Rapid Inference of Geographical Location with an Event-based Electronic Nose

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Artificial Olfaction using Metal-Oxide Gas Sensors

- Sensor resistance drop when reducing gases react with TiO$_2$
- Sensitive, but not very specific
- Conventionally, heated to constant ~300°C
- Heater modulation increases specificity and decreases integration time
4-Chn Heater Modulated (H-M) Electronic Nose
4-Chn H-M Electronic Nose: Field Recordings
4-Chn H-M Electronic Nose: Features

- 140 ms data features, locked in phase
- Robust to baseline drift
- Enabling accurate olfactory scene classification

84.2 ± 1.2% (6 classes)
4-Chn H-M Electronic Nose: Events

- Change-event generation via send-on-delta sampling
- Comparing classification performance for different event encoding schemes (reconstruction, rate code, latency code, rank code)

![Graph showing sensor response over time with up and down events indicated.](Image)

![Graph showing validation accuracy at different spiking thresholds.](Image)
Key Takeaways

- Novel electronic nose design using heater modulated MOx gas sensors
- Heater cycles lend themselves for fast and robust odour classification features
- When considering events, the full temporal dynamics of event trains yield much better results than rate code, latency code and rank code
Work in Progress and Next Steps

- Verify results in controlled environment
- Explore analogies to biological olfactory system (oscillations in activity of tufted & mitral cells)
- Implement spike-based processing (SNNs)
- Consider full hardware implementation of neuromorphic olfactory sensor front-end

Cury & Uchida, 2010
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