Title
Mapping and Exploitation of Signals of Opportunity

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Mapping and Exploitation of Signals of Opportunity
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Motivation
Global navigation satellite system (GNSS) is at the heart of autonomous vehicle navigation systems. However, GNSS signals are unreliable due to:
- Severe attenuation in deep urban canyons
- Intentional and/or unintentional jamming
- Spooﬁng

Approach: COPNAV
Collaborative opportunistic navigation aims to exploit signals of opportunity (SOPs) in the environment.

Challenges
- Unavailability of most SOP emitters’ states (position and clock)
- Less stable clocks than GNSS satellite vehicles
- Unavailability of receiver architectures for navigation observables extraction

Advantages
- Available from varying geometric conﬁgurations
- Abundant and free to use
- Higher received power compared to GNSS signals

Optimal Receiver Placement
Consider a planar environment comprising $M$ unknown SOPs and $N$ arbitrarily placed receivers with knowledge about their own states. The receivers draw pseudorange observations given by

$$m z_n = \|r_{r,n} - r_{s,n}\| + c \cdot (\delta r_{r,n} - \delta s_{r,n}) + m \delta n,$$

(a) minimize

$$\min \ r_{r,n+1} \ \sqrt{\text{tr} \left[ H^T (r_{r,n+1}) H (r_{r,n+1}) \right]^{-1}}$$

(b) maximize

$$\max \ r_{r,n+1} \ \det \left[ H^T (r_{r,n+1}) H (r_{r,n+1}) \right]$$

(c) maximize

$$\max \sum_{m=1}^{M} \log \left[m A \left( m \phi_{n+1} \right) \right]$$

Exploiting SOPs
1. Accuracy Improvement: GPS+SOPs

2. UAV Simulation Results

Optimal Emitter Mapping

Experimental Demo
1. Collaborative Mapping of SOP

2. Receiver localization improvement

References
REFERENCES


