

Location Verification Performance in the Presence of Verifier Location Error

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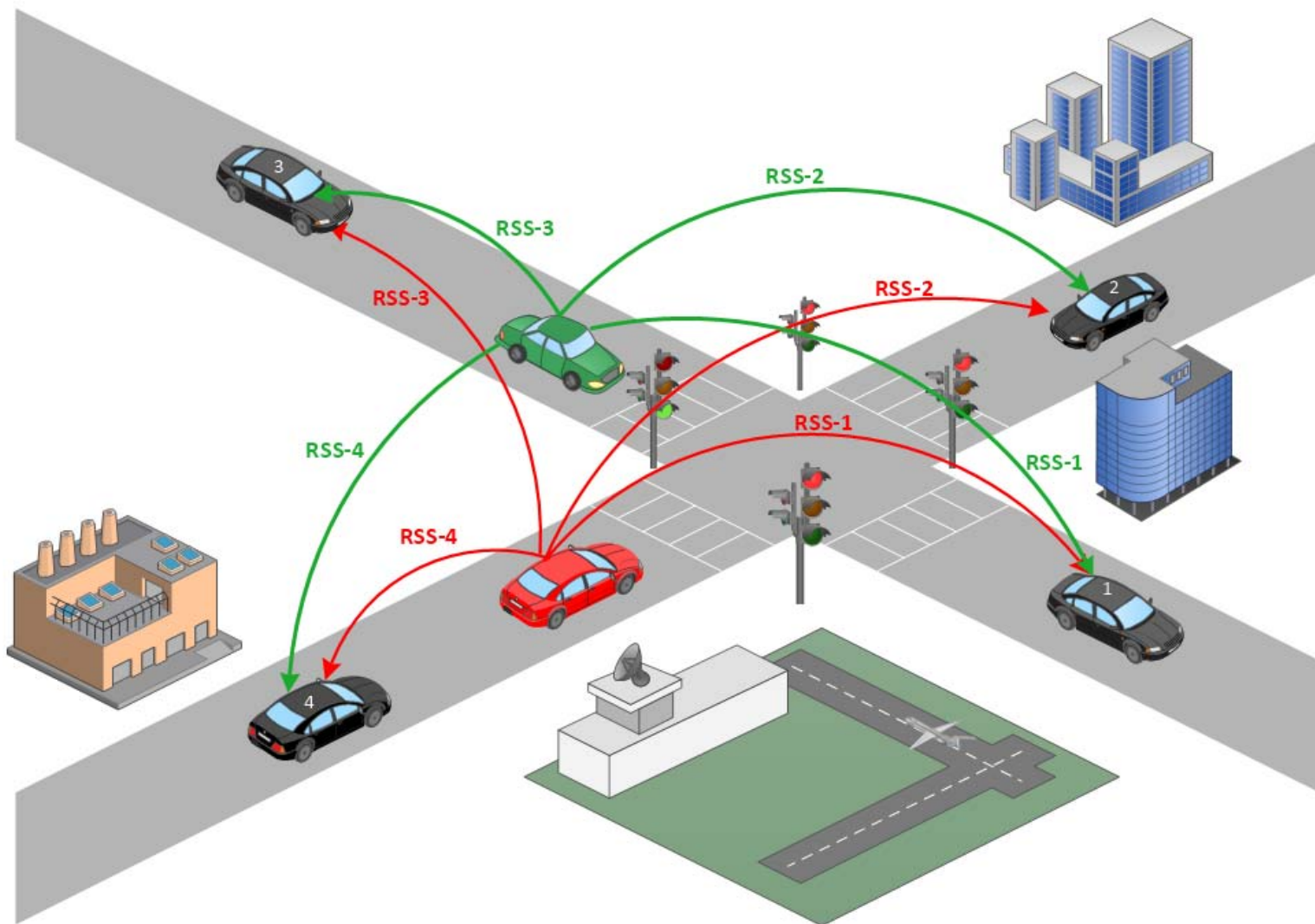
