SESAR Project 9.47
Initial STM Performance Evaluation – preliminary results
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Honeywell

Objectives of the STM Performance Validation
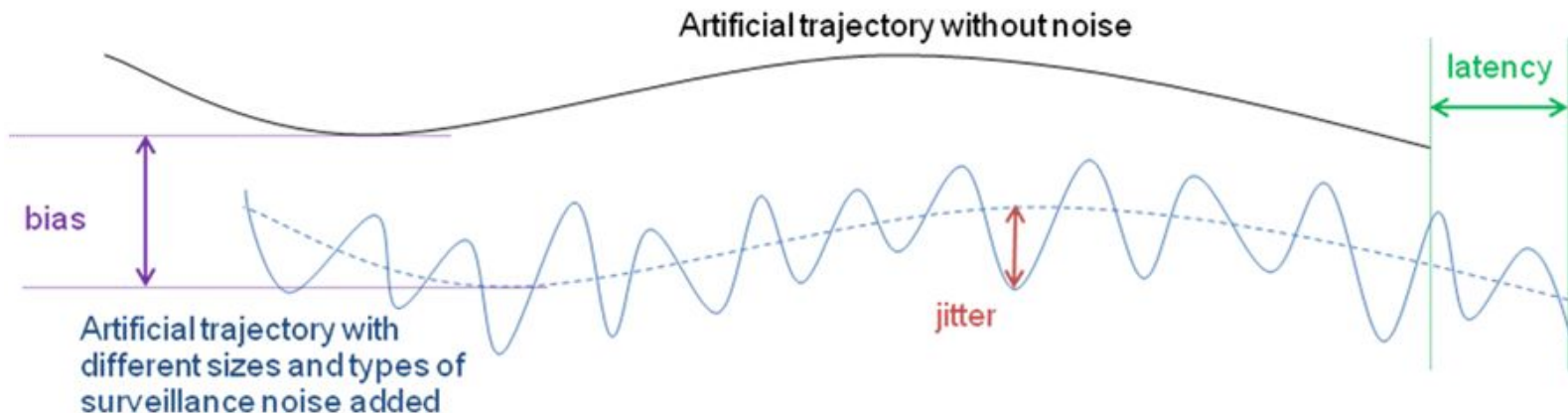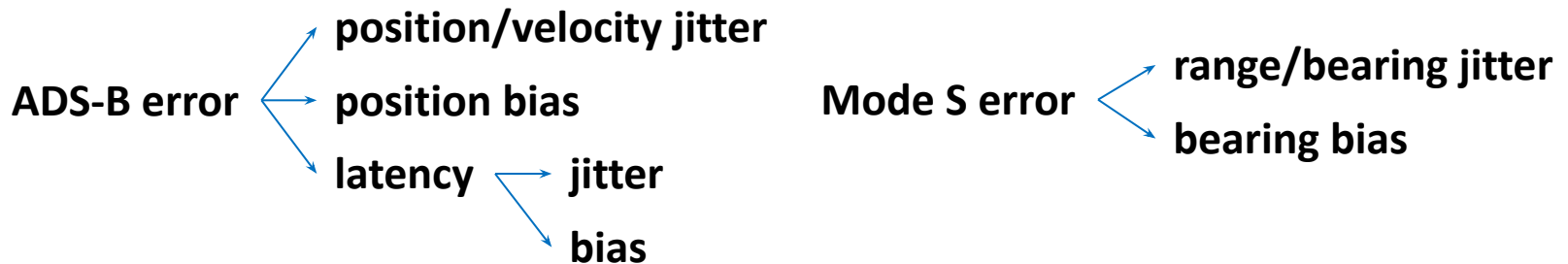
Three Exercises Performed within SESAR 9.47

1. **Performance evaluation of the STM and included tracking algorithms using real flight data,**

2. **Sensitivity study of the STM tracking algorithms varying quality of the surveillance data, and**

