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Data Article

Dataset from chemical gas sensor array in turbulent wind tunnel

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ABSTRACT

The dataset includes the acquired time series of a chemical detection platform exposed to different gas conditions in a turbulent wind tunnel. The chemo-sensory elements were sampling directly the environment. In contrast to traditional approaches that include measurement chambers, open sampling systems are sensitive to dispersion mechanisms of gaseous chemical analytes, namely diffusion, turbulence, and advection, making the identification and monitoring of chemical substances more challenging.

The sensing platform included 72 metal-oxide gas sensors that were positioned at 6 different locations of the wind tunnel. At each location, 10 distinct chemical gases were released in the wind tunnel, the sensors were evaluated at 5 different operating temperatures, and 3 different wind speeds were generated in the wind tunnel to induce different levels of turbulence. Moreover, each configuration was repeated 20 times, yielding a dataset of 18,000 measurements. The dataset was collected over a period of 16 months.

The data is related to "On the performance of gas sensor arrays in open sampling systems using Inhibitory Support Vector Machines", by Vergara et al.[1].

The dataset can be accessed publicly at the UCI repository upon citation of [1]: http://archive.ics.uci.edu/ml/datasets/Gas+sensor+arrays+in+open+sampling+settings

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Specifications Table

Subject area	Chemistry
More specific subject area	Chemometrics, Machine Olfaction, Electronic Nose, Chemical Sensing, Machine Learning
Type of data	Text Files
How data was acquired	Metal Oxide (MOX) gas sensors provided by Figaro Inc. placed in a turbulent wind tunnel. Temperature and RH were recorded continuously with SHT15 sensor (Sensirion).
Data format	Raw data. Time-series.
Experimental factors	For each measurement 72 time series corresponding to MOX sensors' conductivity are provided. Temperature and humidity are provided in additional time series.
Experimental features	Sensors were exposed to clean air before and after sample presentation to acquire rising/decay transient portions of the signals.
Data source location	San Diego, California, US.
Data accessibility	Data in public repository:
	http://archive.ics.uci.edu/ml/datasets/Gas+sensor+arrays+in+open+sampling+settings Citation of [1] is required.

Value of the data

- Extensive dataset (18,000 measurements) generated from chemical sensors exposed to ten different volatiles, at different locations, and five operating temperatures.
- Realistic scenario: sensors sampling in turbulent environment, with different levels of turbulence.
- Response of the same chemical detection platform measured consistently over a period of 16 months.
- Complete time series are provided, including baseline, rising/decay portion, and steady state. System sensitive to gas turbulence.
- Dataset suitable for the benchmark of different Machine Learning techniques for chemical sensing.

1. Experimental design, materials and methods

1.1. Experimental setup

1.1.1. Chemical detection platform

Conductometric sensing principles have been widely studied in several types of gas sensing schemes because they are stable in many environments and within a wide temperature range, sensitive to many analytes at a wide variety of concentrations, respond quickly and reversibly, and are inexpensive, while performing reasonably well in discriminating chemical analytes [2]. Although they have been predominantly used in isolated settings that include measurement chambers, their high sensitivity and rapid response to a wide variety of volatiles distinguishes MOX sensors as suitable chemo-transducers for ambient conditions.

We designed a general purpose chemical sensing platform containing nine portable chemo-sensory modules, each endowed with eight commercialized metal oxide gas sensors, provided by Figaro Inc., to detect analytes and follow the changes of their concentration in a wind tunnel facility.