Data in Brief 3 (2015) 216–220

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Data set from chemical sensor array exposed to turbulent gas mixtures

Jordi Fonollosa*, Irene Rodríguez-Luján, Marco Trincavelli, Ramón Huerta

University of California, San Diego, USA

ARTICLE INFO

Article history:
Received 31 December 2014
Received in revised form
24 February 2015
Accepted 25 February 2015
Available online 20 March 2015

Keywords:
Chemometrics
Machine olfaction
Electronic nose
Chemical Sensing
Machine learning

ABSTRACT

A chemical detection platform composed of 8 chemo-resistive gas sensors was exposed to turbulent gas mixtures generated naturally in a wind tunnel. The acquired time series of the sensors are provided. The experimental setup was designed to test gas sensors in realistic environments. Traditionally, chemical detection systems based on chemo-resistive sensors include a gas chamber to control the sample air flow and minimize turbulence. Instead, we utilized a wind tunnel with two independent gas sources that generate two gas plumes. The plumes get naturally mixed along a turbulent flow and reproduce the gas concentration fluctuations observed in natural environments. Hence, the gas sensors can capture the spatio-temporal information contained in the gas plumes. The sensor array was exposed to binary mixtures of ethylene with either methane or carbon monoxide. Volatiles were released at four different rates to induce different concentration levels in the vicinity of the sensor array. Each configuration was repeated 6 times, for a total of 180 measurements. The data is related to "Chemical Discrimination in Turbulent Gas Mixtures with MOX Sensors Validated by Gas Chromatography-Mass Spectrometry", by Fonollosa 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+senso+rarray+exposed+to+turbulent+gas+mixtures.

* Corresponding author.
E-mail address: fonollosa@ucsd.edu (J. Fonollosa).

http://dx.doi.org/10.1016/j.dib.2015.02.022

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 8 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+array+exposed+to+turbulent+gas+mixtures *Citation of [1] is required.*

Value of the data

- Realistic scenario: Sensors sampling in turbulent environment, in which generated gas plumes were mixed naturally along a wind tunnel, creating fluctuations in the gas concentrations.
- Complete time series are provided, including baseline, rising/decay portion, and steady state. System sensitive to gas turbulence.
- Dataset generated from chemical sensors exposed to three different volatiles, each volatile presented at different concentration levels. The problem can be formulated either as a classification problem to determine which gas is present or as a regression task to determine the gas concentration levels.
- Concentration levels validated by means of gas chromatography analysis.
- 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

The spatio-temporal structure of gas plumes in outdoor environments is mainly determined by turbulent diffusion rather than molecular diffusion. Hence, when a volatile is emitted from its source, the released molecules are carried in the direction of the fluid flow, forming a patchy plume in the downstream direction and decreasing the mean concentration as the volatile molecules spread out. Since, in open environments, air direction and intensity change in time, generated gas plumes have complex, irregular, shifting structures [2]. Similarly, when sources of different volatiles are present, the concentration of the compounds changes dynamically in time and space, generating non-uniform gas mixtures.

We designed a general purpose chemical sensing platform that included 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. The sensor's response magnitude to the chemical analyte is signaled by a change in the electrical conductivity of the sensor's film. Hence, changes in the analyte concentration (mostly due to patches and eddies in the chemical plume) are reflected in the sensor's response in real-time and are the origin of the temporal resolution (i.e. fluctuations in the time series). Table 1 shows the models and number of units included in the sensor array. The operating