Title
Cooperative Acoustic Vehicle Localization (SYS 1)

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Cooperative Acoustic Vehicle Localization

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CENS - http://research.cens.ucla.edu/

Introduction: Improving vehicle safety by position tracking in GPS-denied area.

Problem Description: Develop a system to acoustically track vehicle location and speed

Proposed Solution: Localization based on time of arrival using pseudo-noise sequence

Application Vision

- Cooperative system
  - System coordinates acoustic vehicle tracking via RF signaling, informs vehicle of position relative to potential hazard

Project Goal

- Assess use of audible acoustic ranging for vehicle safety applications in GPS-denied areas
- Develop a testing platform to enable experimentation
- Perform some initial experiments to test signaling waveforms

Application Vision

- Receivers over road receive acoustic signals
- Emitters in bumper emit acoustic signals

Receiver Setup

- Linear array of 14 microphones
- Sampled at 48KHz
- Suspended over the roadway
- Wirelessly synchronized to vehicle

Emitter Setup

- Two emitters: one on each side of the front bumper
- Driven from laptop inside the vehicle
- Connection to OBD-II port to record reported vehicle speed
- Connection to 433 MHz radio logs synchronization and break beam events

System Architecture

- Emitter Setup
  - One broadcaster radio emits periodic signals
  - Receivers feed correlated sync symbols into the ADC
  - Offline processing matches up sync symbols
  - Rate conversion to correct for ADC clock skew (166 PPM)

Synchronization Issue

- We implemented wireless synchronization
- Single broadcaster radio emits periodic signals
- Receivers feed correlated sync symbols into the ADC
- Offline processing matches up sync symbols
- Rate conversion to correct for ADC clock skew (166 PPM)
- For an on-line system, must be integrated into RF protocol

Position Tracking

- Each line represents a tracked location, corresponding to the axis between emitters
- Time is represented by color: Blue → Green → Red
- The array is positioned at (0,0) → (3.5,0)

In this test, we:
- Drove towards the array, and stopped
- Drove back quickly in reverse
- Drove forward, weaving intentionally from side to side