) source prior to its detonation or release.

# Scenario

- Macy's Thanksgiving Day Parade
  - Central Park West from 75th Avenue to 74th Avenue
  - Radioactive / Nuclear Source moving through crowd

# Assumptions

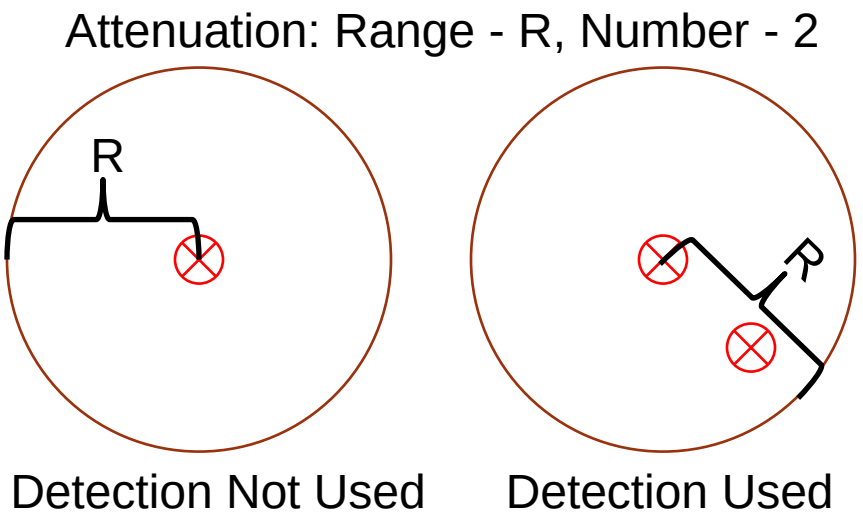
- Personal privacy legality is a non-issue
- Sensor implementation is feasible
- Agnostic Sensor/Source
  - Radioactive/Nuclear type emanation
- One sensor per person/parade participant
  - Source does not have a sensor
- No weather effects on sensor detection or source emanation
- One source
  - False detections will be analyzed, but not false targets (multi-target)
  - Entry point/drop off location are fixed for all runs

# Variables

- Base Case
  - Crowd Density
  - Sensor Strength
  - Source Strength
- Excursion - Movement
  - Source
    - Randomness
  - Crowd
    - Individual Chance
  - Parade
- Excursions - Degradation
  - Minimum Sensor Efficiency
  - False Detection
    - Recur Rate
    - Attenuation
      - Range
      - Number of Sensors
  - Negative Detection
    - Recur Rate

# Variables- Important Definitions

- False Detections
  - Recur Rate
  - Attenuation Range
  - Attenuation Number
- Negative Detections
  - Recur Rate



# “See Distance"

- Largest distance at which a sensor can detect the source
- Distance from source to sensor must be less than or equal to the “See Distance” for a detection to occur

| Source Strength \ Sensor Strength | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.0 | 1.41 | 2.00 | 2.45 | 2.83 | 3.16 | 3.46 | 3.74 | 4.00 | 4.24 | 4.47 | 4.69 | 4.90 | 5.10 | 5.29 | 5.48 | 5.66 | 5.83 | 6.00 | 6.16 | 6.32 |
| 1.9 | 1.38 | 1.95 | 2.39 | 2.76 | 3.08 | 3.38 | 3.65 | 3.90 | 4.14 | 4.36 | 4.57 | 4.77 | 4.97 | 5.16 | 5.34 | 5.51 | 5.68 | 5.85 | 6.01 | 6.16 |
| 1.8 | 1.34 | 1.90 | 2.32 | 2.68 | 3.00 | 3.29 | 3.55 | 3.79 | 4.02 | 4.24 | 4.45 | 4.65 | 4.84 | 5.02 | 5.20 | 5.37 | 5.53 | 5.69 | 5.85 | 6.00 |
| 1.7 | 1.30 | 1.84 | 2.26 | 2.61 | 2.92 | 3.19 | 3.45 | 3.69 | 3.91 | 4.12 | 4.32 | 4.52 | 4.70 | 4.88 | 5.05 | 5.22 | 5.38 | 5.53 | 5.68 | 5.83 |
| 1.6 | 1.26 | 1.79 | 2.19 | 2.53 | 2.83 | 3.10 | 3.35 | 3.58 | 3.79 | 4.00 | 4.20 | 4.38 | 4.56 | 4.73 | 4.90 | 5.06 | 5.22 | 5.37 | 5.51 | 5.66 |
| 1.5 | 1.22 | 1.73 | 2.12 | 2.45 | 2.74 | 3.00 | 3.24 | 3.46 | 3.67 | 3.87 | 4.06 | 4.24 | 4.42 | 4.58 | 4.74 | 4.90 | 5.05 | 5.20 | 5.34 | 5.48 |
| 1.4 | 1.18 | 1.67 | 2.05 | 2.37 | 2.65 | 2.90 | 3.13 | 3.35 | 3.55 | 3.74 | 3.92 | 4.10 | 4.27 | 4.43 | 4.58 | 4.73 | 4.88 | 5.02 | 5.16 | 5.29 |
| 1.3 | 1.14 | 1.61 | 1.97 | 2.28 | 2.55 | 2.79 | 3.02 | 3.22 | 3.42 | 3.61 | 3.78 | 3.95 | 4.11 | 4.27 | 4.42 | 4.56 | 4.70 | 4.84 | 4.97 | 5.10 |
| 1.2 | 1.10 | 1.55 | 1.90 | 2.19 | 2.45 | 2.68 | 2.90 | 3.10 | 3.29 | 3.46 | 3.63 | 3.79 | 3.95 | 4.10 | 4.24 | 4.38 | 4.52 | 4.65 | 4.77 | 4.90 |
| 1.1 | 1.05 | 1.48 | 1.82 | 2.10 | 2.35 | 2.57 | 2.77 | 2.97 | 3.15 | 3.32 | 3.48 | 3.63 | 3.78 | 3.92 | 4.06 | 4.20 | 4.32 | 4.45 | 4.57 | 4.69 |
| 1.0 | 1.00 | 1.41 | 1.73 | 2.00 | 2.24 | 2.45 | 2.65 | 2.83 | 3.00 | 3.16 | 3.32 | 3.46 | 3.61 | 3.74 | 3.87 | 4.00 | 4.12 | 4.24 | 4.36 | 4.47 |
| 0.9 | 0.95 | 1.34 | 1.64 | 1.90 | 2.12 | 2.32 | 2.51 | 2.68 | 2.85 | 3.00 | 3.15 | 3.29 | 3.42 | 3.55 | 3.67 | 3.79 | 3.91 | 4.02 | 4.14 | 4.24 |
| 0.8 | 0.89 | 1.26 | 1.55 | 1.79 | 2.00 | 2.19 | 2.37 | 2.53 | 2.68 | 2.83 | 2.97 | 3.10 | 3.22 | 3.35 | 3.46 | 3.58 | 3.69 | 3.79 | 3.90 | 4.00 |
| 0.7 | 0.84 | 1.18 | 1.45 | 1.67 | 1.87 | 2.05 | 2.21 | 2.37 | 2.51 | 2.65 | 2.77 | 2.90 | 3.02 | 3.13 | 3.24 | 3.35 | 3.45 | 3.55 | 3.65 | 3.74 |
| 0.6 | 0.77 | 1.10 | 1.34 | 1.55 | 1.73 | 1.90 | 2.05 | 2.19 | 2.32 | 2.45 | 2.57 | 2.68 | 2.79 | 2.90 | 3.00 | 3.10 | 3.19 | 3.29 | 3.38 | 3.46 |
| 0.5 | 0.71 | 1.00 | 1.22 | 1.41 | 1.58 | 1.73 | 1.87 | 2.00 | 2.12 | 2.24 | 2.35 | 2.45 | 2.55 | 2.65 | 2.74 | 2.83 | 2.92 | 3.00 | 3.08 | 3.16 |
| 0.4 | 0.63 | 0.89 | 1.10 | 1.26 | 1.41 | 1.55 | 1.67 | 1.79 | 1.90 | 2.00 | 2.10 | 2.19 | 2.28 | 2.37 | 2.45 | 2.53 | 2.61 | 2.68 | 2.76 | 2.83 |
| 0.3 | 0.55 | 0.77 | 0.95 | 1.10 | 1.22 | 1.34 | 1.45 | 1.55 | 1.64 | 1.73 | 1.82 | 1.90 | 1.97 | 2.05 | 2.12 | 2.19 | 2.26 | 2.32 | 2.39 | 2.45 |
| 0.2 | 0.45 | 0.63 | 0.77 | 0.89 | 1.00 | 1.10 | 1.18 | 1.26 | 1.34 | 1.41 | 1.48 | 1.55 | 1.61 | 1.67 | 1.73 | 1.79 | 1.84 | 1.90 | 1.95 | 2.00 |
| 0.1 | 0.32 | 0.45 | 0.55 | 0.63 | 0.71 | 0.77 | 0.84 | 0.89 | 0.95 | 1.00 | 1.05 | 1.10 | 1.14 | 1.18 | 1.22 | 1.26 | 1.30 | 1.34 | 1.38 | 1.41 |

Source Strength

Sensor Strength

Source/Sensor → See Distance

1.8/5.0 1.5/6.0 1.0/9.0 → 3.00

$$\text{Max See Distance} = \sqrt{\text{sensor strength} * \text{source strength}}$$

# Model - Input

Status: Runs complete.

| | Single Variable | Multiple Variable Run | | | |
|---|---|---|---|---|---|
| **Main Variables** | | Start | End | Steps | Note |
| What Density do you want (people/m^2)? | 0.25 | 0.25 | 7.00 | 11.00 | Between 0.1 & 7.0 |
| Source Strength | 7.00 | 0.50 | 7.00 | 7.00 | Give a range |
| Sensor Strength | 0.14 | 0.14 | 7.00 | 7.00 | Give a range |
| Max See Distance | SR: 1 | Low: 0.27 | High: 7 | 539 | |

Clear Output

Clear Visuals

Clear GIS & LL

Clear all Data

| **Movement** | **Value** | **Range** |
|---|---|---|
| Randomness of Source Movement | 0 | From 0 to 100% |
| Source avoids crowd | 0 | 1-Yes, 0-No |
| Persistance | 0 | Positive Integer |
| Turn Crowd Movement on | 0 | 1-Yes, 0-No |
| Chance for each individual to move | 0 | From 0 to 100% |
| Chance of Crowd Member Leaving | 0 | From 0 to 100% |
| Parade Movement | 0 | 1-Yes, 0-No |
| **Data Writing** | | |
| Write data for 'Visuals' Tab | 0 | 1-Yes 0-No |
| Write GIS data | 0 | 1-Yes 0-No |
| **System Degradation** | | |
| Minimum Sensor Efficiency | 100 | From 0 to 100% |
| False Detection | 0 | From 0 to 100% |
| False Detection Chance | 5 | From 0 to 100% |
| Negative Detection | 0 | From 0 to 100% |
| Negative Detection Chance | 0 | From 0 to 100% |
| Attenuation | 0 | 2-3 as starting value |
| Range | 9 | 5 as starting value |

| | **Values** |
|---|---|
| Data Sets: | 5 |
| Runs: | 200 |
| Time: | 0:00:11 |
| Not Seen: | 133 |
| Total Steps: | 165 |
| % Time Seen: | 19% |
| Avg Detects for Est. Pos. | 1.1 |
| Min Error: | 0.000 |
| Average Error: | 0.74 |
| Max Error: | 1.00 |
| Last Position Error: | 7.52 |
| Max Location Error: | 32.14 |
| Confindence Level: | 95% |

