

# Experiences Using Gas Sensors on an Autonomous Mobile Robot

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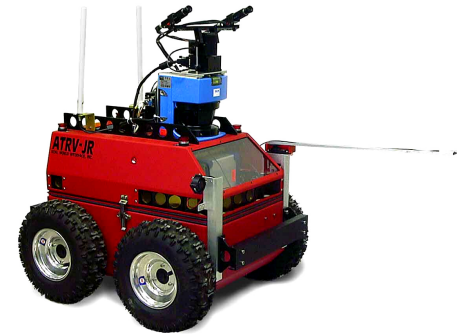
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# Contents

- 1. Defining the Goal: An Electronic Watchman
- 2. Hardware Setup
  - electronic nose
  - mobile robot
- 3. Previous Experiments (1D)
- 4. Experimental Setup (2D)
- 5. Results (2D)
- 6. Conclusion & Outlook





# 1. Defining The Goal: An Electronic Watchman

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- **Required Ability**

- **detection** of gases

- **Desired Abilities**

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

- **Environment**

- unmodified indoor environment

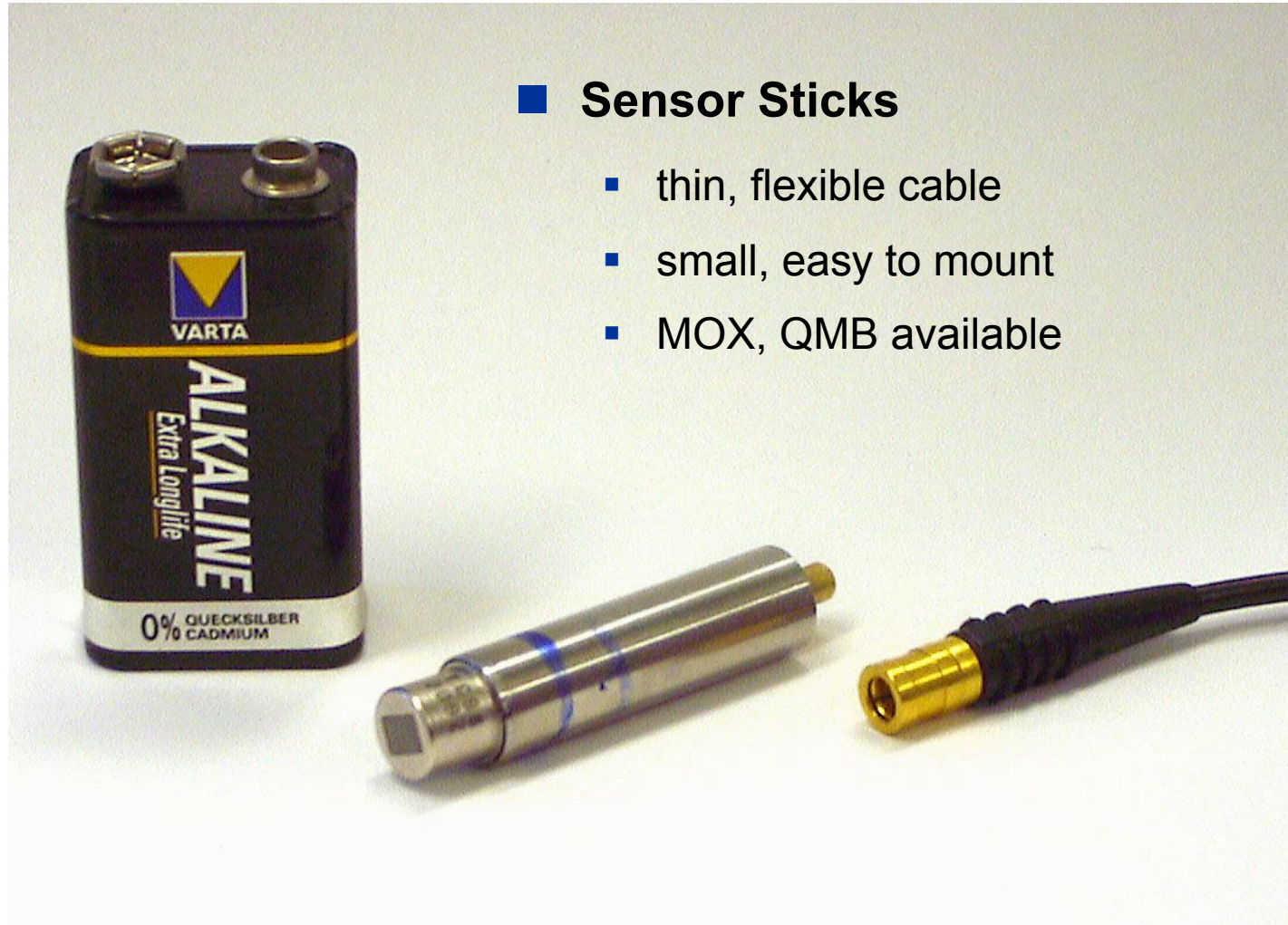
## 2. Hardware Setup, Electronic Nose

### ■ 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



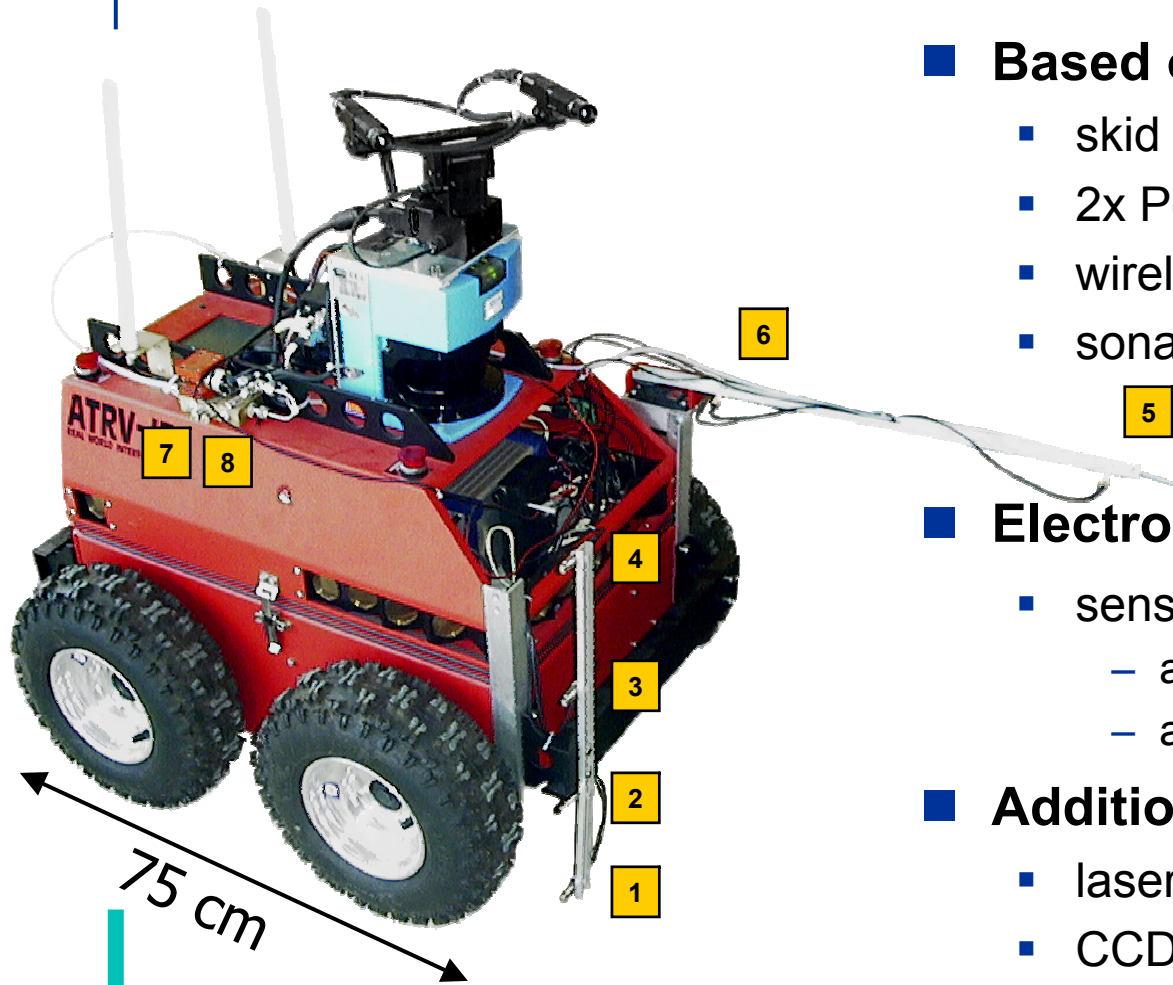
## 2. Hardware Setup, Electronic Nose



### ■ 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

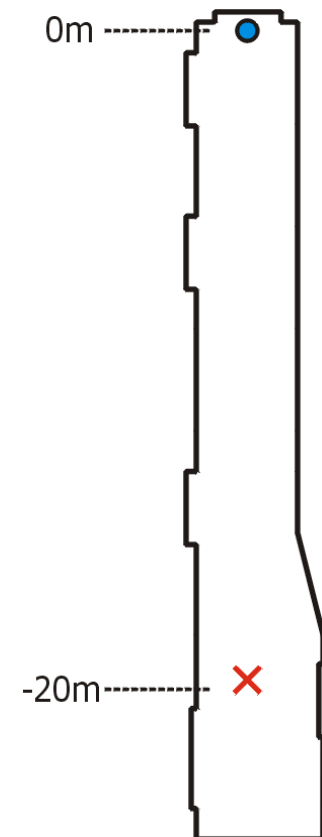
- ethanol, acetone
- placed at the end / in the middle of the corridor
- different intensities:  $130 \text{ cm}^2$ ,  $60 \text{ cm}^2$ ,  $20 \text{ cm}^2$