3. **Evaluation of the impact of quality of the horizontal surveillance data on tau distribution.**

This evaluation is based on a Run 13 model of ACAS Xa surveillance functions within dedicated fast-time simulation

Surveillance Error Model

Surveillance error model was developed to generate:

- Estimated true trajectory (estimated real flown trajectory) which is used to evaluate performance of the trackers and their accuracy

- Surveillance errors which are added to the model trajectory in order to simulate data from real surveillance sensors

ADS-B error
- position/velocity jitter
- position bias
- latency → jitter
- → bias

Mode S error
- range/bearing jitter
- bearing bias

Artificial trajectory without noise

latency

bias

jitter

Artificial trajectory with different sizes and types of surveillance noise added

Input Data to STM

- **Real recorded data (Flight tests of HS around TLS, JFK, LA)**
- **Estimated true data (post-processed from real recorded data by combining passive and active data to remove latency, bias and jitter)**
- **Simulated data (generated trajectories where surveillance errors were added afterwards) – four geometries**

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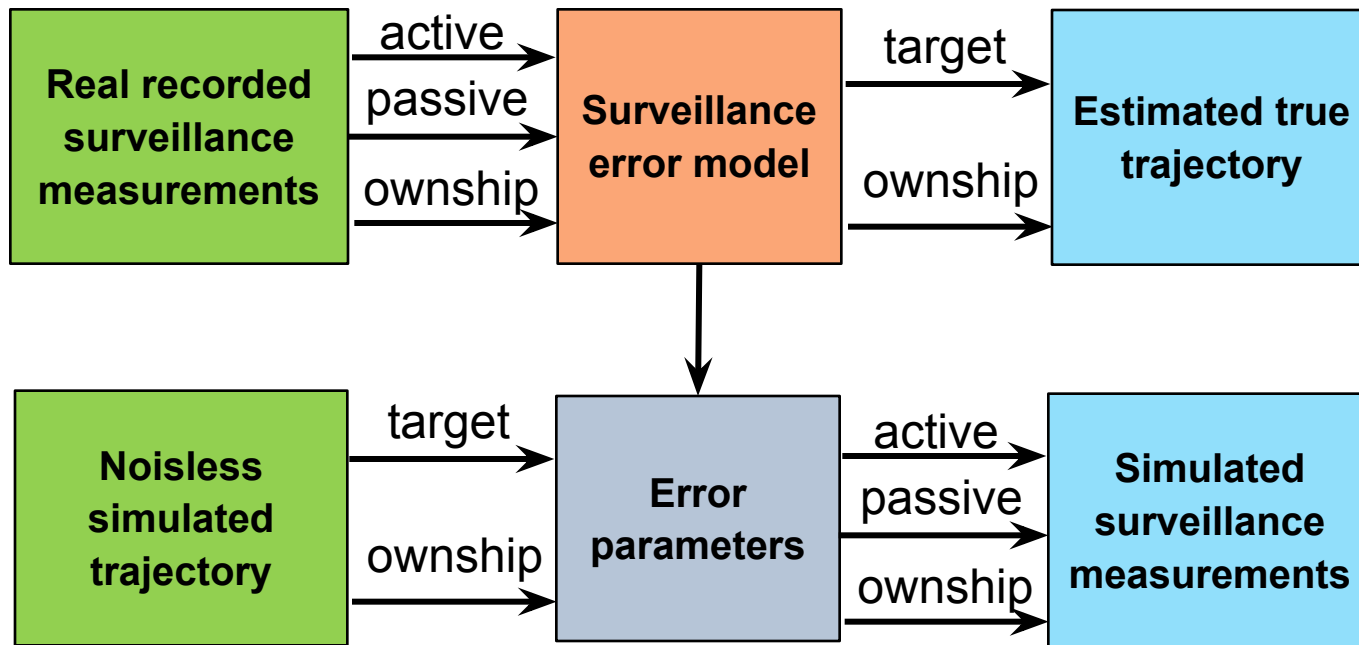
Additional Data Logging