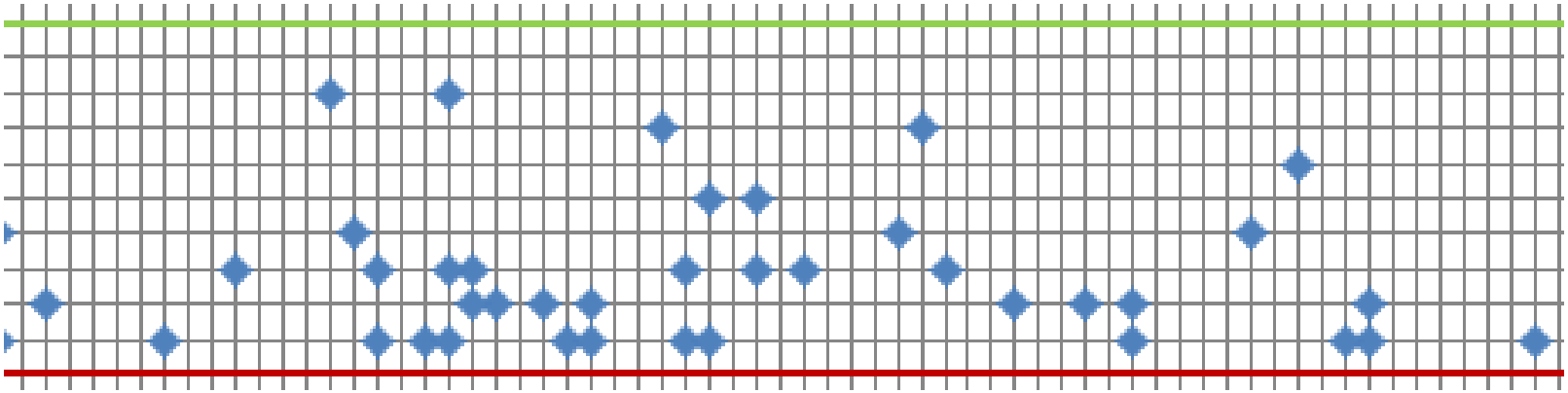
This data column is average values for multiple run data sets.

# Model – Sensor Generation

- Sensor Generation (Parade Participants and Crowd)
  - Crowd
    - Randomly Generated using Uniform x-coordinate and Geometric y-coordinate
    - Density
    - Sensor Efficiency
    - False/Negative Detection Status
  - Parade
    - Set starting position
    - Sensor Efficiency
    - False/Negative Detection Status

# Model Grid

- Max Density = 8 people per meter squared
- Grid unit = $1/\sqrt{8}$ meters (approximately 1.15 ft)



# Model – Main Loop

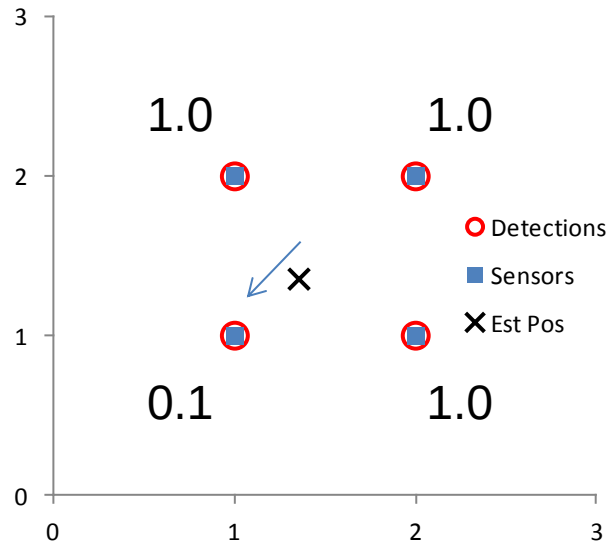
- Following events occur until Source reaches drop off location
    - Source Movement
    - Parade Movement
    - Crowd Movement
    - Detections – Parade/Crowd
    - Source Position Estimated
    - Metric Calculations

# Source Localization

- Center of Mass calculation
- Sensor efficiency 0-100%
  - Efficiency: percentage of designed sensor strength
- “Mass” = 100/sensor efficiency
- Pulls the source closer to sensors with low efficiencies

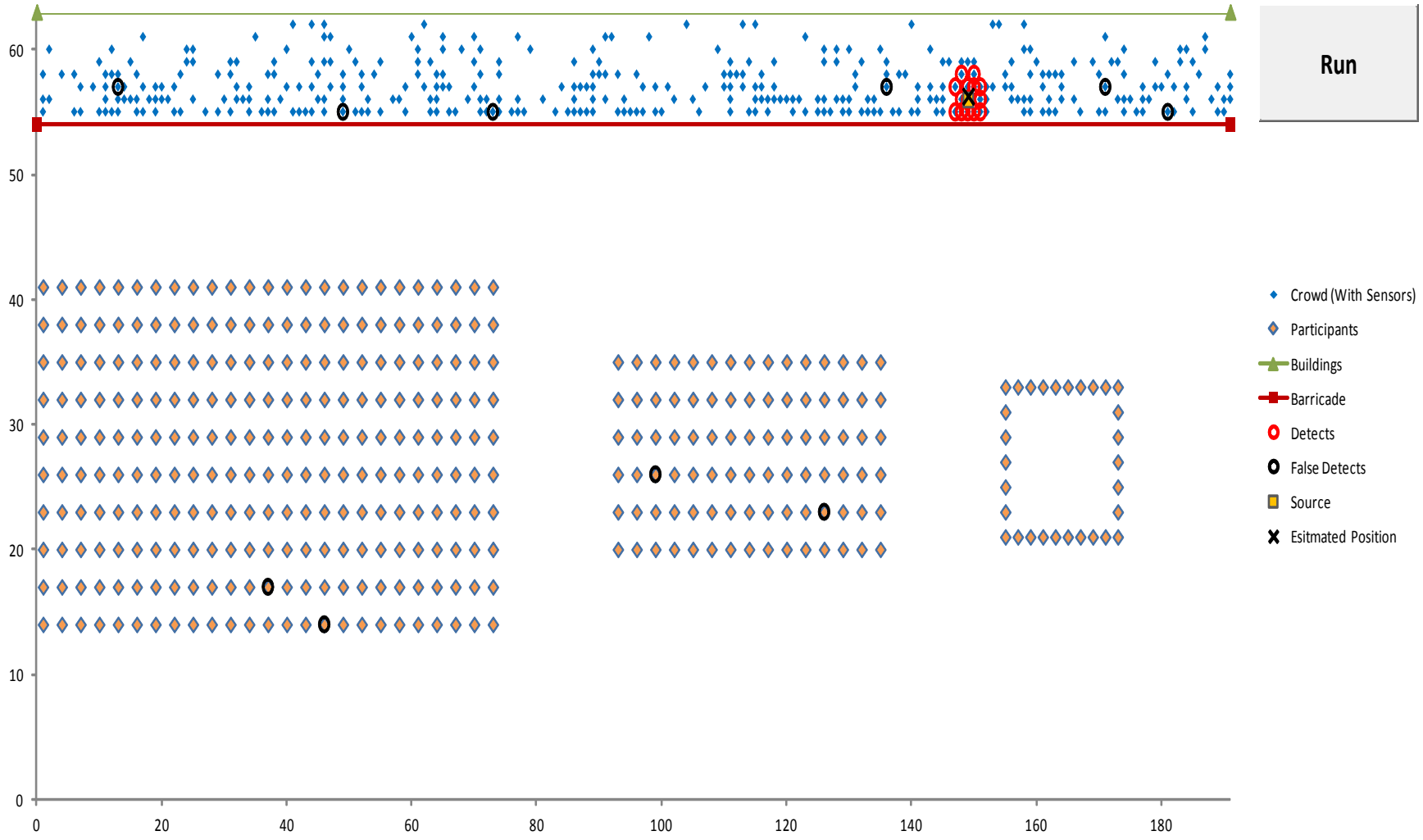
$$Est.\ x = \frac{1}{\sum_{i=1}^{n}\left(\frac{100}{Eff[i] * Str[i]}\right)} \sum_{i=1}^{n} x_i \left(\frac{100}{Eff[i] * Str[i]}\right)$$

$$Est.\ y = \frac{1}{\sum_{i=1}^{n}\left(\frac{100}{Eff[i] * Str[i]}\right)} \sum_{i=1}^{n} y_i \left(\frac{100}{Eff[i] * Str[i]}\right)$$



# Model - Verification

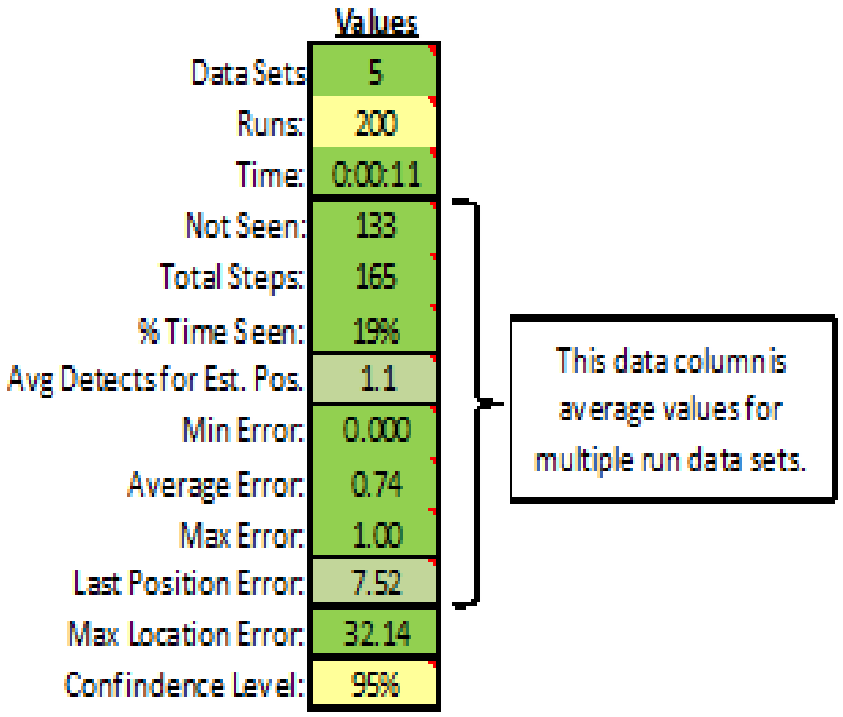
Not Seen: 8 Total Steps: 41 Time Seen: 80% Avg Detects for Est. Pos.: 6.2 Min Error: 0.143 Average Error: 4.82 Max Error: 134.02 Last Position Error: 0.26 Max Location Error 134.0203



# GIS Model: Video

# Metrics

- Percent of  Time Source is Seen
- Average Error When Source Seen
- Max Error When Source Seen
- Last Estimated Position
- Max Location Error