#### ■ Driving Modes

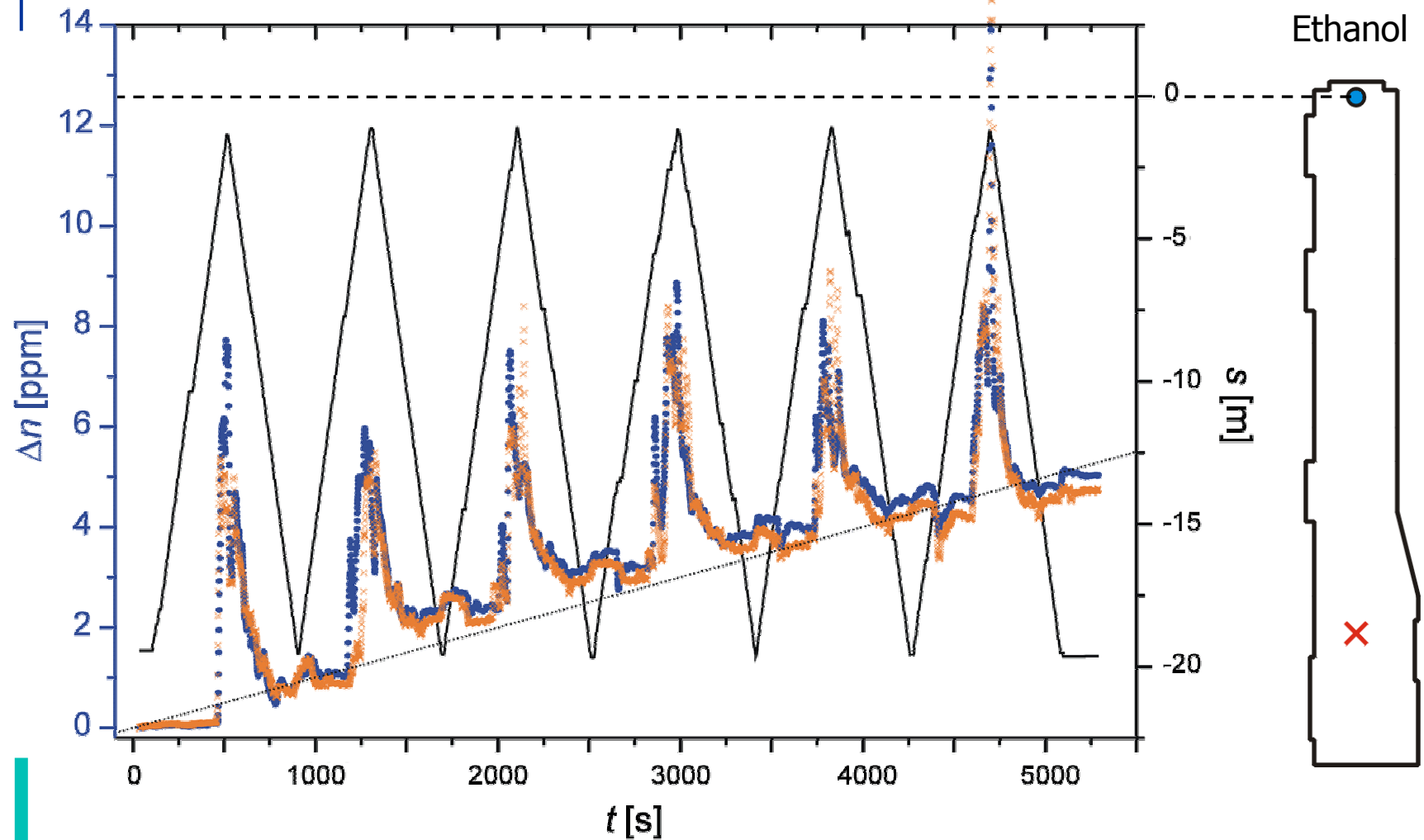
- stop-and-go
- constant velocity

#### ■ Gas Sensors

- mounted on the stiff extension



### 3. Previous Experiments (1D), Results





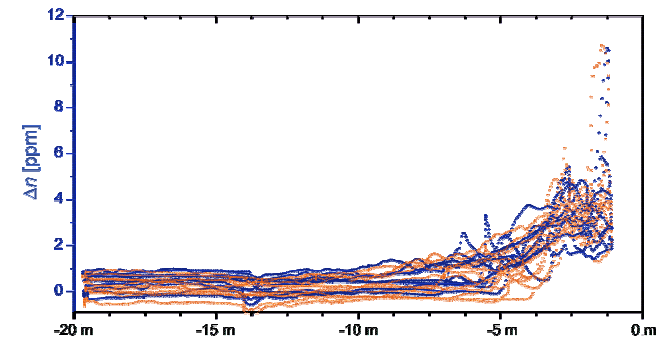