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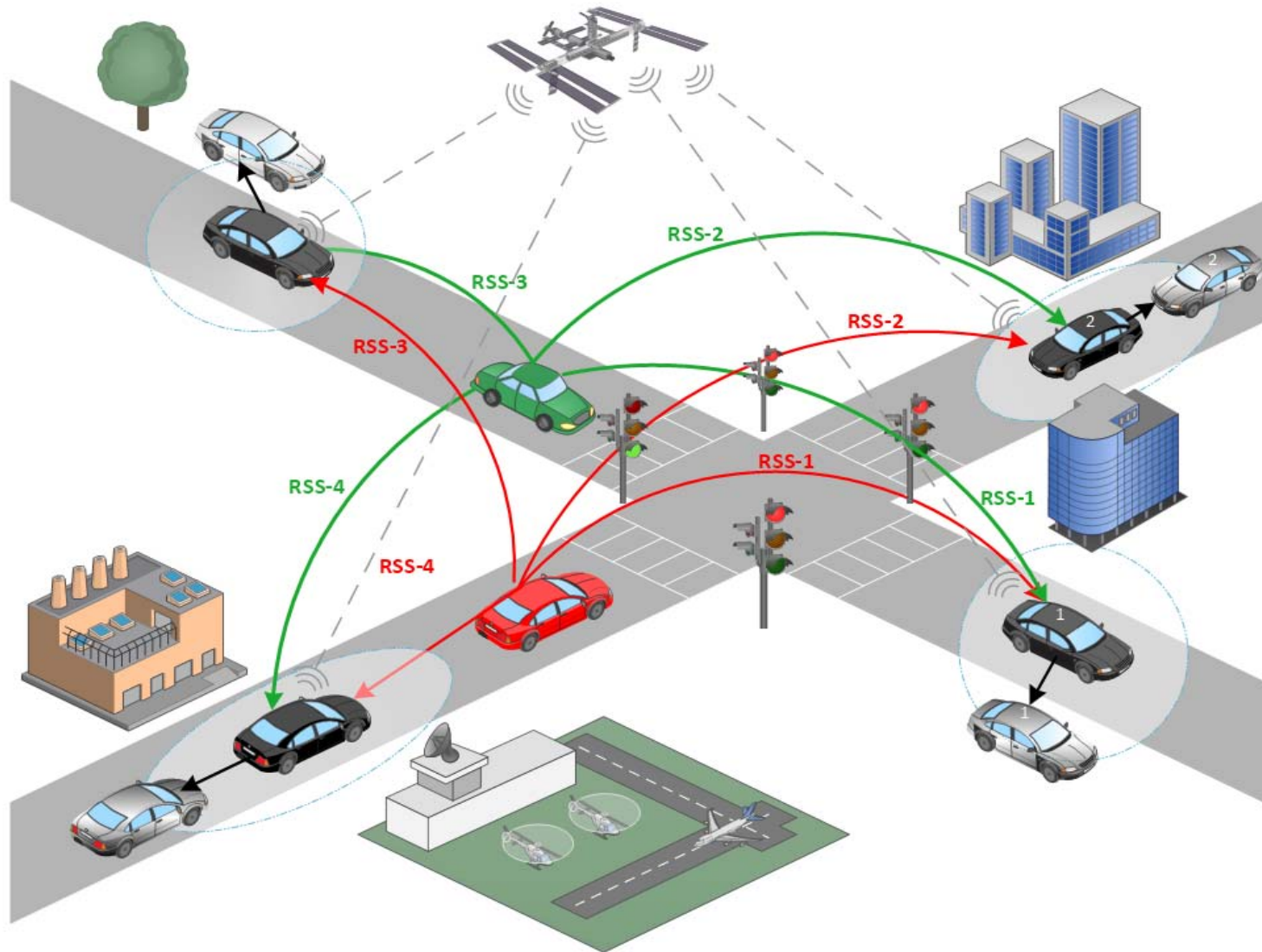
Performance Evaluation of a Signal Strength Location Verification System (LVS) in the presence of GNSS positioning errors.