For our analysis we added three interfaces where we were logging data

A. Tracked values after tracker update

B. Predicted values from Kalman filters for STM report generation

C. Estimated tau distribution
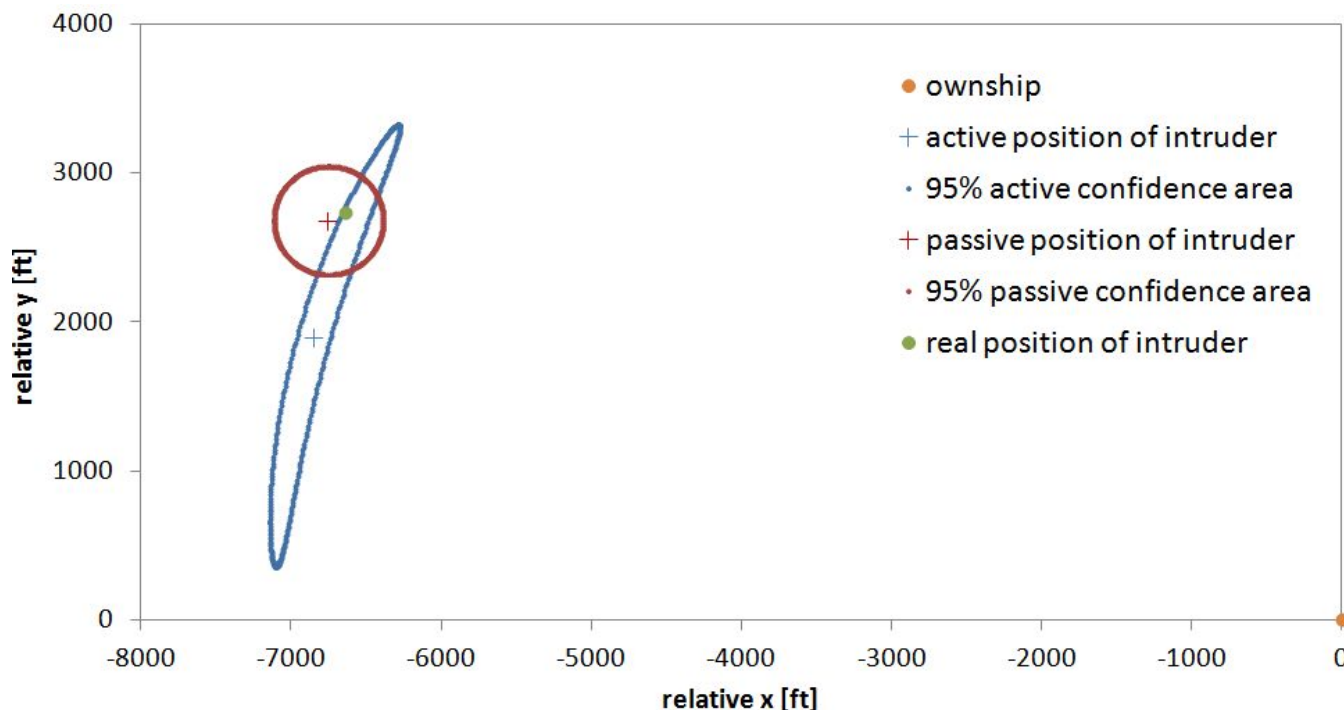
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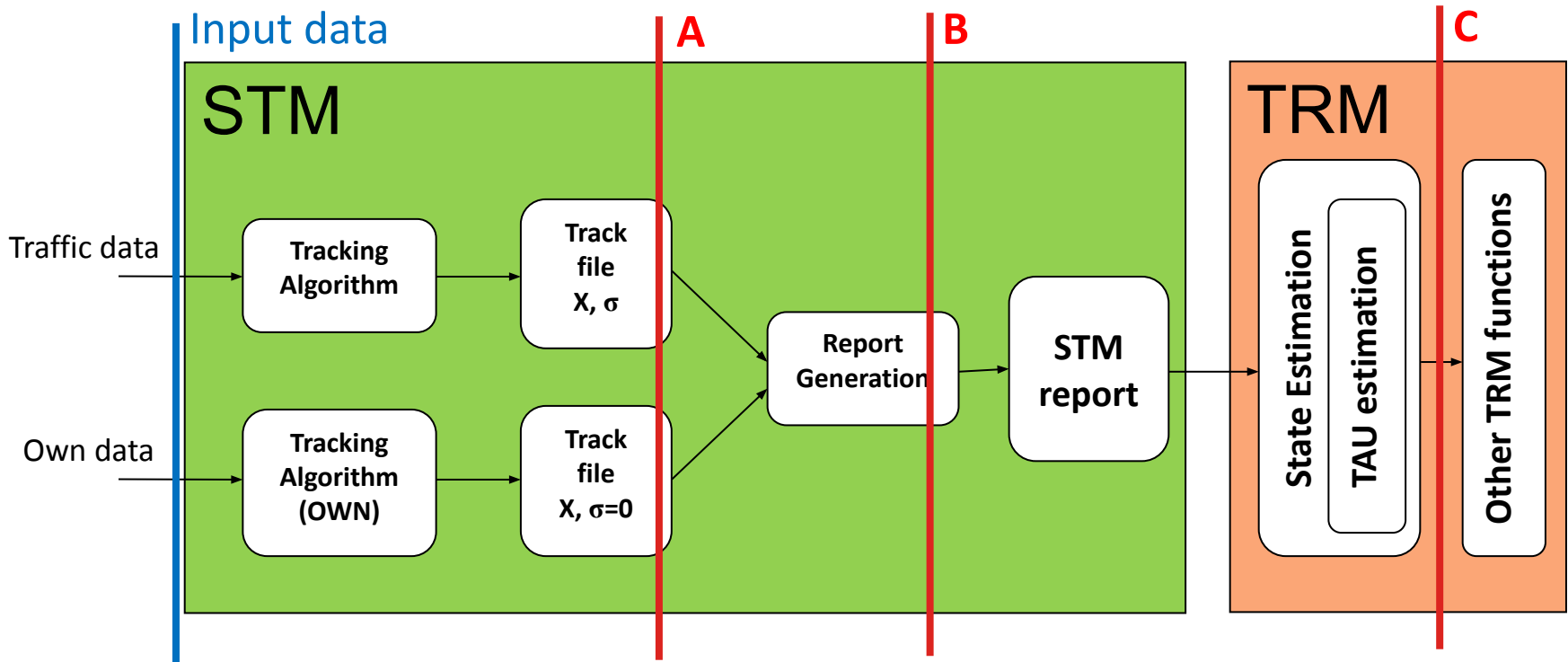
## Data source switching ☐ potential impact