# 3. Previous Experiments (1D), Results

## ■ Detection

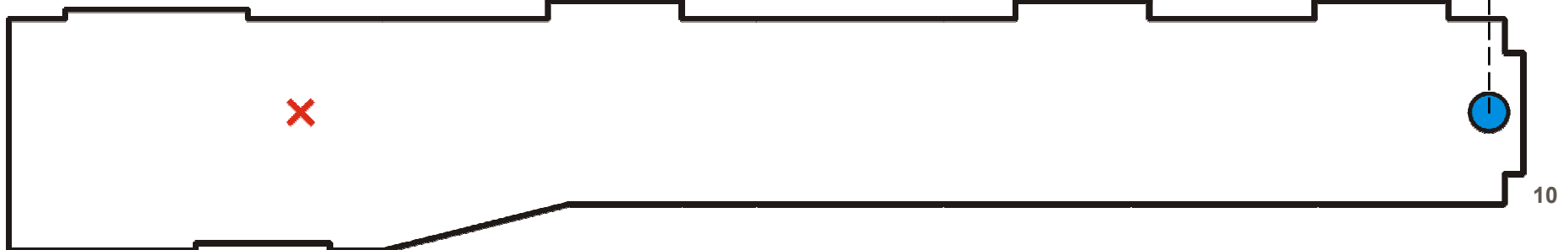
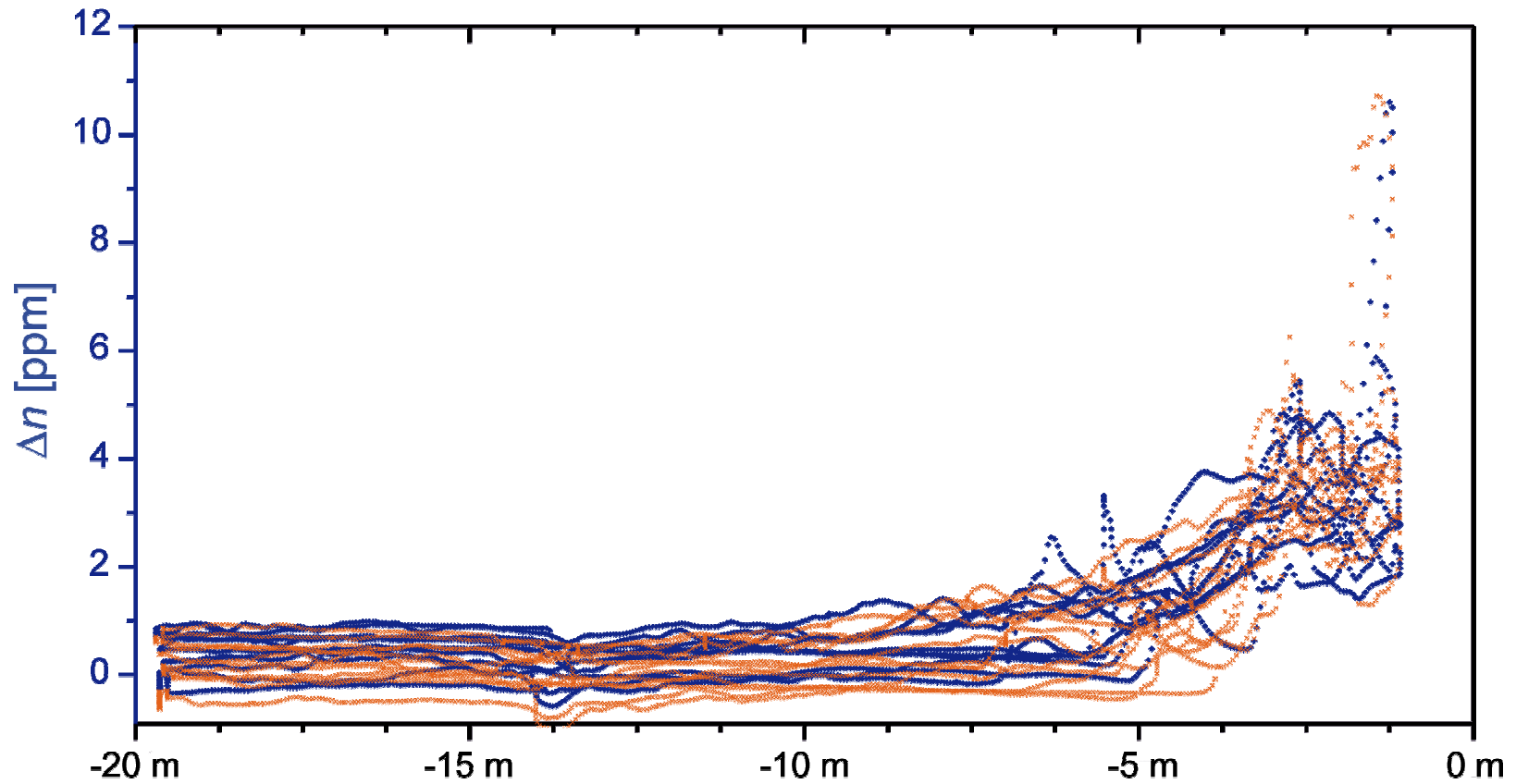
- low intensities
- distance: several meters
- unventilated or weakly ventilated rooms
- weak disruptive elements possible