The Problem Statement

What is Already Done.

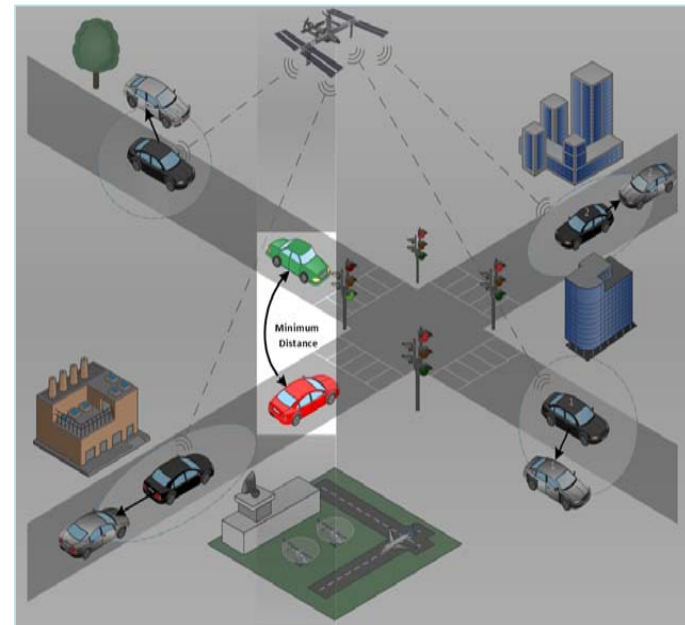
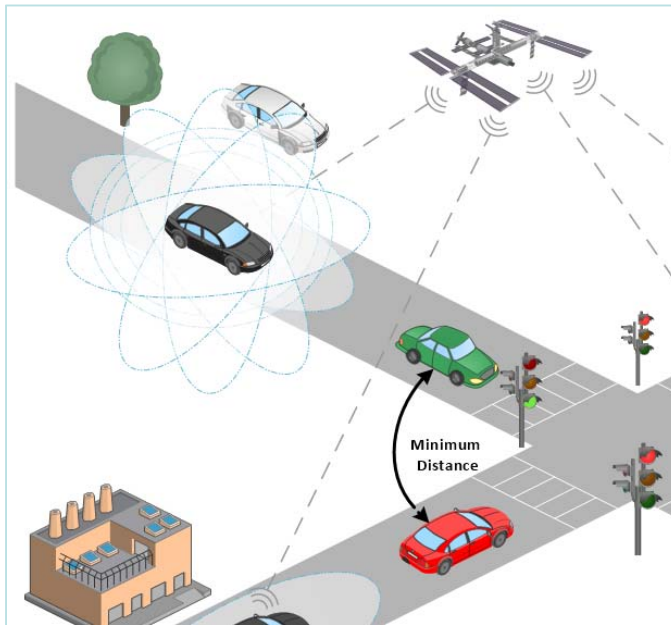


What's New?



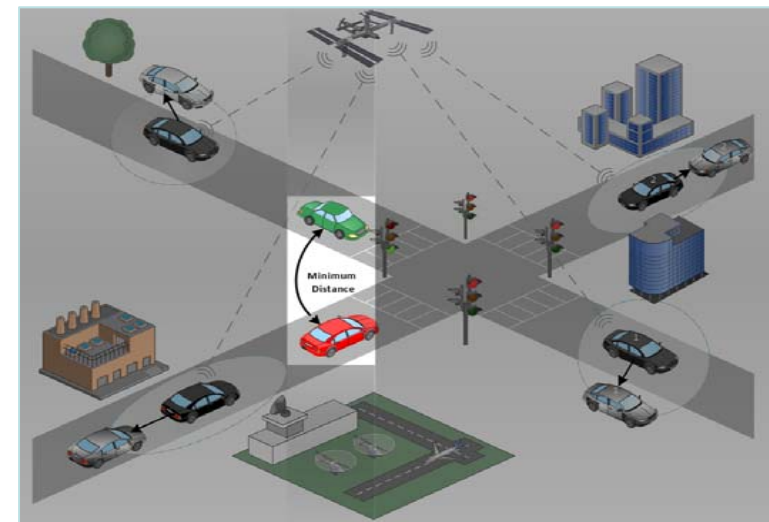
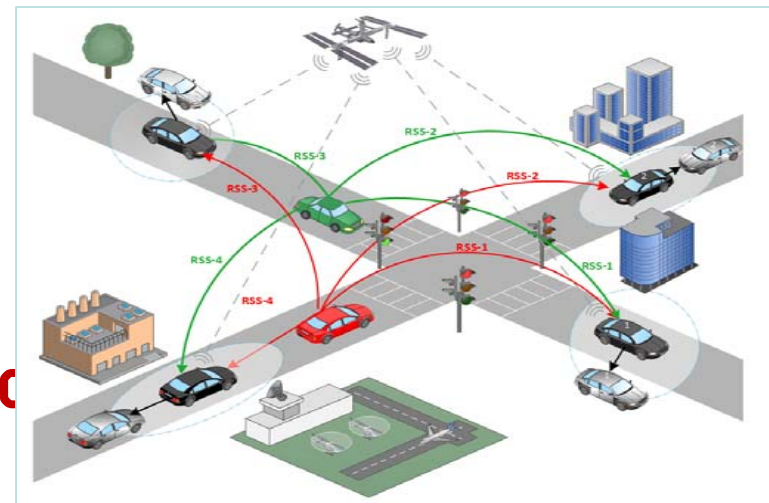
- Studying the performance of optimal DRSS based LVS with,
 - Changing positioning errors in verifiers true location.
 - Changing number of verifiers.
 - Modification of the minimum distance constraint between true and claimed (untrue) position of malicious vehicle.
 - Uniform and non-uniform localization errors in x and y directions.