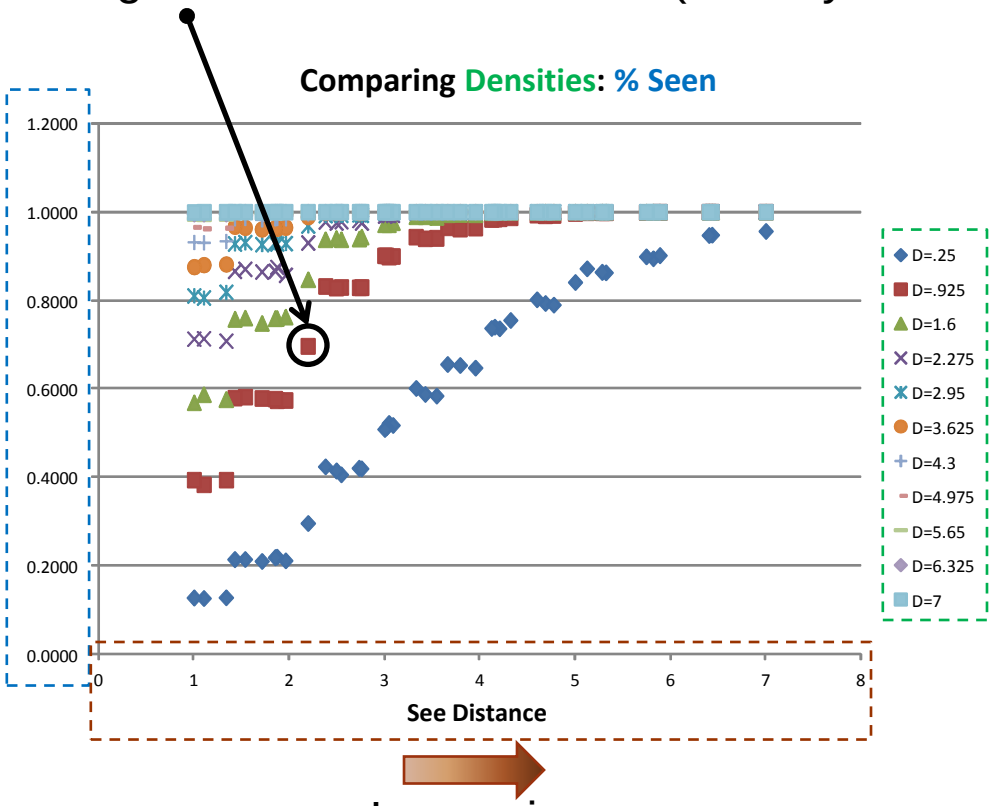


# Analysis

- Base Case
  - Vary Density, Source Strength, Sensor Strength
  - Source Only Movement (Non Random)
  - All Sensors 100% Effective
  - No False/Negative Detections
- Excursions
  - Random Source Movement
  - Crowd/Parade Movement
  - Negative Detects
  - False Detects (Attenuation Parameters)
  - Various Distributions for Sensor Efficiencies

# Analysis – Data Slides

Each Data Point – Average of 200 Individual Runs (Density = .925 See Distance = 2.2)



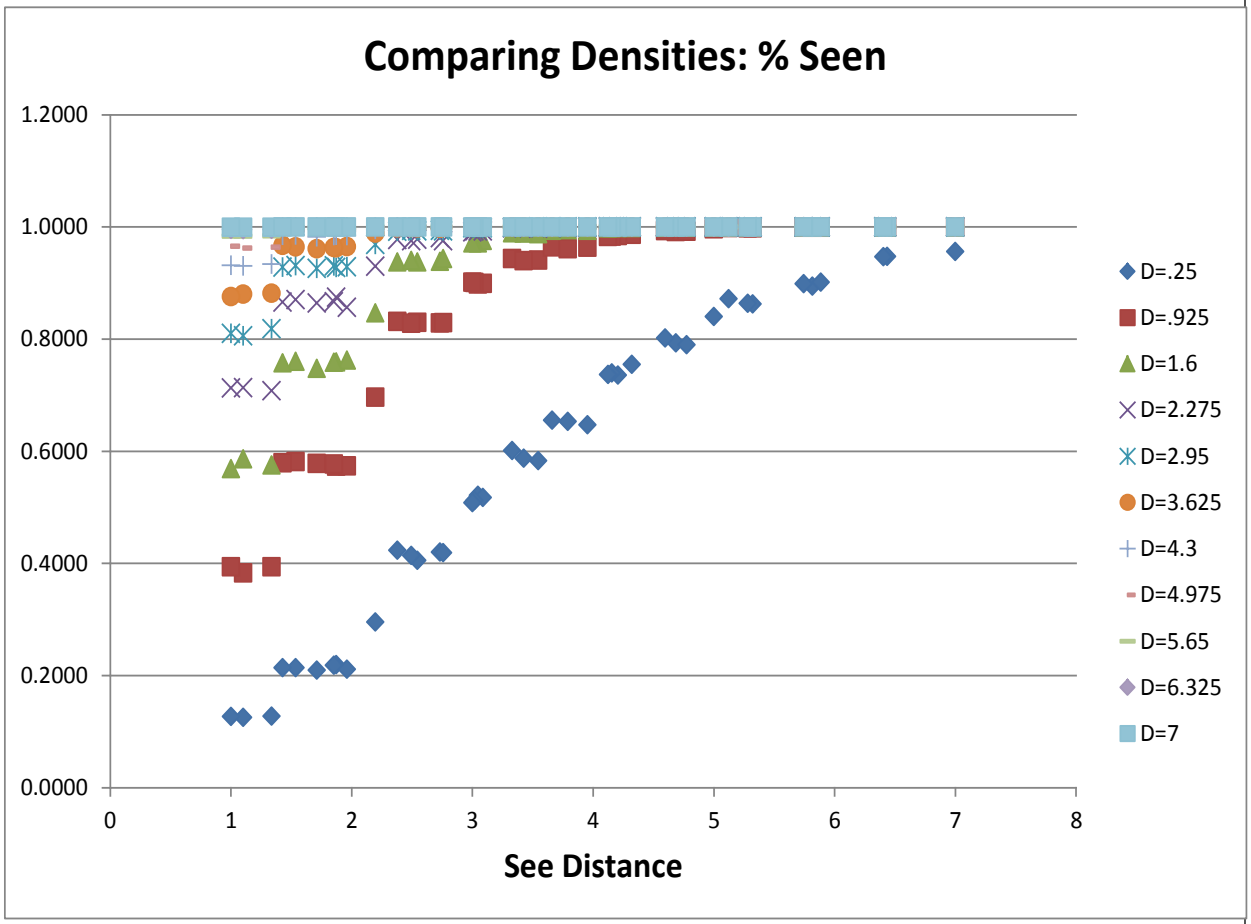

Increasing
% Seen
0 – 100%

Increasing
Density
.25 – 7
People/$m^2$

Increasing
See Distance
1 – 8 Grid Units (1 grid unit ~1.15 Ft)

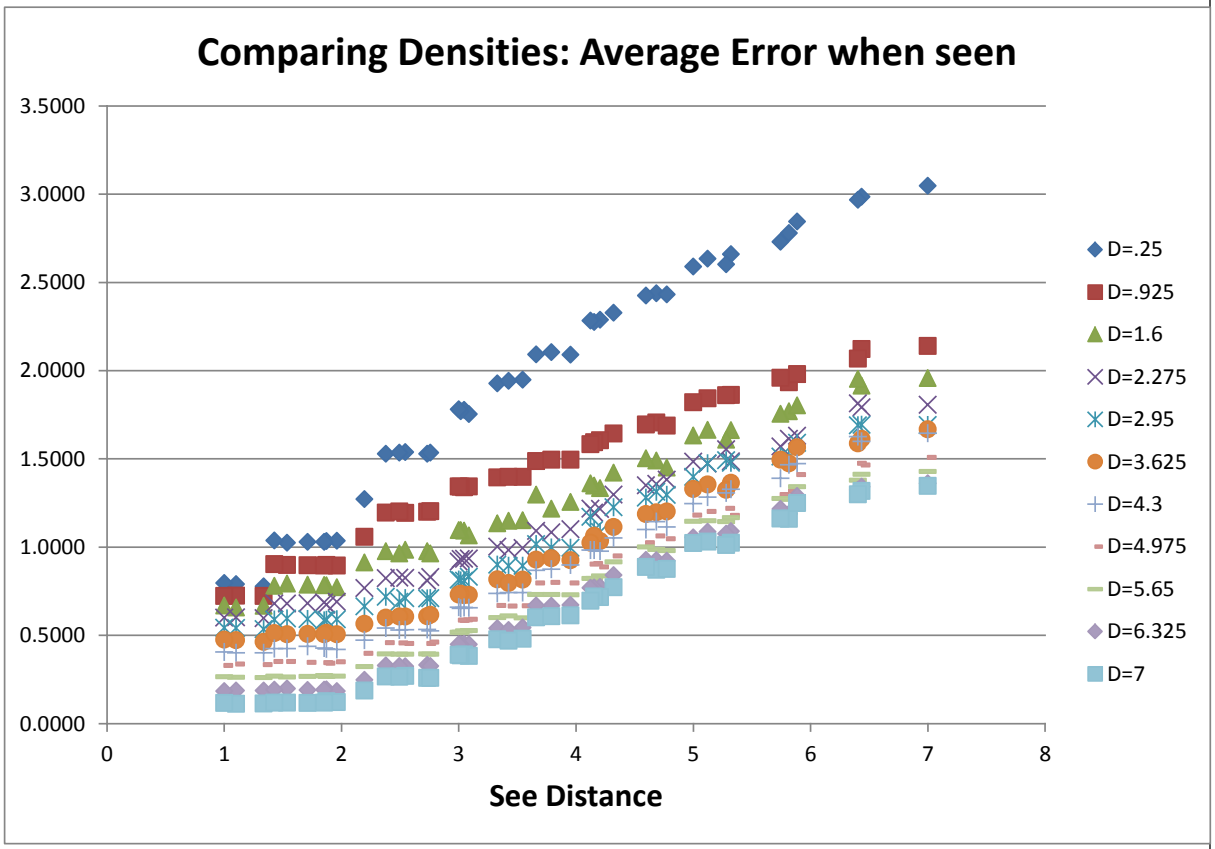
# Base Case Analysis- Percent Seen

- As density increases, the percent of the time the source is seen increases
- As “see distance” increases, the percent of the time the source is seen increases



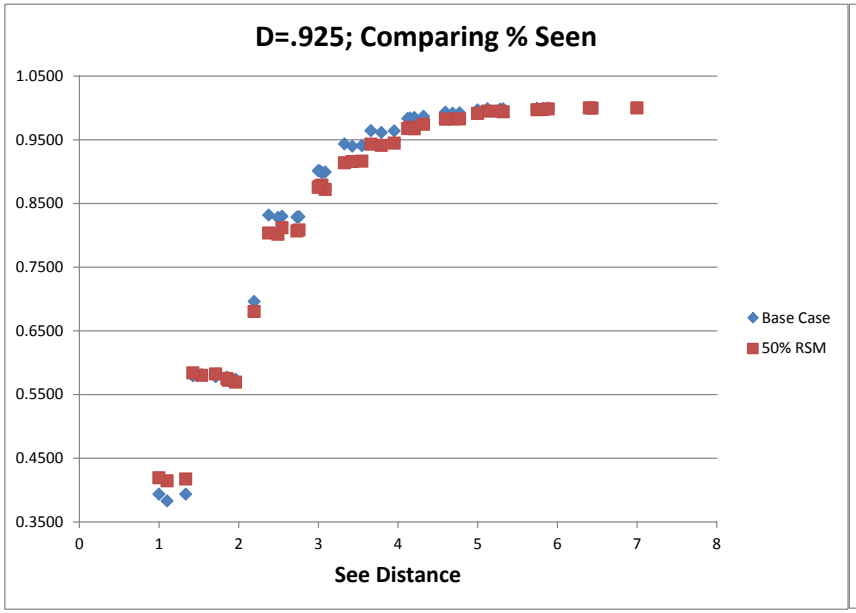
# Base Case Analysis- Average Error When Seen

