Chapter 13
Sensor and Its Application

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ABSTRACT

Electronic nose systems are used to deliver a pattern response to a listed odor, and pattern recognition software is used to perform odor recognition and discrimination by using a series of sensors. The method of electronic noses generally includes time taking measurements in a non-standard test and error process. The sensory panel problem can be solved by electronic nose. For this purpose, a sensor model is used to design sensor array. The generated signal of these sensor array is used further to classify a mixture of two gases using principle component analysis (PCA)-based classification analysis. During classification, the efficiency of PCA classification has been checked over the different signal preprocessing technique. Continuous real monitoring of odor is done at specific sites in the field over hours, days, weeks, or even months. An electronic machine can also avoid many other troubles linked with the employ of human panels. Each and every variability, adaptation (becoming minimum sensitive during extended exposure), and revelation to hazardous compounds all come to mind.

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INTRODUCTION

Some twenty years ago, “electronic noses” went for a great deal of development, since the inception of the first applications of solid state gas sensors. Around a thousand articles on this subject have been published over the last 4 years, mainly in relation to the food and beverage industry (Hudon, Guy & Hermia, 2000), but also concerning environmental, agricultural, and medical topics, in the automotive industry, etc. Electronic noses automatically detect and recognize odors, vapors and gases. Electronic noses (e-nose) comprise of a set of gas sensors with dissimilar selectivity shapes, a signal collecting unit and pattern recognition software applied to computer (Rahman, Usmani & Saeed, 2013). The identification of gases and smells are of main interest because it has a significant number of possible applications, few of which are linked to quality control in foods and cosmetics industries and to checking air quality. In the past 15 years, electronic noses mimic the human olfactory method and have developed rapidly. Many number of companies have now developed commercial instruments, which consist of an array of non-selective gas/odour sensor with a pattern recognition engine (Gardner & Bartlett, 1999; Gardner & Hines, 1997). The design of model is generally a test and error process through which the number and type of smell sensors and the pattern recognition tools are selected under the constraints determined by each application.

The e-nose attempts to emulate the mammalian nose by using an array of sensors that can simulate mammalian olfactory responses to aromas (Hudon, Guy & Hermia, 2000). The odour molecules are drawn into the e-nose using sampling techniques such as headspace sampling, diffusion methods, bubblers or pre-concentrators (Pearce et al., 2003). The odor sample is drawn across the sensor array and induces a reversible physical and/or chemical change in the sensing material, which causes an associated change in electrical properties, such as conductivity (G) (Singh, Hines & Garner, 1996).

DESCRIPTION OF ERROR MODELS

Figure 1 shows sensor A, B, C and D are designed at different parameters. Figure 2 shows the block diagram of the designed sensor and figure 3 shows the Simulink model for mixture of two gases for each sensor in which the sensor parameter used for feature extraction is sensor element conductance Gs. Feature evaluation Gs is evaluated using following equation:

\[
G_s = G_0 e^{E_A / kT} + K_1 e^{E_A / kT} C_1 n_1 T + K_2 e^{E_A / kT} C_2 n_2 T + \ldots K_{mix} e^{E_{mix} / kT} C_1 n_1 C_2 n_2 T
\]  

(1)
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