Main Idea



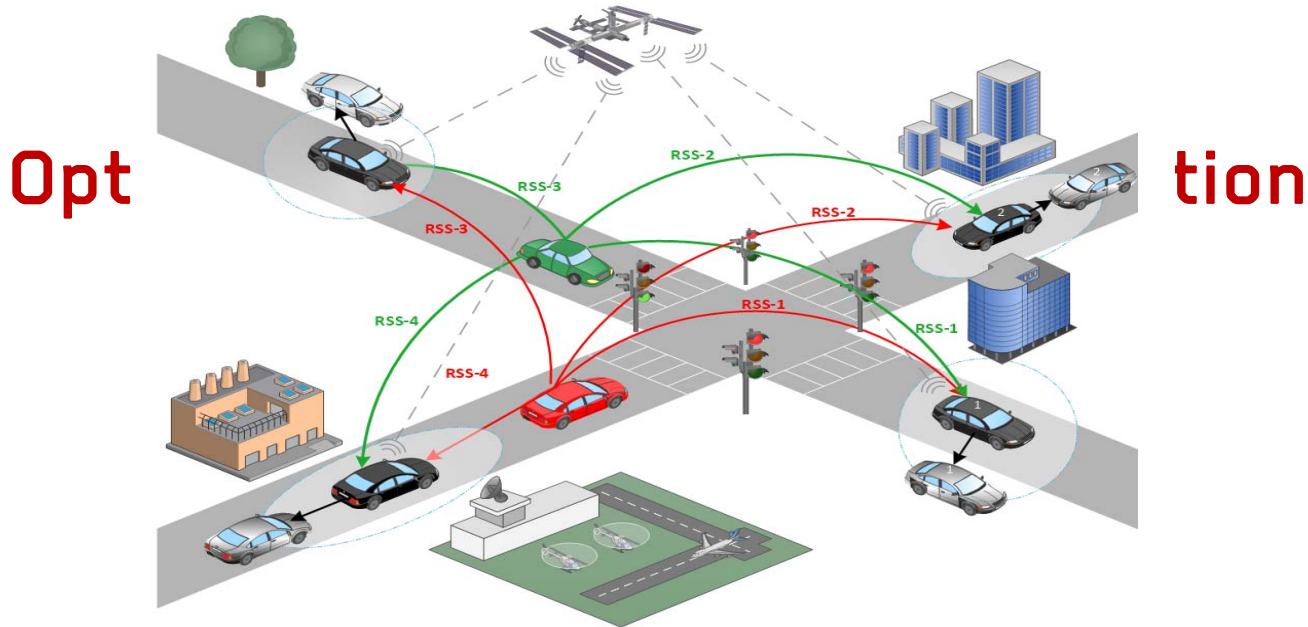
System Model

- Channel conditions are a priori.
- 'N' number of verifiers with known location.
- Introducing a gaussian localization error to the positions of verifiers.
- A good user at the claimed location and a malicious user at the optimal attack location.
- A minimum distance constraint for the malicious user.
- LRT is used in the detection system.
- System performance is evaluated by 'False Positive Rate' and 'Detection Rate'.



Calculation of optimal location for the malicious vehicle,

$$\mathbf{X}_t^* = \underset{\|\mathbf{X}_t - \mathbf{X}_c\| \geq r}{\operatorname{argmin}} \varphi(\mathbf{X}_t)$$



Whereas,

$$\varphi(\mathbf{X}_t) = \frac{1}{2} (\Delta \mathbf{v} - \Delta \mathbf{u})^T \mathbf{D}^{-1} (\Delta \mathbf{v} - \Delta \mathbf{u})$$