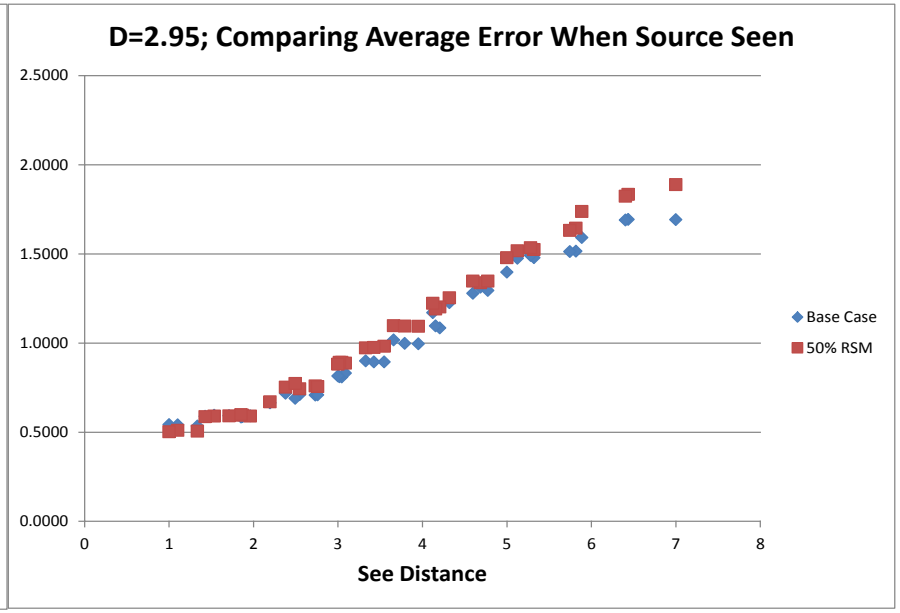
- As density increases, the average error when the source is seen decreases
- As “see distance” increases, the average error when the source is seen increases



# Excursion Analysis: Random Source Movement

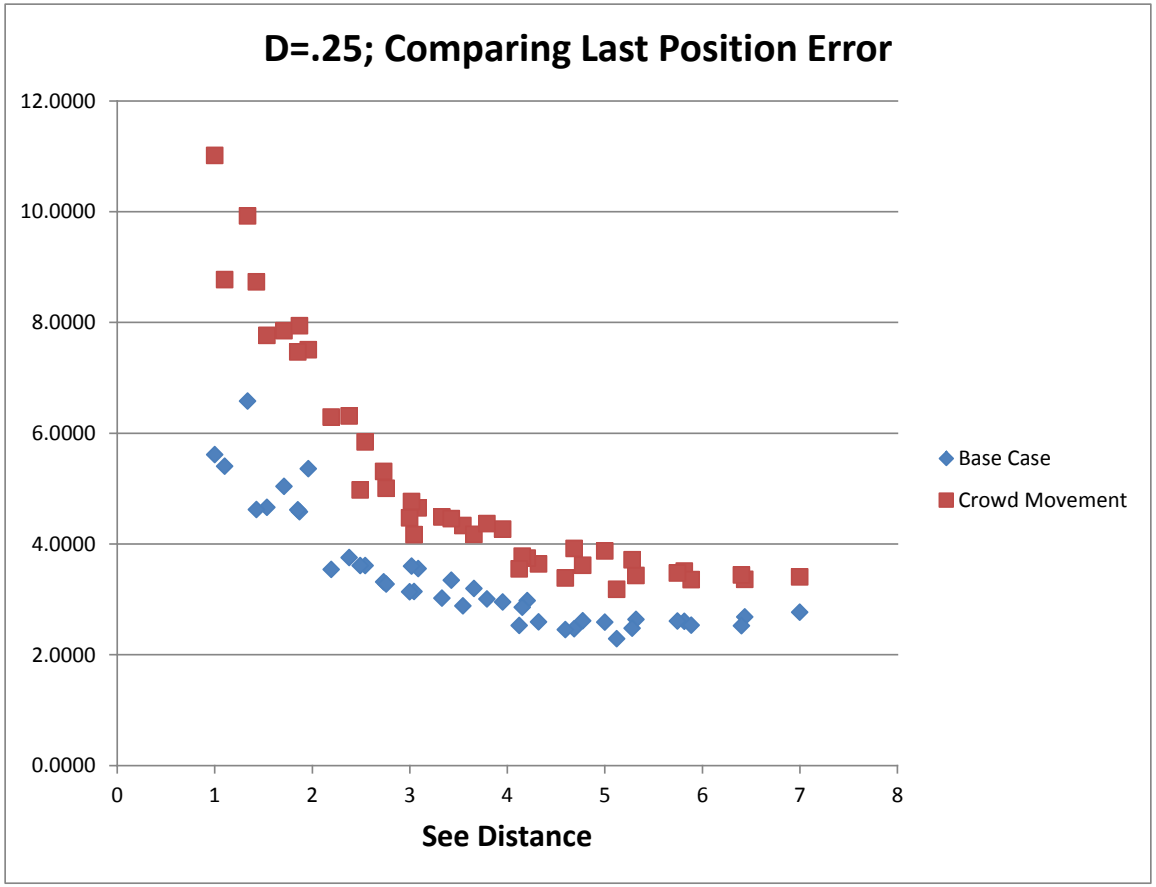
- Little to no variation from the base case for all metrics