Quality of real recorded data

Trackers' performance

Data source switching (preliminary results)

- **State estimation differs significantly between active and passive tracker.**
- **Tau estimations based on active and passive data are quite close to each other and also close to real tau value.**
- **Sensitivity of tau distribution to horizontal position data uncertainty seems to be relatively low.**
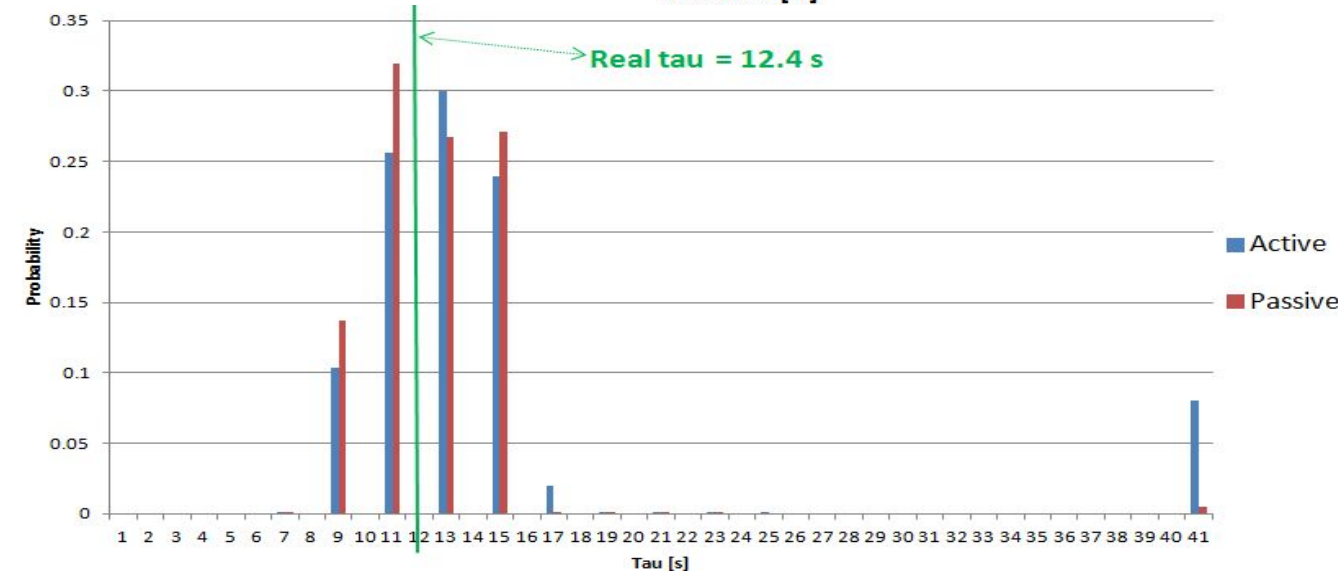
Outliers at Active Track (preliminary results)

- **There are scenarios where the creation of first STM report is delayed (so late that in the first STM report non-zero probabilities are indicated for the small tau values already)**
  - Active tracker is not able to start working properly when intruder has high closure rate (~850kt) – second active range measurement is signed as a outlier and tracker is restarted with this measurement
  - STM report can't be created from passive data when they are not validated with active data

**Handling of outliers in case of active data should be probably revised**

Quality of Real Recorded Data (prel. results)

- Only 8 intruders (4%) reported the appropriate quality (better than NIC = 8, NACp = 8, NACv = 1, SIL = 3) to enter to the STM report

- The active validation process on these data was successful in 97%

- Overall the active validation process for all intruders (including NACp=0) was still quite successful (84%)

- Probability that the **estimated true state** of the intruder lies outside the 95% confidence area of the pre-STM data is **62%**

- Probability that the **real recorded measurement** of the intruder lies outside the 95% confidence area of the pre-STM data is **6%**

Tracker can remove jitter of the measurement but is not able to detect any kind of offset (biased data) in the measurement from a single type of measurements.

Pseudo-radius (preliminary results)

- **The horizontal tunnel is based on the 2D Gaussian distribution (for both passive and active measurements)**

- **Pseudo-radius is a radius of circle which has the same area as cross-section of the tunnel**