## ■ Localization

- seems to be possible



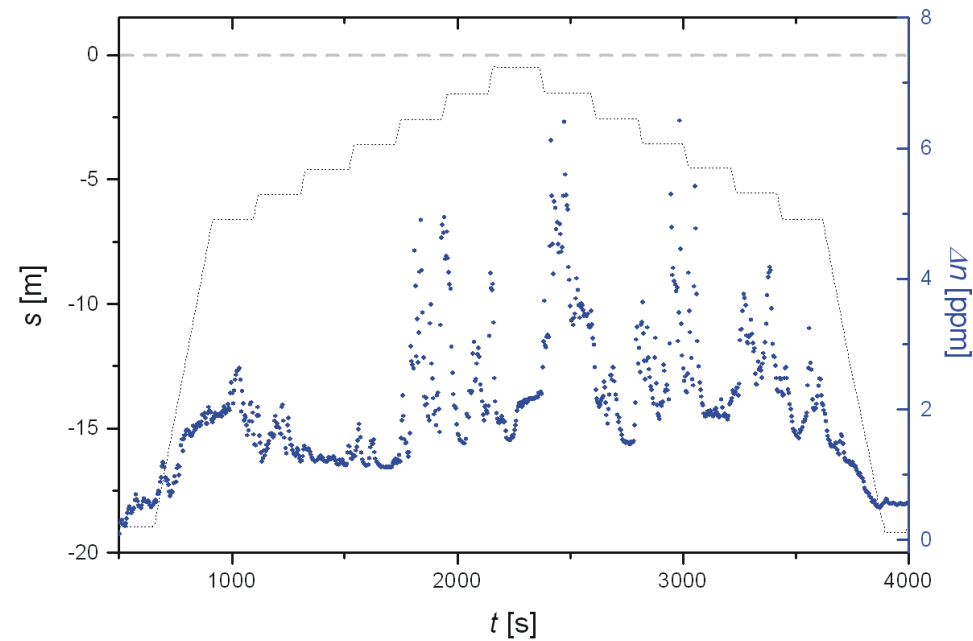
### 3. Previous Experiments (1D), Results