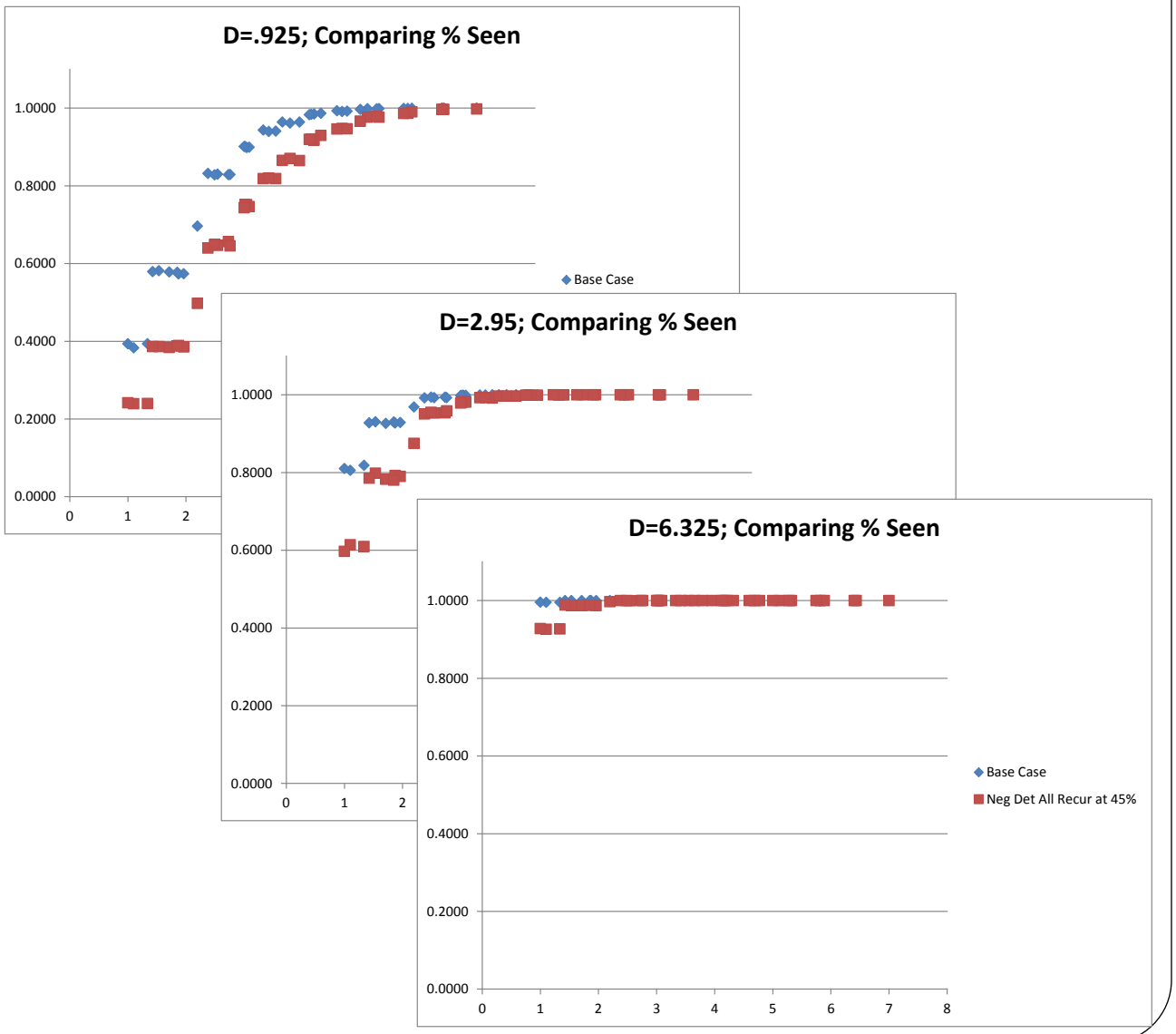
# Excursion Analysis- Crowd Movement

- Minor effect on percent seen
- Significant effect on last position error

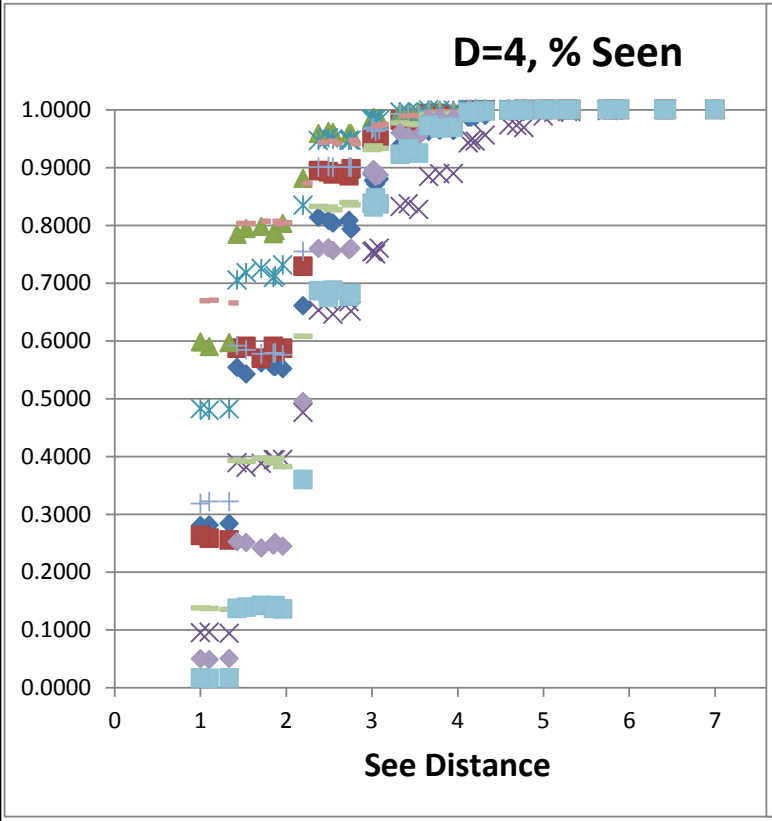


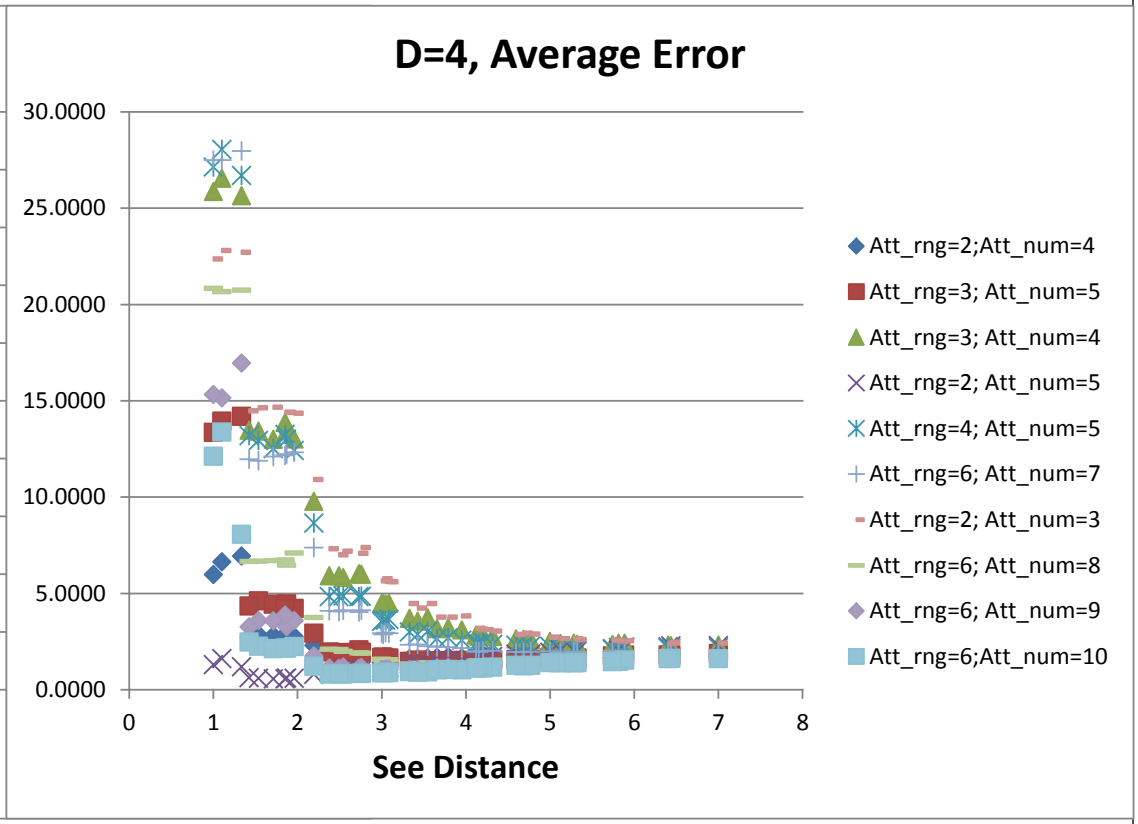
# Excursion Analysis-Negative Detections

- 5% recurrence: no significant effect
- 25% and 45% recurrence: percent seen and maximum location error are affected.
- These effects occur at low densities and/or low “see distances”



# Excursion Analysis-False Detects



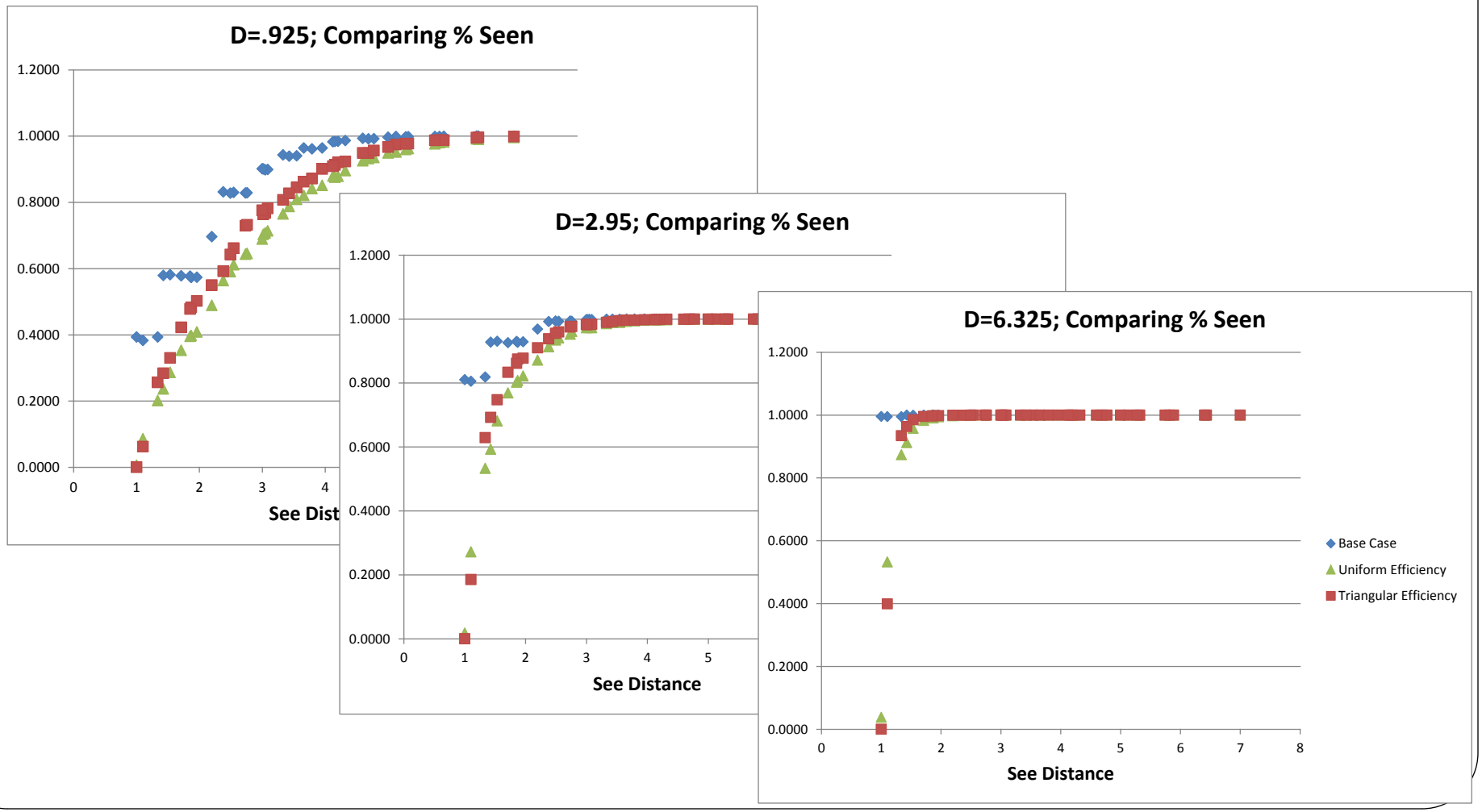
# Excursion Analysis-Distribution of Efficiencies

- Little difference between Uniform[0,100] and Triangular[0,75,100]
- “See distances” in the interval [2, 4] give the most effective network
  - The higher the density, a lower “see distance” is desired to give a better average error
  - The lower the density, a higher “see distance” is desired to give a better percent seen

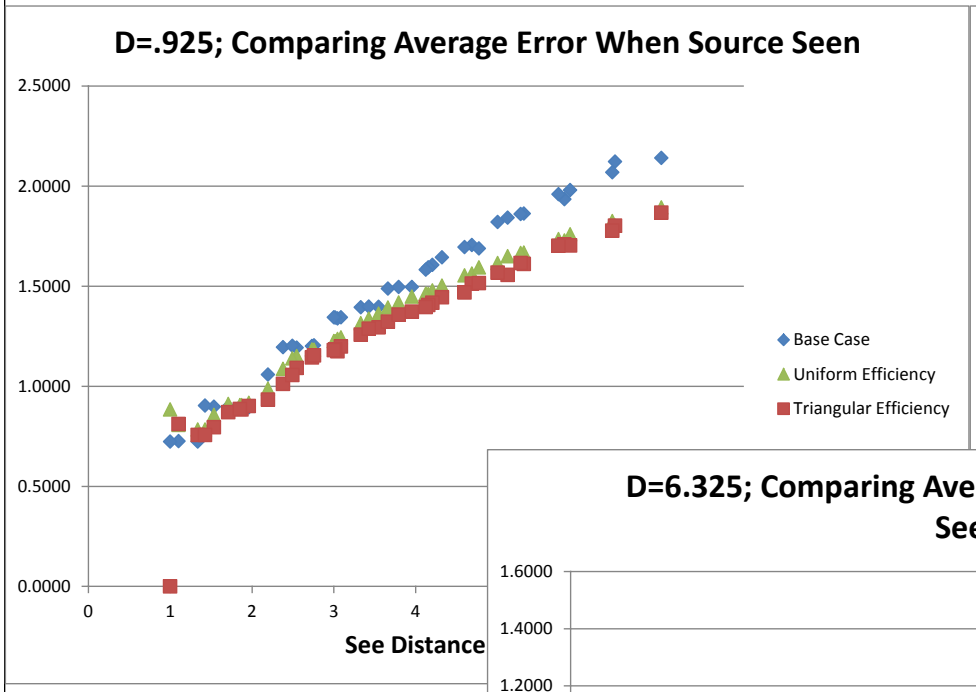
**A balance is needed for an effective network**

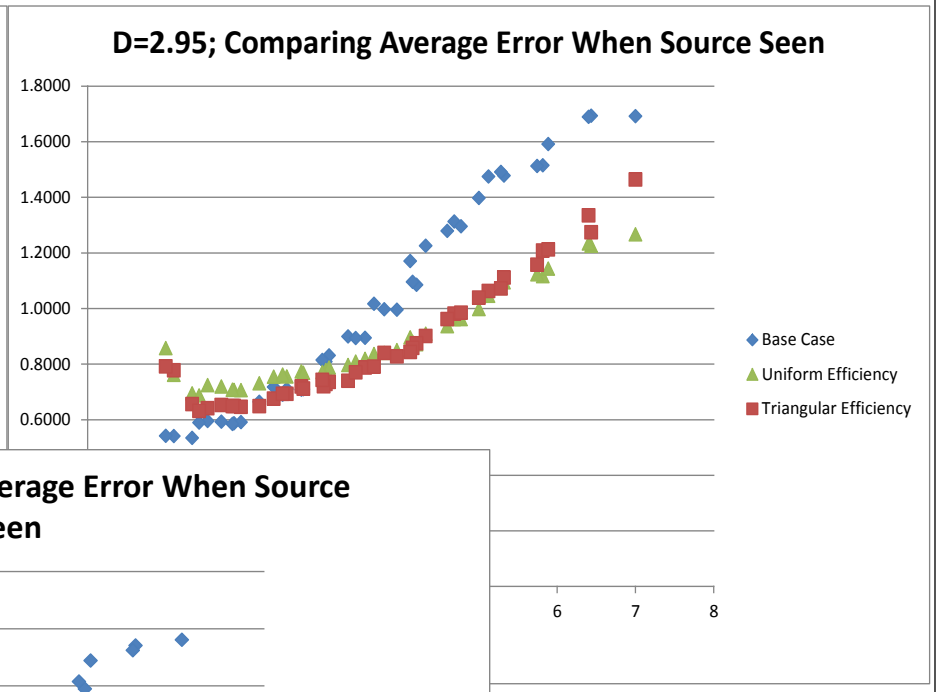
# Excursion Analysis-Distribution of Efficiencies (Percent Seen)