- **As expected, with increasing NACp the pseudo-radius become smaller**
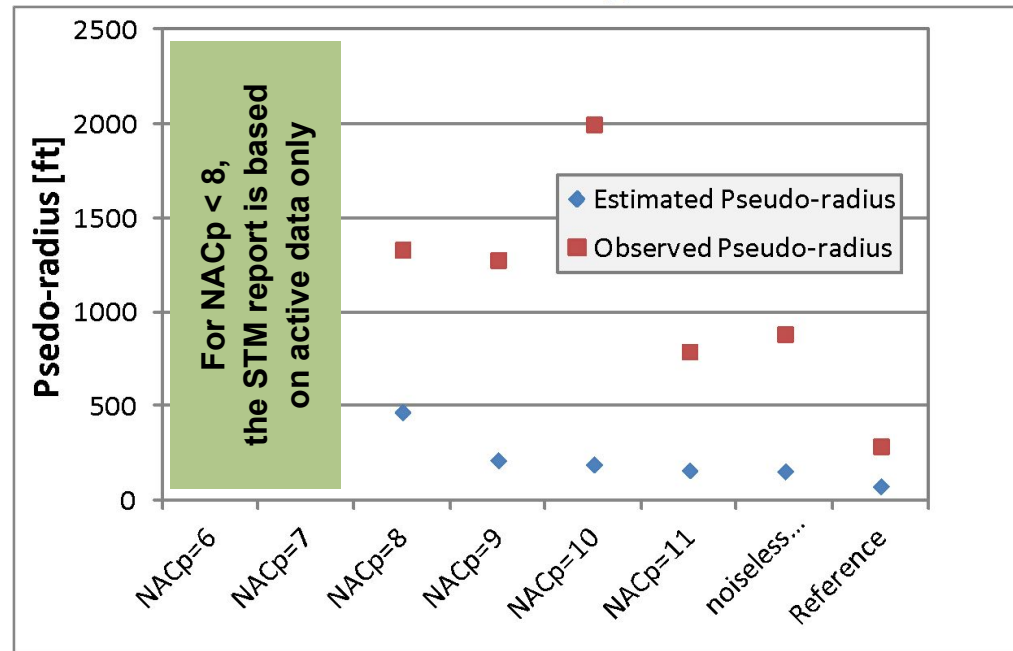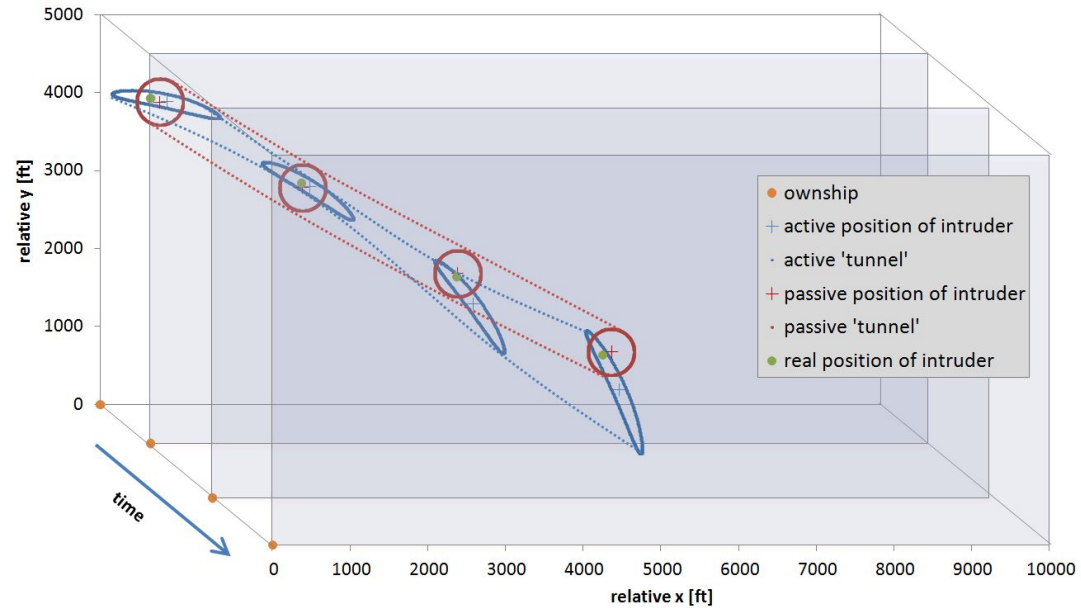
Out of tunnel observations (prel. results)