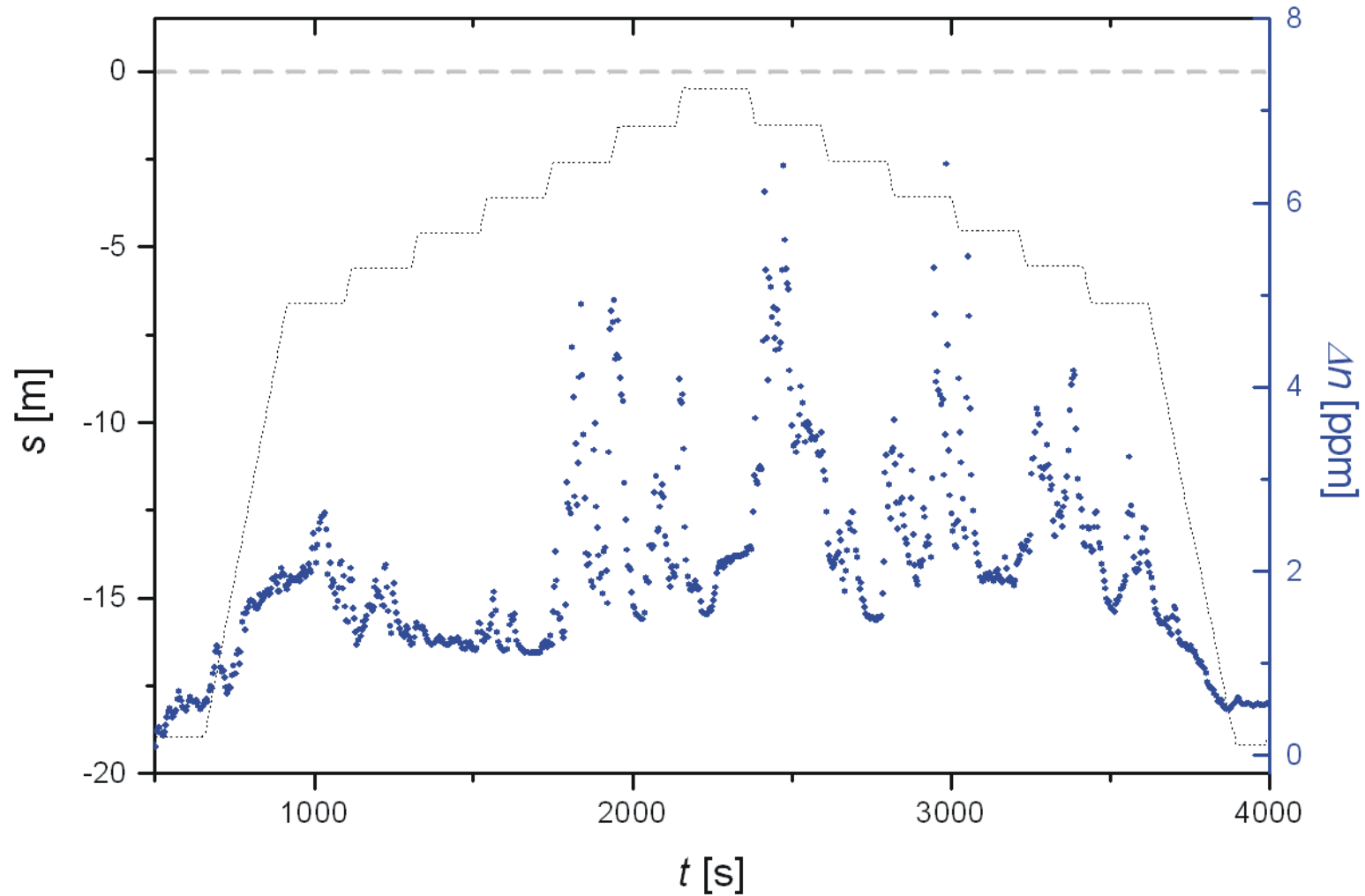
# 3. Previous Experiments (1D), Results

## ■ Driving Mode

- constant speed, not too slow