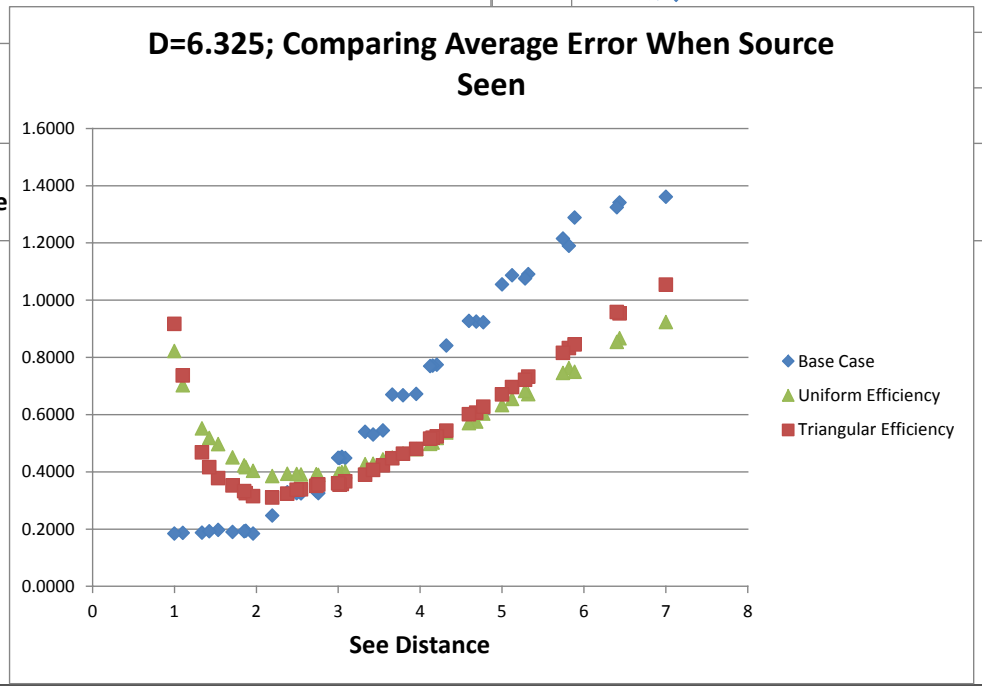
- Major effect at low densities and/or low see distances



# Excursion Analysis-Distribution of Efficiencies (Average Error)



# Conclusions : Framework Characteristics I

- **An estimated strength of a source determines the required sensor strength**

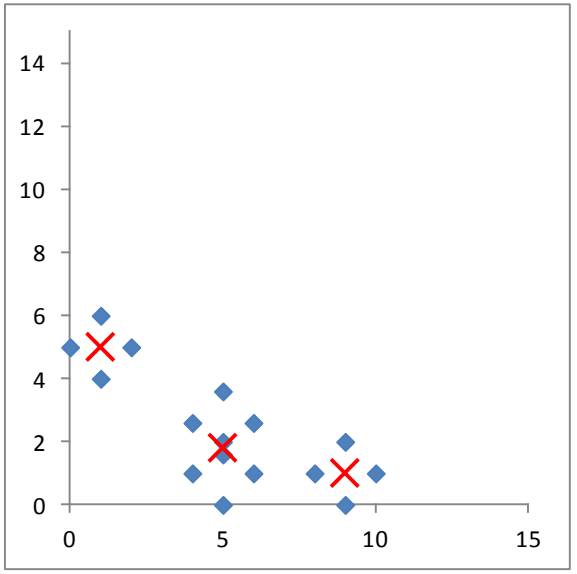
- **Beneficial Sensor Characteristics**
  - A strong sensor that can be dampened
    - Higher density  network – lower sensor strength
    - Lower density network – higher sensor strength
  - A sensor able to detect levels of source emanation
    - Strong sensor

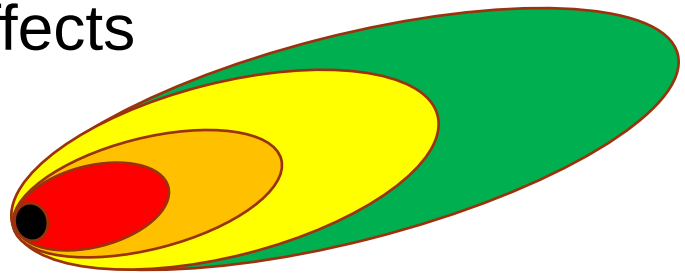
# Conclusions : Framework Characteristics II

- **Negative Detections**
  - Limit the percentage chance of a negative detection
  - High sensor strength/network density can minimize the effects of negative detections
- **False Detections**
  - Use an attenuation parameter
  - Non-detect mode
  - Other localization methods (time-based) and multi targeting algorithms are significant for providing better source position estimation

# Recommendations

- **Multiple target tracking**
  - Multiple Sources
  - False Targets
- **Time based tracking**
  - Target Prediction
  - False Target Elimination
- **Fluid type dispersion**
  - Chemical, Biological, Explosive Source
  - Weather Effects



# Thank You

- Allen Harvey, TASC, Inc.
- Lorton Team, TASC, Inc.
- Dr. Laskey, Capstone Instructor
- George Mason Faculty

# Backup Slides

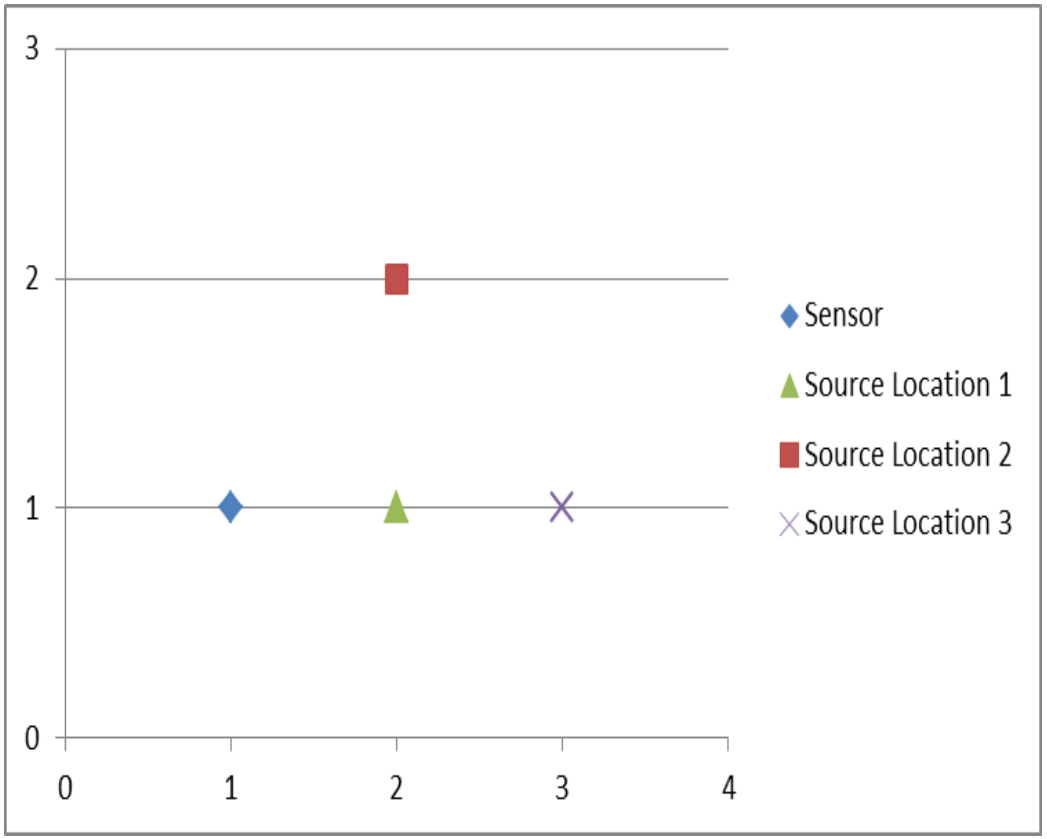
# Deriving “See Distance”

- A sensor strength of Se has the ability to see $\frac{1}{Se}\frac{\text{source units}}{\text{grid units}^2}$
- Source degrades using $\frac{So}{R^2}$
- For a detection:
  - $\frac{So}{R^2} \geq \frac{1}{Se}$
  - $R \leq \sqrt{So * Se}$

- R=distance from source to sensor
- So= Source strength
- Se= Sensor strength

# Reason For Data Clusters

- Detection if:
  - Distance from So to Se $\leq \sqrt{\text{So Strength} * \text{Se Strength}}$



