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Introduction to Essentials of Machine Olfaction and Tastes

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Although there are a variety of sophisticated machines for visual and auditory senses, machines for chemical senses such as olfaction and taste are still prematured. However, they are very important since they are deeply related to our primitive but fundamental capabilities. We can search for foods in daily life as well as can avoid danger using olfactory sense. Although animal's capability is nowadays superior to human ones, we still have them. Those chemical senses cannot be ignored in our daily life. Nowadays we can create cyberspace made up of visual and auditory senses. However, that cyberspace still lacks reality since olfactory and gustatory senses are not included.

The first machine olfaction was proposed about 30 years ago. Then, it was extended and an electronic nose community appeared. Although many papers have been already published, its application toward to industry is still limited. Its sensitivity, selectivity, and robustness against disturbance should be much improved for the actual application. A variety of applications are waiting for its progress. This book describes the current effort of sensing part of machine olfaction.

Machine olfaction has another part such as olfactory display. It works as an actuator in olfaction. An olfactory display is relatively new compared with odor sensing technology. Researchers in virtual reality have focused on the olfactory display to realize cyberspace with chemical sense. Although researcher population of olfactory display is still small, it gradually spreads into the world.

A human olfactory interface has both odor sensing and olfactory display. It is now growing up in the field of human interface. Utilizing those two techniques, odor recorder and teleolfaction system are being studied.

In contrast to olfaction, a taste sensor has been applied to a certain application area. Especially, medical field is its good customer. However, we still wait for simple easy-to-use taste sensor to include taste sense in cyberspace. The attempt to realize it will be later shown.

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Recently we often hear the world such as cyber-physical system. Cyber-physical system enables cyberspace with physical senses. However, we have never heard the word "cyber-chemical system." We can have cyber-chemical system if the technologies of machine olfaction and taste are easily available.

This book describes the essential parts of machine olfaction and taste. Chapter 2 describes olfactory mechanism of a living body. Utilizing it, olfactory biosensor is being developed. Chapter 2 also explains the olfactory biosensor.

Chapter 3 shows odor sensing technology. It explains the basics of artificial sensors. Moreover, a large-scale sensor array in the same way as biological one is being studied. This trend in electronic nose is introduced in Chapter 3.

Chapter 4 shows the taste sensor. It describes the principle and its application toward foods and medicines. This chapter explains the latest research review as well as the fundamentals of taste sensor.

Chapter 5 describes the current pattern recognition technologies available in electronic noses. The pattern of many ORN responses is recognized by an olfactory neuron system. Thus, the output pattern of the array of sensors with partially overlapping specificities is recognized in machine olfaction. Chapter 5 describes the basics of pattern recognition technologies together with its advanced technologies.

Chapter 6 explains mobile robot technology with chemical senses. It can search for the target chemical in the field. Its sensor, algorithm to look for the target and the experiment is shown in this chapter.

Chapter 7 shows olfactory display and odor recorder. Various types of olfactory displays are systematically described. Moreover, the review of odor recorder is shown in this chapter.

Chapter 8 is the summary and describes the perspective of machine olfaction and taste.

Each chapter covers an essential part of machine olfaction and taste. It describes basic part at first and then extends their contents to the advanced technology.