- stop-measure-and-go strategy not suitable



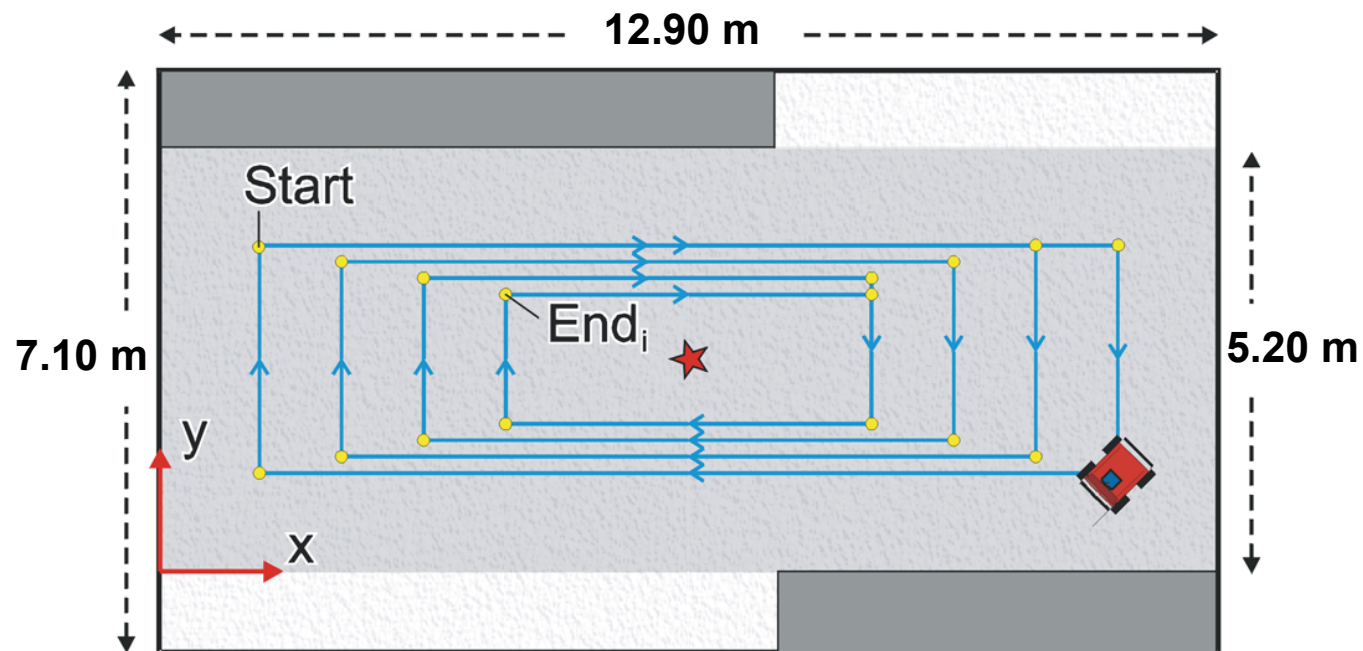
### 3. Previous Experiments (1D), Results