# Model - Output

| 42.0000 | Input | | | | | | | | | | | | | | | | | | | Output | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Main Variables | | | Movement | | | | | | | Visuals | | System Degradation | | | | | | | | | Steps | | | | | | Error | | | | | | | | | | | | |
| Data Set # | Density | Source Str | Sensor Str | So Rnd | So Avoid | So Persist | Crowd Move | Crowd % | Crowd Leave | Parade | Vis | GIS | Min Sensor Eff | False Detect | False % | Neg Detect | Neg % | Att. Number | Att. Dist | # Runs | CL | Steps Not Seen | HW | Steps | HW | % Seen | HW | Avg Detects for Est. Pos. | HW | Min Error | HW | Avg Error | HW | Max Error | HW | Last Position Error: | HW | Max Location Error | HW |
| 1.0000 | 0.2500 | 0.5000 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 142.0600 | 0.6959 | 165.0000 | 0.0000 | 0.1390 | 0.0042 | 2.2013 | 0.0167 | 1.4450 | 0.3333 | 51.8647 | 1.3207 | 142.0891 | 2.6705 | 59.6061 | 7.4702 | 143.6606 | 2.5416 |
| 2.0000 | 0.2500 | 0.5000 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 142.5000 | 0.6670 | 165.0000 | 0.0000 | 0.1364 | 0.0040 | 2.1842 | 0.0166 | 1.2583 | 0.3920 | 51.1133 | 1.5791 | 140.7740 | 3.2851 | 60.9100 | 7.3249 | 142.5349 | 3.1239 |
| 3.0000 | 0.2500 | 0.5000 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 138.7650 | 0.8062 | 165.0000 | 0.0000 | 0.1590 | 0.0049 | 2.2354 | 0.0196 | 0.5041 | 0.0858 | 43.1811 | 1.3905 | 138.6480 | 3.0447 | 54.5834 | 7.3038 | 140.4886 | 2.8988 |
| 4.0000 | 0.2500 | 0.5000 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 139.1750 | 0.8216 | 165.0000 | 0.0000 | 0.1565 | 0.0050 | 2.2385 | 0.0193 | 0.4787 | 0.0838 | 43.5868 | 1.4228 | 141.8580 | 3.0189 | 54.0278 | 7.0604 | 143.0737 | 2.9469 |
| 5.0000 | 0.2500 | 0.5000 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 138.9250 | 0.8685 | 165.0000 | 0.0000 | 0.1580 | 0.0053 | 2.2481 | 0.0203 | 0.5815 | 0.1426 | 44.4106 | 1.5167 | 141.2184 | 3.4523 | 50.1880 | 7.1765 | 142.5717 | 3.3586 |
| 6.0000 | 0.2500 | 1.5833 | 1.2857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 137.8750 | 0.8530 | 165.0000 | 0.0000 | 0.1644 | 0.0052 | 2.2405 | 0.0201 | 0.5004 | 0.0889 | 41.8490 | 1.4710 | 138.9752 | 3.0734 | 50.6231 | 7.2352 | 140.3935 | 2.9327 |
| 7.0000 | 0.2500 | 1.5833 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 137.9500 | 0.8837 | 165.0000 | 0.0000 | 0.1639 | 0.0054 | 2.2396 | 0.0176 | 0.5000 | 0.0772 | 43.7362 | 1.5107 | 140.2378 | 3.0527 | 45.2850 | 6.9631 | 141.8053 | 2.9136 |
| 8.0000 | 0.2500 | 1.5833 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 124.8900 | 1.1284 | 165.0000 | 0.0000 | 0.2431 | 0.0068 | 2.3752 | 0.0221 | 0.2699 | 0.0406 | 29.8098 | 1.2966 | 141.0296 | 3.1052 | 43.6104 | 7.3073 | 142.3990 | 3.0031 |
| 9.0000 | 0.2500 | 1.5833 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 125.1550 | 1.2252 | 165.0000 | 0.0000 | 0.2415 | 0.0074 | 2.3694 | 0.0223 | 0.2952 | 0.0524 | 28.8536 | 1.3163 | 138.7061 | 3.0273 | 41.6658 | 7.0548 | 139.9898 | 2.9351 |
| 10.0000 | 0.2500 | 1.5833 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 115.0600 | 1.4958 | 165.0000 | 0.0000 | 0.3027 | 0.0091 | 2.4681 | 0.0223 | 0.2455 | 0.0371 | 23.2198 | 1.0681 | 141.6164 | 3.4177 | 31.1647 | 6.3383 | 142.4000 | 3.3546 |
| 11.0000 | 0.2500 | 1.5833 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 105.1850 | 1.6108 | 165.0000 | 0.0000 | 0.3625 | 0.0098 | 2.5713 | 0.0248 | 0.2737 | 0.0384 | 19.1214 | 0.8705 | 137.9536 | 3.2341 | 31.2803 | 6.6671 | 139.2824 | 3.1310 |
| 12.0000 | 0.2500 | 2.6667 | 1.2857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 137.9700 | 0.8643 | 165.0000 | 0.0000 | 0.1638 | 0.0052 | 2.2344 | 0.0170 | 0.6627 | 0.3491 | 43.7567 | 1.5567 | 141.5294 | 2.8914 | 53.7748 | 7.2402 | 143.1249 | 2.7332 |
| 13.0000 | 0.2500 | 2.6667 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 126.3000 | 1.1531 | 165.0000 | 0.0000 | 0.2345 | 0.0070 | 2.3613 | 0.0214 | 0.2643 | 0.0403 | 28.5350 | 1.2333 | 138.2975 | 3.3834 | 34.1558 | 6.4961 | 139.6157 | 3.2932 |
| 14.0000 | 0.2500 | 2.6667 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 115.7050 | 1.3745 | 165.0000 | 0.0000 | 0.2988 | 0.0083 | 2.4650 | 0.0253 | 0.2473 | 0.0370 | 22.2092 | 1.0121 | 136.6682 | 3.2824 | 33.0460 | 6.0205 | 137.5945 | 3.2187 |
| 15.0000 | 0.2500 | 2.6667 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 107.2550 | 1.5061 | 165.0000 | 0.0000 | 0.3500 | 0.0091 | 2.5790 | 0.0279 | 0.2683 | 0.0338 | 19.2460 | 0.8088 | 138.8961 | 3.3666 | 31.9051 | 6.1862 | 139.5145 | 3.3366 |
| 16.0000 | 0.2500 | 2.6667 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 96.7550 | 1.6825 | 165.0000 | 0.0000 | 0.4136 | 0.0102 | 2.7118 | 0.0301 | 0.2680 | 0.0346 | 15.8343 | 0.8197 | 136.5925 | 3.7408 | 26.6887 | 5.7659 | 137.4122 | 3.6769 |
| 17.0000 | 0.2500 | 2.6667 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 84.0500 | 1.8119 | 165.0000 | 0.0000 | 0.4906 | 0.0110 | 2.8627 | 0.0347 | 0.3118 | 0.0356 | 13.2953 | 0.5874 | 132.3623 | 3.4345 | 24.3040 | 5.5967 | 133.4202 | 3.3701 |
| 18.0000 | 0.2500 | 3.7500 | 1.2857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 134.1850 | 0.8727 | 165.0000 | 0.0000 | 0.1868 | 0.0053 | 2.2701 | 0.0191 | 0.3702 | 0.0558 | 39.0357 | 1.4942 | 142.2745 | 3.1960 | 46.2644 | 7.0460 | 143.7451 | 3.0497 |
| 19.0000 | 0.2500 | 3.7500 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 115.9200 | 1.3788 | 165.0000 | 0.0000 | 0.2975 | 0.0084 | 2.4799 | 0.0246 | 0.2664 | 0.0429 | 23.3187 | 1.0615 | 138.3270 | 3.1362 | 33.0065 | 6.4817 | 139.5460 | 3.0446 |
| 20.0000 | 0.2500 | 3.7500 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 96.7150 | 1.6204 | 165.0000 | 0.0000 | 0.4138 | 0.0098 | 2.6772 | 0.0270 | 0.2405 | 0.0359 | 16.1073 | 0.7801 | 136.6334 | 3.5467 | 30.1354 | 6.4777 | 137.9112 | 3.4233 |
| 21.0000 | 0.2500 | 3.7500 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 87.3050 | 1.8223 | 165.0000 | 0.0000 | 0.4709 | 0.0110 | 2.8041 | 0.0299 | 0.2935 | 0.0369 | 14.2225 | 0.6293 | 135.6566 | 3.6055 | 25.4132 | 5.7167 | 136.5310 | 3.5132 |
| 22.0000 | 0.2500 | 3.7500 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 76.2950 | 1.7812 | 165.0000 | 0.0000 | 0.5376 | 0.0108 | 2.9450 | 0.0324 | 0.2897 | 0.0364 | 12.2351 | 0.5468 | 133.3566 | 3.6397 | 28.2675 | 6.0150 | 134.5989 | 3.5828 |
| 23.0000 | 0.2500 | 3.7500 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 65.3100 | 1.6411 | 165.0000 | 0.0000 | 0.6042 | 0.0099 | 3.1440 | 0.0374 | 0.3295 | 0.0334 | 10.3141 | 0.4079 | 129.0644 | 4.1023 | 21.4842 | 5.2474 | 130.1319 | 4.0248 |
| 24.0000 | 0.2500 | 4.8333 | 1.2857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 125.3400 | 1.1827 | 165.0000 | 0.0000 | 0.2404 | 0.0072 | 2.3571 | 0.0223 | 0.2416 | 0.0404 | 28.3986 | 1.2461 | 136.9278 | 3.2445 | 39.8731 | 6.7901 | 138.2411 | 3.1315 |
| 25.0000 | 0.2500 | 4.8333 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 106.2100 | 1.4923 | 165.0000 | 0.0000 | 0.3563 | 0.0090 | 2.5803 | 0.0262 | 0.2566 | 0.0333 | 18.6968 | 0.8085 | 138.9721 | 3.4318 | 27.4143 | 5.6226 | 139.5782 | 3.3956 |
| 26.0000 | 0.2500 | 4.8333 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 88.0550 | 1.6314 | 165.0000 | 0.0000 | 0.4663 | 0.0099 | 2.8171 | 0.0338 | 0.2924 | 0.0336 | 13.9634 | 0.6413 | 134.3420 | 3.9159 | 25.2817 | 5.4200 | 135.1134 | 3.8792 |
| 27.0000 | 0.2500 | 4.8333 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 76.6050 | 1.9486 | 165.0000 | 0.0000 | 0.5357 | 0.0118 | 2.9643 | 0.0347 | 0.3007 | 0.0346 | 11.9345 | 0.5744 | 131.0990 | 3.7964 | 23.1328 | 5.5541 | 132.0878 | 3.7613 |
| 28.0000 | 0.2500 | 4.8333 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 63.8400 | 1.6884 | 165.0000 | 0.0000 | 0.6131 | 0.0102 | 3.1578 | 0.0399 | 0.3180 | 0.0375 | 10.6648 | 0.4236 | 129.1409 | 3.9691 | 16.0718 | 4.3287 | 129.8980 | 3.8972 |
| 29.0000 | 0.2500 | 4.8333 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 57.7650 | 1.6673 | 165.0000 | 0.0000 | 0.6499 | 0.0101 | 3.2676 | 0.0366 | 0.3555 | 0.0419 | 9.9686 | 0.4144 | 127.5096 | 4.1352 | 25.6441 | 6.1422 | 128.7356 | 4.0748 |
| 30.0000 | 0.2500 | 5.9167 | 1.2857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 124.8400 | 1.2702 | 165.0000 | 0.0000 | 0.2434 | 0.0077 | 2.3655 | 0.0218 | 0.2923 | 0.0517 | 29.0611 | 1.3243 | 139.6109 | 3.0411 | 42.5016 | 7.1645 | 140.8754 | 2.9527 |
| 31.0000 | 0.2500 | 5.9167 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 97.3700 | 1.7174 | 165.0000 | 0.0000 | 0.4099 | 0.0104 | 2.6582 | 0.0268 | 0.2820 | 0.0375 | 16.6970 | 0.8122 | 141.1203 | 3.5794 | 25.8779 | 5.8900 | 141.8187 | 3.4961 |
| 32.0000 | 0.2500 | 5.9167 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 76.8450 | 1.7480 | 165.0000 | 0.0000 | 0.5343 | 0.0106 | 2.9556 | 0.0333 | 0.2598 | 0.0370 | 12.1589 | 0.4995 | 131.2879 | 3.6999 | 24.6605 | 5.7225 | 132.6069 | 3.6331 |
| 33.0000 | 0.2500 | 5.9167 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 63.6100 | 1.6508 | 165.0000 | 0.0000 | 0.6145 | 0.0100 | 3.1619 | 0.0363 | 0.3509 | 0.0344 | 10.4213 | 0.4510 | 127.8872 | 3.7909 | 28.5482 | 5.9309 | 129.1750 | 3.7002 |
| 34.0000 | 0.2500 | 5.9167 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 55.2850 | 1.4841 | 165.0000 | 0.0000 | 0.6649 | 0.0090 | 3.3082 | 0.0402 | 0.3805 | 0.0420 | 9.1834 | 0.3335 | 122.1927 | 4.4391 | 16.6510 | 4.5342 | 123.1727 | 4.4246 |
| 35.0000 | 0.2500 | 5.9167 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 43.3250 | 1.4744 | 165.0000 | 0.0000 | 0.7374 | 0.0089 | 3.5949 | 0.0408 | 0.3522 | 0.0350 | 8.3799 | 0.3003 | 117.6716 | 4.7005 | 13.9286 | 4.1014 | 118.5612 | 4.6628 |
| 36.0000 | 0.2500 | 7.0000 | 0.1429 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 142.5500 | 0.7942 | 165.0000 | 0.0000 | 0.1361 | 0.0048 | 2.2120 | 0.0201 | 1.2581 | 0.2716 | 51.7095 | 1.5126 | 140.4709 | 3.2790 | 61.8015 | 7.3552 | 142.0764 | 3.1720 |
| 37.0000 | 0.2500 | 7.0000 | 1.2857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 114.4300 | 1.3887 | 165.0000 | 0.0000 | 0.3065 | 0.0084 | 2.5011 | 0.0264 | 0.2879 | 0.0366 | 22.0068 | 1.0491 | 138.9390 | 3.3884 | 28.3103 | 6.0112 | 139.8939 | 3.3053 |
| 38.0000 | 0.2500 | 7.0000 | 2.4286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 86.9350 | 1.8303 | 165.0000 | 0.0000 | 0.4731 | 0.0111 | 2.8201 | 0.0338 | 0.2922 | 0.0367 | 13.8433 | 0.6406 | 133.6591 | 3.4128 | 24.3489 | 5.5236 | 134.8016 | 3.3346 |
| 39.0000 | 0.2500 | 7.0000 | 3.5714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 68.6800 | 1.6430 | 165.0000 | 0.0000 | 0.5838 | 0.0100 | 3.0434 | 0.0328 | 0.3027 | 0.0377 | 11.5406 | 0.4943 | 135.4330 | 3.8687 | 21.6964 | 5.5422 | 136.0068 | 3.8178 |
| 40.0000 | 0.2500 | 7.0000 | 4.7143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 59.0950 | 1.6499 | 165.0000 | 0.0000 | 0.6418 | 0.0100 | 3.2748 | 0.0383 | 0.3489 | 0.0425 | 10.0096 | 0.4102 | 126.5632 | 4.0501 | 21.1844 | 5.4503 | 127.9056 | 3.9750 |
| 41.0000 | 0.2500 | 7.0000 | 5.8571 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 41.0850 | 1.2835 | 165.0000 | 0.0000 | 0.7510 | 0.0078 | 3.5858 | 0.0387 | 0.3799 | 0.0441 | 8.4139 | 0.3154 | 116.6970 | 4.7154 | 18.3999 | 5.0420 | 117.5811 | 4.6946 |
| 42.0000 | 0.2500 | 7.0000 | 7.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 5.0000 | 0.0000 | 0.0000 | 2.0000 | 6.0000 | 200.0000 | 0.9500 | 39.4600 | 1.4664 | 165.0000 | 0.0000 | 0.7608 | 0.0089 | 3.6941 | 0.0427 | 0.3761 | 0.0397 | 8.3850 | 0.2766 | 112.7273 | 4.4088 | 20.0841 | 5.2554 | 113.8093 | 4.3957 |