- **While the pseudo-radius decreases with increasing NACp, the out of tunnel observations increase up to more than 90% for highest NACp**
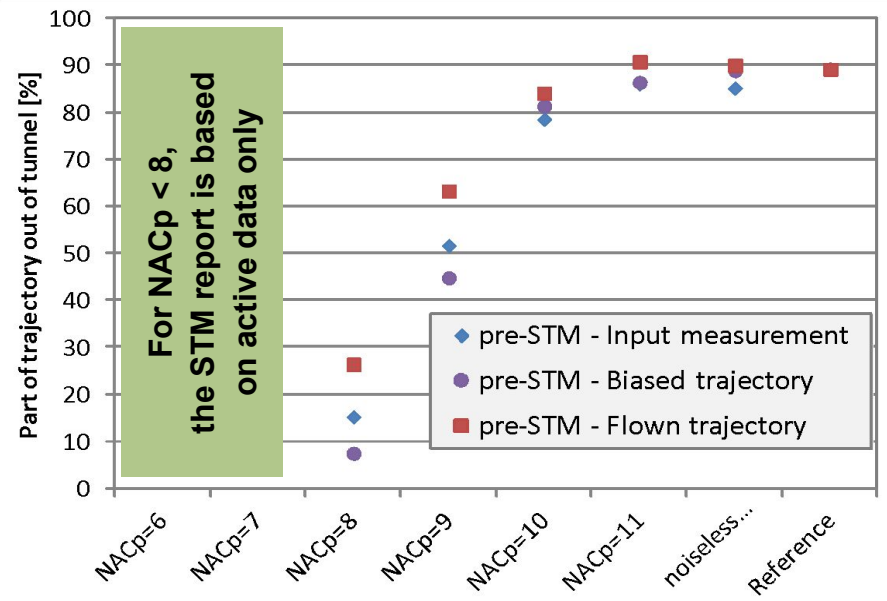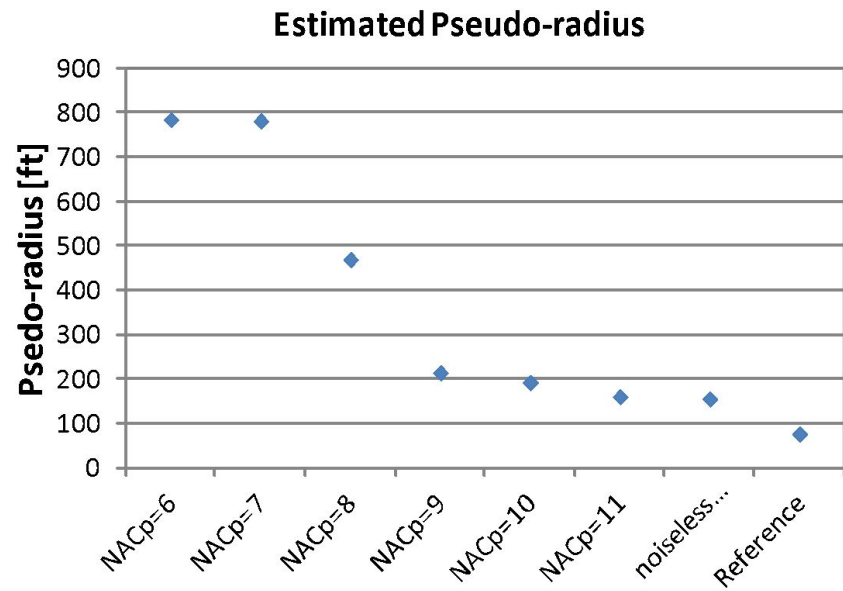
Precision which is declared by STM is higher than observed precision. This was observed on the real recorded data as well as on the simulated data.

Next Steps

- **Final results and conclusions to be completed**
- **More details will be presented during July's F2F meeting at Boston**

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- SESAR 9.47 team
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Your feedback is welcome