## 4. Experimental Setup (2D)

### ■ Experimental Conditions

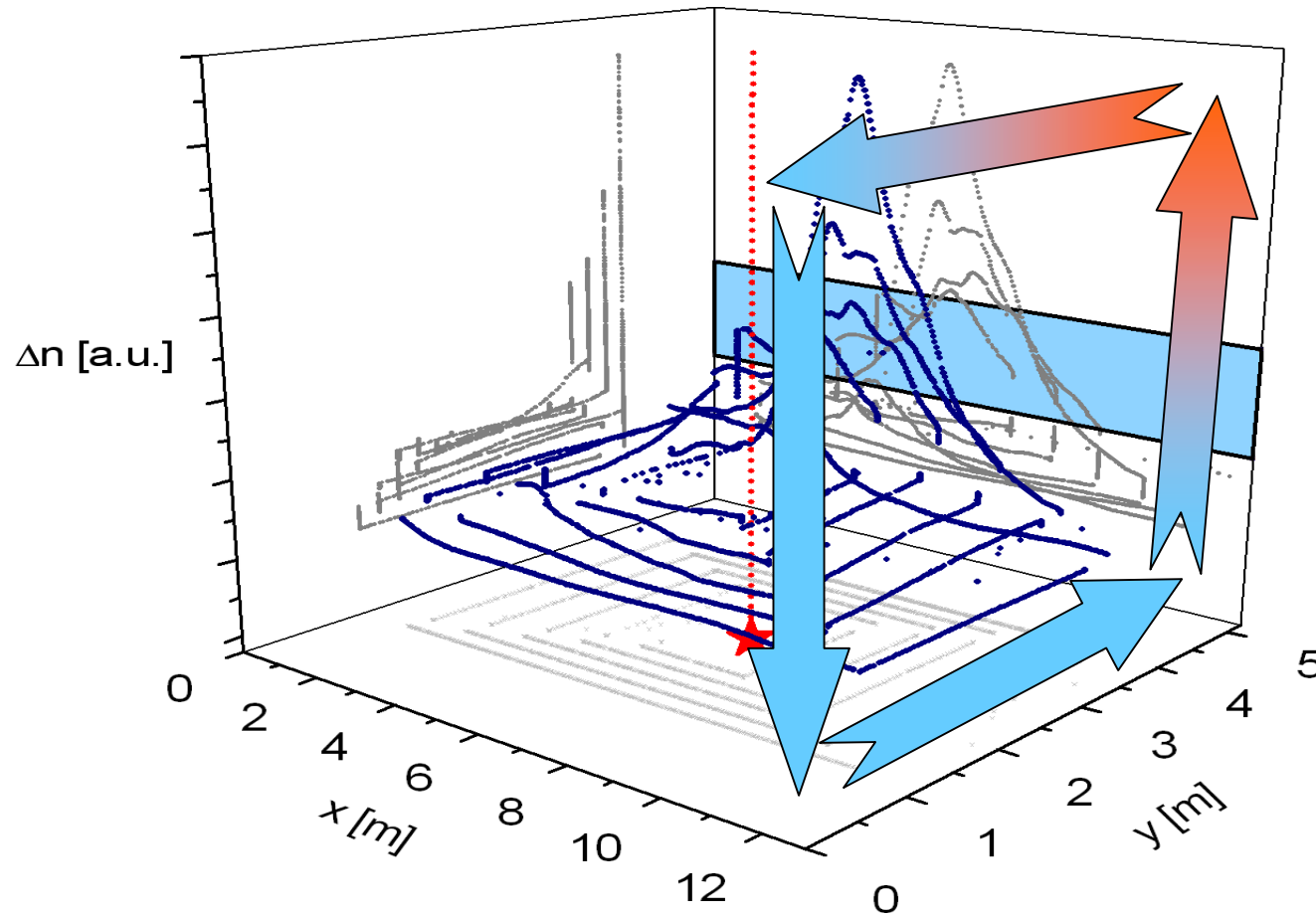
- unventilated room, no people passing by
- jar in the middle of the room
- robot moved along a **rectangular spiral**



## 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  $cm^2$ )
- 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

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- **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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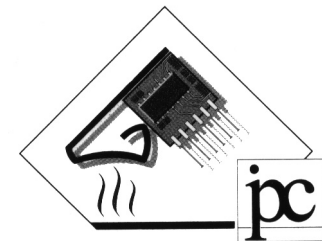


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# Thank you!

