Abstract: A framework is proposed to improve car navigation through cooperative data fusion. We consider incorporating information from GPS-enabled neighboring cars and Received Signal Strength Indication (RSSI) out of IEEE 802.11p messages. The solution includes prediction-based data resynchronization, links selection mechanisms using RSSI measurements pre-validation or a Cramèr-Rao Lower Bound (CLRB) indicator eliminating non-informative data, and finally a Bayesian tracking filter. First simulations show benefits from selective cooperation in terms of navigation continuity under harsh GPS conditions.

Cooperative Positioning (CP) in VANETs

- **Motivations**
  - Poor/lost GPS $\rightarrow$ Needs for improved navigation continuity
  - CP involves mobile-to-mobile measurements (e.g., RSSI)
  - Pure VANET context $\rightarrow$ No real known anchors (only GPS-aided neighbors)
  - Existing Cooperative Awareness Message (CAM) traffic (e.g., 802.11p) $\rightarrow$ Support to both RSSI and cooperative data fusion

- **Problem statement**
  - Asynchronous/missing CAMs $\rightarrow$ Re-align in time
  - Poor CAM-based RSSI measurements $\rightarrow$ Reject
  - Coarsely positioned neighbors $\rightarrow$ Perform selective cooperation

Links Selection

- **Pre-validation step**: Innovation monitoring rejecting non-reliable neighboring info & poor RSSIs
- **Links selection step**: Choosing an “optimized” shorter list among pre-validated links
  - **Nearest Neighbor (NN):**
    - Predicted RSSI distribution
    - Validation region (gray)
- **Modified CLRB (MCRLB)-based scheme**:
  - CRLB, $(5, 5, 3, 1) < \text{CRLB}, (9, 5, 3, 1) < \text{CRLB}, (4, 5, 3, 1)$

Performance Evaluation

- **Simulation settings**
  - 3-lane highway, 9 vehicles, Gauss Markov mobility model
  - Gaussian GPS error model, log-distance path loss model
  - Coop. data fusion at “ego” car, filtered GPS at neighbors
- **Evaluation scenario 1 (S1)**: Time-variant GPS level (20% of loss) at the “ego” car with 1 trial/run
- **Evaluation scenario 2 (S2)**: Time-invariant GPS level with 1000 Monte Carlo simulations

Conclusions

- Practical low-complexity solutions for data synchronisation and links/measurements selection before fusion
- Exhaustive cooperation not systematically helpful
- Better resilience through selective cooperation, mostly in harsh/host GPS conditions $\rightarrow$ Context-aware cooperation

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