# Model – GIS Data

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | 56 | 1 | 14 | 47 | 56 | 74 | 58 | 49 | 58 | 49.7 | 56.8 | 61 | 56 | 1 | 14 | 47 | 56 | 106 | 57 | 48 | 58 | 48.2 | 56.6 | 61 | 56 | 1 | 14 | 47 | 56 | 4 | 55 | 47 | 58 | 46.8 | 56.7 |
| 174 | 58 | 4 | 14 | 49 | 58 | 136 | 57 | | | | | 174 | 58 | 4 | 14 | 49 | 58 | 104 | 58 | | | | | 174 | 58 | 4 | 14 | 49 | 58 | 1 | 59 | | | | |
| 47 | 56 | 7 | 14 | 45 | 57 | 3 | 58 | | | | | 47 | 56 | 7 | 14 | 45 | 57 | 15 | 57 | | | | | 47 | 56 | 7 | 14 | 45 | 57 | 58 | 20 | | | | |
| 174 | 56 | 10 | 14 | 52 | 60 | 187 | 56 | | | | | 174 | 56 | 10 | 14 | 52 | 57 | 187 | 56 | | | | | 174 | 56 | 10 | 14 | 43 | 59 | 61 | 32 | | | | |
| 22 | 60 | 13 | 14 | 53 | 57 | 103 | 55 | | | | | 22 | 60 | 13 | 14 | 51 | 58 | 129 | 59 | | | | | 22 | 60 | 13 | 14 | 51 | 58 | 105 | 35 | | | | |
| 59 | 55 | 16 | 14 | 52 | 57 | 24 | 57 | | | | | 59 | 55 | 16 | 14 | 50 | 58 | 70 | 26 | | | | | 59 | 55 | 16 | 14 | 50 | 58 | 126 | 35 | | | | |
| 141 | 56 | 19 | 14 | 53 | 59 | 34 | 35 | | | | | 141 | 56 | 19 | 14 | 51 | 56 | 43 | 32 | | | | | 141 | 56 | 19 | 14 | 48 | 55 | 161 | 21 | | | | |
| 93 | 57 | 22 | 14 | 51 | 58 | 73 | 38 | | | | | 93 | 57 | 22 | 14 | 48 | 55 | 155 | 23 | | | | | 93 | 57 | 22 | 14 | 44 | 57 | 165 | 33 | | | | |
| 145 | 55 | 25 | 14 | 50 | 58 | 155 | 23 | | | | | 145 | 55 | 25 | 14 | 44 | 57 | | | | | | | 145 | 55 | 25 | 14 | 43 | 58 | | | | | | |
| 84 | 58 | 28 | 14 | 51 | 56 | | | | | | | 84 | 58 | 28 | 14 | 45 | 55 | | | | | | | 84 | 58 | 28 | 14 | 45 | 55 | | | | | | |
| 49 | 58 | 31 | 14 | 48 | 55 | | | | | | | 49 | 58 | 31 | 14 | 49 | 56 | | | | | | | 49 | 58 | 31 | 14 | 44 | 55 | | | | | | |
| 186 | 57 | 34 | 14 | 49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 106 | 60 | 37 | 14 | 50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | 58 | 40 | 14 | 49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 151 | 55 | 43 | 14 | 50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 97 | 55 | 46 | 14 | 46 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 90 | 57 | 49 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | 56 | 52 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45 | 57 | 55 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | 57 | 58 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | 55 | 61 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 167 | 55 | 64 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 95 | 58 | 67 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | 58 | 70 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Convert

| Crowd | | Parade | | True Detects | | False Detects | | Current | | Estimated | | Crowd | | Parade | | True Detects | | False Detects | | Current | | Estimated | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.77779 | -73.975 | 40.77756 | -73.9749 | 40.77775 | -73.975 | 40.77783 | -73.9749 | 40.77776 | -73.975 | 40.77776 | -73.975 | 40.77779 | -73.975 | 40.77756 | -73.9749 | 40.77775 | -73.975 | 40.77792 | -73.9749 | 40.77776 | -73.975 | 40.77776 | -73.975 |
| 40.7781 | -73.9747 | 40.77757 | -73.9749 | 40.77776 | -73.975 | 40.778 | -73.9748 | | | | | 40.7781 | -73.9747 | 40.77757 | -73.9749 | 40.77776 | -73.975 | 40.77791 | -73.9749 | | | | |
| 40.77775 | -73.975 | 40.77758 | -73.9749 | 40.77775 | -73.975 | 40.77763 | -73.9751 | | | | | 40.77775 | -73.975 | 40.77758 | -73.9749 | 40.77775 | -73.975 | 40.77766 | -73.9751 | | | | |
| 40.7781 | -73.9747 | 40.77759 | -73.9749 | 40.77777 | -73.975 | 40.77814 | -73.9747 | | | | | 40.7781 | -73.9747 | 40.77759 | -73.9749 | 40.77777 | -73.975 | 40.77814 | -73.9747 | | | | |
| 40.77769 | -73.9751 | 40.7776 | -73.9749 | 40.77777 | -73.975 | 40.77791 | -73.9749 | | | | | 40.77769 | -73.9751 | 40.7776 | -73.9749 | 40.77777 | -73.975 | 40.77798 | -73.9748 | | | | |
| 40.77778 | -73.975 | 40.7776 | -73.9749 | 40.77777 | -73.975 | 40.77769 | -73.975 | | | | | 40.77778 | -73.975 | 40.7776 | -73.9749 | 40.77776 | -73.975 | 40.77777 | -73.9748 | | | | |
| 40.77801 | -73.9748 | 40.77761 | -73.9749 | 40.77777 | -73.975 | 40.77769 | -73.9749 | | | | | 40.77801 | -73.9748 | 40.77761 | -73.9749 | 40.77776 | -73.975 | 40.77771 | -73.9749 | | | | |
| 40.77788 | -73.9749 | 40.77762 | -73.9749 | 40.77777 | -73.975 | 40.7778 | -73.9749 | | | | | 40.77788 | -73.9749 | 40.77762 | -73.9749 | 40.77775 | -73.975 | 40.778 | -73.9746 | | | | |
| 40.77802 | -73.9748 | 40.77763 | -73.9749 | 40.77776 | -73.975 | 40.778 | -73.9746 | | | | | 40.77802 | -73.9748 | 40.77763 | -73.9749 | 40.77774 | -73.975 | | | | | | |
| 40.77786 | -73.9749 | 40.77764 | -73.9749 | 40.77776 | -73.975 | | | | | | | 40.77786 | -73.9749 | 40.77764 | -73.9749 | 40.77775 | -73.975 | | | | | | |
| 40.77776 | -73.975 | 40.77765 | -73.9749 | 40.77775 | -73.975 | | | | | | | 40.77776 | -73.975 | 40.77765 | -73.9749 | 40.77776 | -73.975 | | | | | | |
| 40.77814 | -73.9747 | 40.77765 | -73.9749 | 40.77776 | -73.975 | | | | | | | 40.77814 | -73.9747 | 40.77765 | -73.9749 | 40.77776 | -73.975 | | | | | | |
| 40.77792 | -73.9749 | 40.77766 | -73.9748 | 40.77776 | -73.975 | | | | | | | 40.77792 | -73.9749 | 40.77766 | -73.9748 | 40.77776 | -73.975 | | | | | | |
| 40.77769 | -73.975 | 40.77767 | -73.9748 | 40.77776 | -73.975 | | | | | | | 40.77769 | -73.975 | 40.77767 | -73.9748 | 40.77776 | -73.975 | | | | | | |
| 40.77804 | -73.9748 | 40.77768 | -73.9748 | 40.77776 | -73.975 | | | | | | | 40.77804 | -73.9748 | 40.77768 | -73.9748 | 40.77775 | -73.975 | | | | | | |
| 40.77789 | -73.9749 | 40.77769 | -73.9748 | 40.77775 | -73.975 | | | | | | | 40.77789 | -73.9749 | 40.77769 | -73.9748 | 40.77775 | -73.975 | | | | | | |
| 40.77787 | -73.9749 | 40.7777 | -73.9748 | | | | | | | | | 40.77787 | -73.9749 | 40.7777 | -73.9748 | | | | | | | | |
| 40.77768 | -73.975 | 40.7777 | -73.9748 | | | | | | | | | 40.77768 | -73.975 | 40.7777 | -73.9748 | | | | | | | | |
| 40.77775 | -73.975 | 40.77771 | -73.9748 | | | | | | | | | 40.77775 | -73.975 | 40.77771 | -73.9748 | | | | | | | | |
| 40.77767 | -73.9751 | 40.77772 | -73.9748 | | | | | | | | | 40.77767 | -73.9751 | 40.77772 | -73.9748 | | | | | | | | |
| 40.77765 | -73.9751 | 40.77773 | -73.9748 | | | | | | | | | 40.77765 | -73.9751 | 40.77773 | -73.9748 | | | | | | | | |
| 40.77808 | -73.9747 | 40.77774 | -73.9748 | | | | | | | | | 40.77808 | -73.9747 | 40.77774 | -73.9748 | | | | | | | | |
| 40.77789 | -73.9749 | 40.77775 | -73.9748 | | | | | | | | | 40.77789 | -73.9749 | 40.77775 | -73.9748 | | | | | | | | |