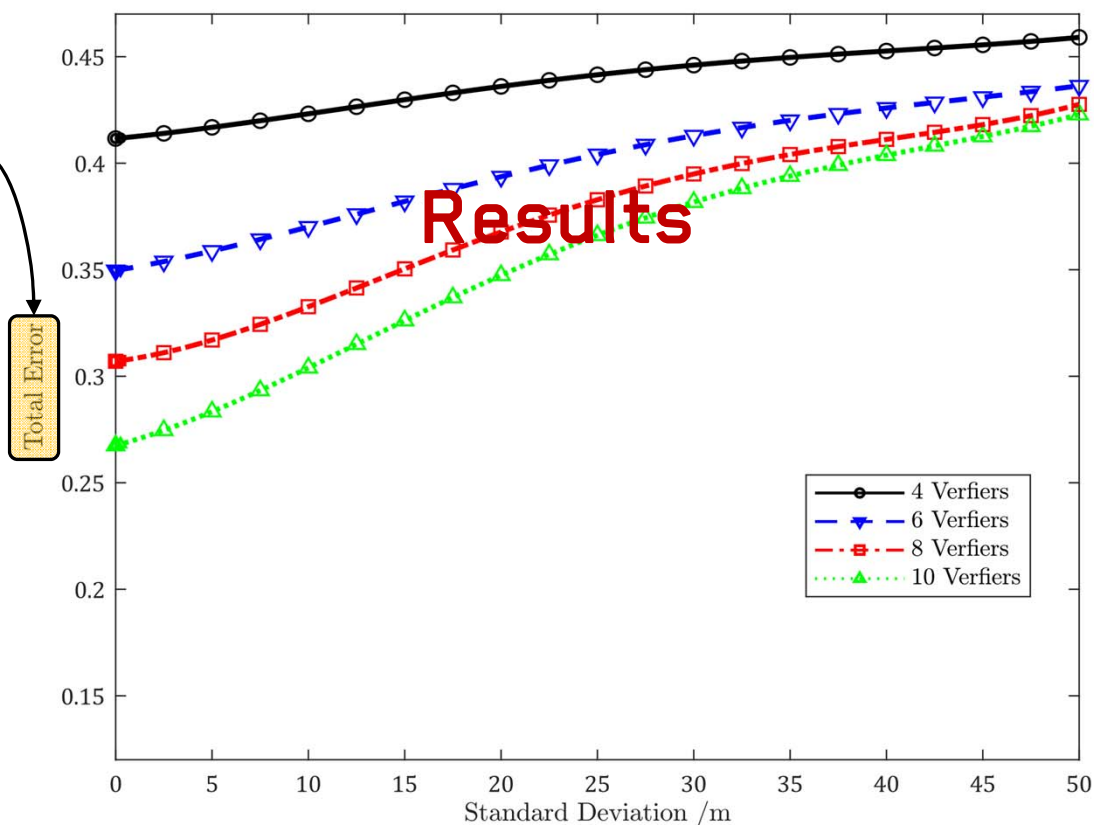
Bayes average cost function for LVS performance evaluation,

