Experiences Using Gas Sensors on an Autonomous Mobile Robot

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1. Defining The Goal: An Electronic Watchman

- **Required Ability**
  - detection of gases

- **Desired Abilities**
  - localization of the gas source
  - identification of the odour

- **Environment**
  - unmodified indoor environment
2. Hardware Setup, Electronic Nose

- **VOCmeter Vario**
  - commercially available
  - lightweight, small
  - 24V DC supply possible
  - low power consumption
  - operates up to 8 sensors
  - gathers readings with 4 Hz
  - RS-232 interface
2. Hardware Setup, Electronic Nose

- **Sensor Sticks**
  - thin, flexible cable
  - small, easy to mount
  - MOX, QMB available
2. Hardware Setup, ARTHUR

- Based on "ATRV-Jr" (RWI)
  - skid steering
  - 2x Pentium II, 333 MHz
  - wireless LAN (BreezeCOM)
  - sonar sensors

- Electronic Nose
  - sensors: MOX
    - at an outstanding rotatable bar
    - at fixed positions

- Additional Sensors
  - laser scanner (SICK)
  - CCD cameras
3. Previous Experiments (1D), Setup

- **Experimental Conditions**
  - no / weak ventilation
  - no / few people passing by

- **Odour Source**
  - ethanol, aceton
  - placed at the end / in the middle of the corridor
  - different intensities: 130 cm², 60 cm², 20 cm²

- **Driving Modes**
  - stop-and-go
  - constant velocity

- **Gas Sensors**
  - mounted on the stiff extension
3. Previous Experiments (1D), Results

[Graph showing experimental results for Ethanol]
3. Previous Experiments (1D), Results

- **Detection**
  - low intensities
  - distance: several meters
  - unventilated or weakly ventilated rooms
  - weak disruptive elements possible

- **Localization**
  - seems to be possible
3. Previous Experiments (1D), Results
3. Previous Experiments (1D), Results

- Driving Mode
  - constant speed, not too slow
  - stop-measure-and-go strategy not suitable
3. Previous Experiments (1D), Results
4. Experimental Setup (2D)

**Experimental Conditions**
- unventilated room, no people passing by
- jar in the middle of the room
- robot moved along a **rectangular spiral**

![Diagram of experimental setup](image)
5. Experimental Setup (2D)
5. Results (2D)
6. Conclusion

- Setup
  - signal nearly independent of stick position
  - meaningful results only during movement
  - no improvement could be detected using either a
    - pumped cell
    - pc fan

- Detection and Localisation in a '1D Environment'
  - even small sources (about 20 cm²)
  - distance of about 5 m
  - possible after hours

- Detection and Localisation in a '2D Environment'
  - distinctive peaks along pathways level with the odour source
  - measured distribution not centered at the location of the source
6. Outlook

- Implementing Intelligent Search/Navigation Strategies
  - dealing with a partially unknown airflow situation

- Investigate the "Moving Effect"
  - further testing with the pumped cell (trunk)

- Identification
  - using sensor array: MOX and QMB

- Environment
  - less artificial indoor conditions
  - outdoor conditions
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Thank you!