$$\epsilon = 0.5 \times \alpha + 0.5 \times (1 - \beta).$$

Total Error

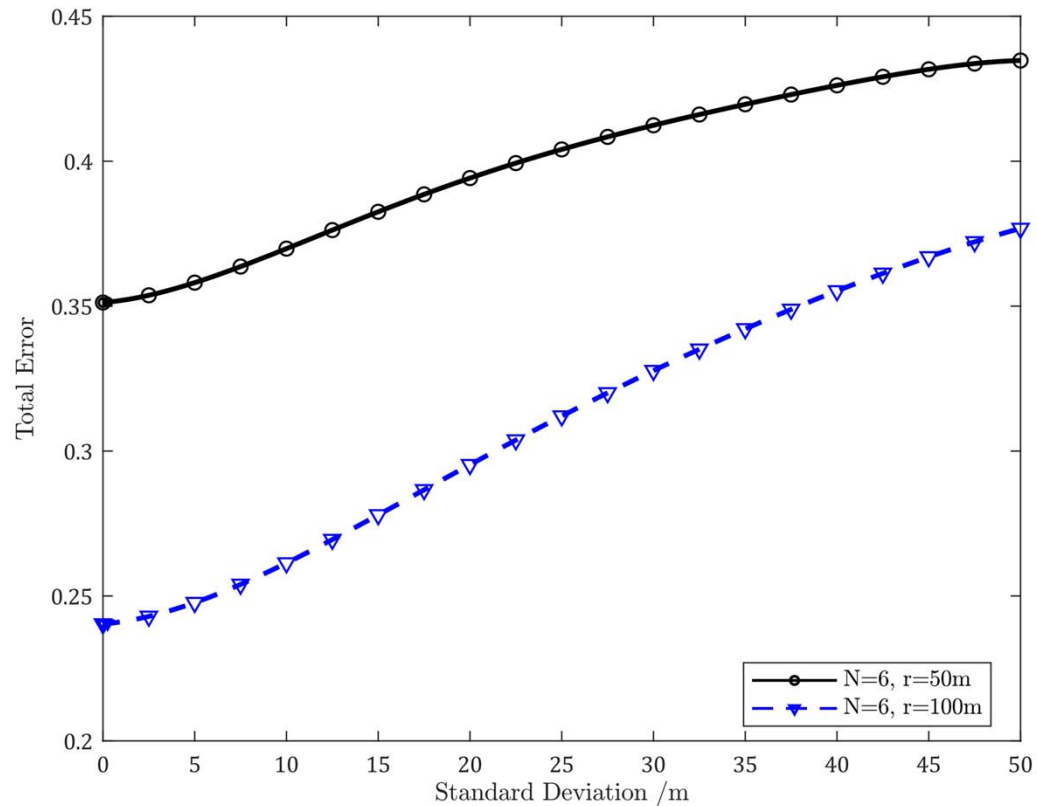
False Positive Rate

Detection Rate



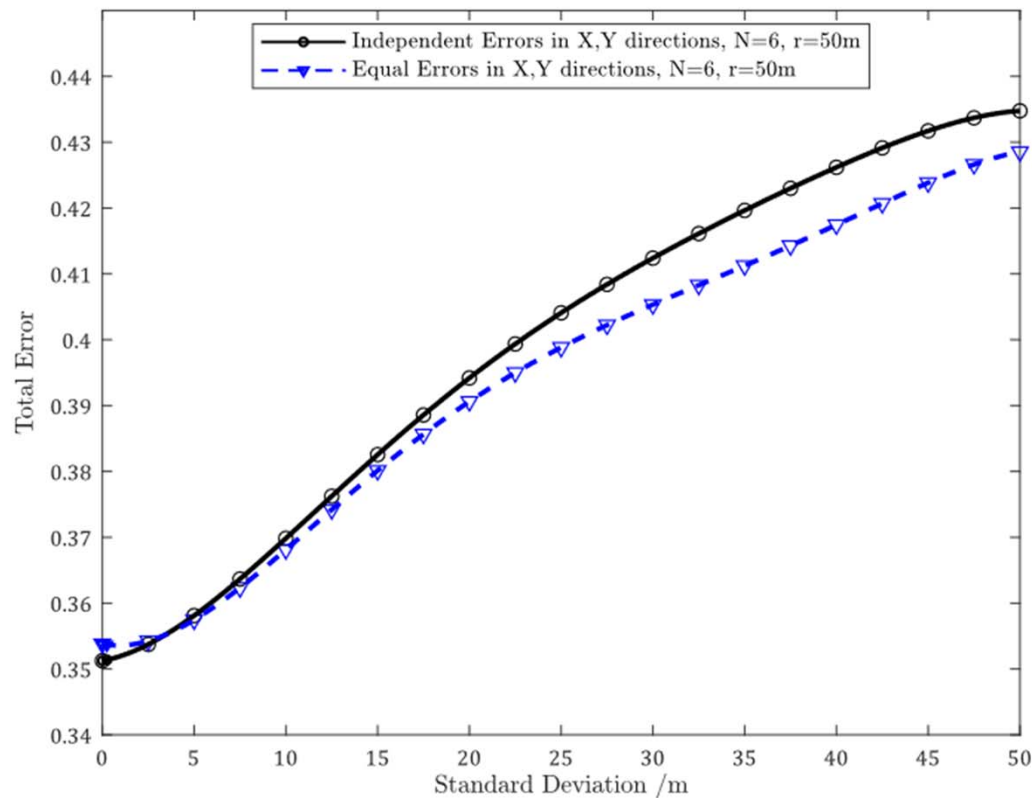
Total error curves of the DRSS-based LVS for $\sigma_{dB} = 5$, $D_c = 400m$, $r = 50m$, $X_t = X_t^*$ and $N = 4, 6, 8, 10$

Results (Changing Distance Constraint)



Total error curves for $\sigma_{dB} = 5$, $D_c = 400m$, $r = 50m$ & $100m$, $X_t = X_t^*$ and $N = 6$.

Results (Uniform/Non-Uniform Error in X & Y)



Total error curves (with independent/uniform location errors in X and Y) for $\sigma_{dB} = 5$, $D_c = 400m$, $r = 50m$, $X_t = X_t^*$ and $N = 6$.

- Location verification is critical.
- LVS performance degrades by nearly 15% in the presence of location errors.

Summary

Q & A

Thank You!