【Grant-in-Aid for Scientific Research (S)】

Human tracing based on spatio-temporal fluctuation of odor

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Purpose and Background of the Research

●Outline of the Research

We cannot see the odor. If we can visualize the spatial distribution of odors and their temporal changes, what kind of information value and application paradigm will this new information bring to us? This research aims to answer this academic question by developing odor visualization and information analysis technology. Volatile chemicals (VOCs) that make up odors spread in space by flow and diffusion. The visualized odor space has different characteristics from the distance space in which light travels straight. This study obtains the visualized odor and clarifies the value of spatio-temporal information of odor by demonstrating through the human tracing.

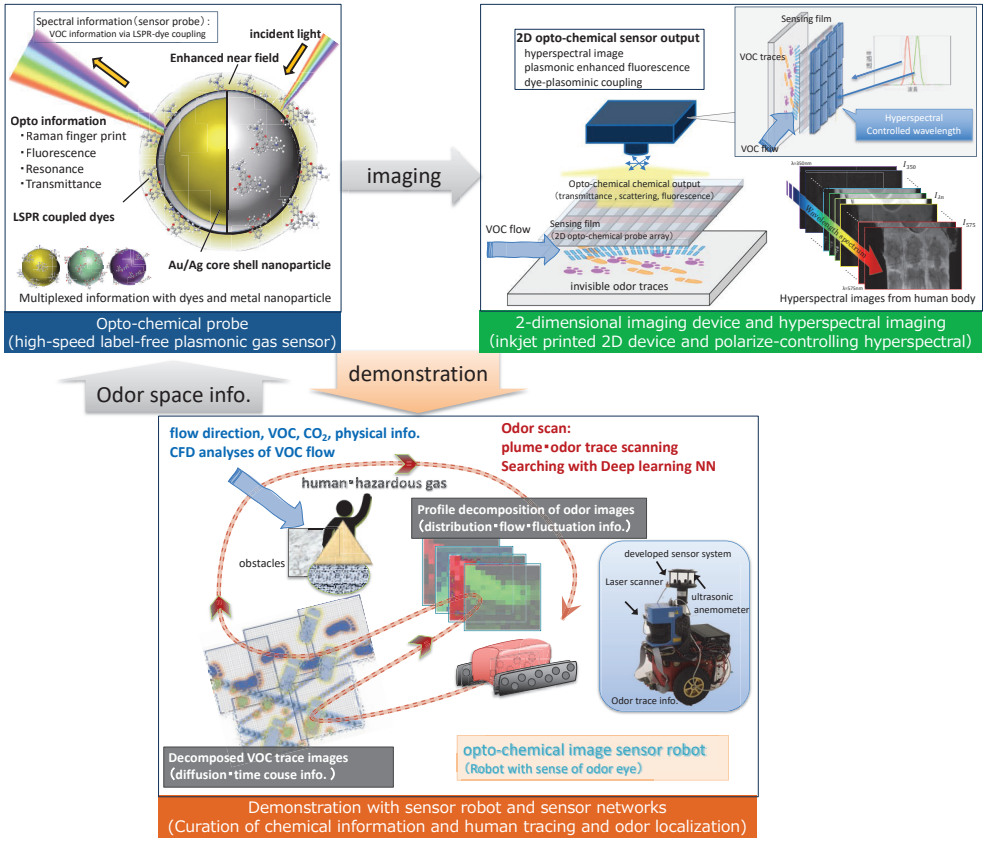

Figure 1. Schematics of the research

●Method

This research realizes the following three research theme.

1. Opto-chemical probe development
2. Two-dimensional chemical sensor device and hyperspectral imaging
3. Gas source search and human search using odor fluctuation information

(1) Opto-chemical probes that convert chemical information into optical information with plasmonic nanoparticles coupled with dyes. This transducer performs high-speed information detection using localized plasmon resonance (LSPR) and high-sensitive surface enhanced Raman Scattering (SERS). (2) Develop a two-dimensional odor image sensor device using spin-coating and inkjet printing technology. (3) Measure the sensor film with hyperspectral imaging to realize high-throughput sensing. The 2D image sensor is installed on a robot to scan and localize odor sources in the field. Using the spatio-temporal fluctuations of the odor and the odor traces remaining on the ground as information, odor space estimation analysis that obtains information from VOC flow and distribution, and odor constituent substance information analysis (odor profile decomposition) are performed, and realize the human tracing.

Expected Research Achievements

●High throughput chemical sensing

Odors can provide a wide variety of information related to chemical substances, such as environmental information and human health conditions. However, the chemical sensor has a low information speed. Due to rich information by 2D chemical sensors, calibration and information acquisition can be achieved in parallel, and data science methods can be applied, so chemical sensors can be pushed to a practical use.

●Utility value of rich chemical information in spatio-temporal space

Information acquisition by humans is mainly based on visual, and brain development, digital information processing, and Internet information are heavily biased by images and sounds. It is not self-evident that comprehensive analysis of chemical substances have important utility value. In this study, we confirm the importance of rich spatio-temporal information of odors by this human tracing project.

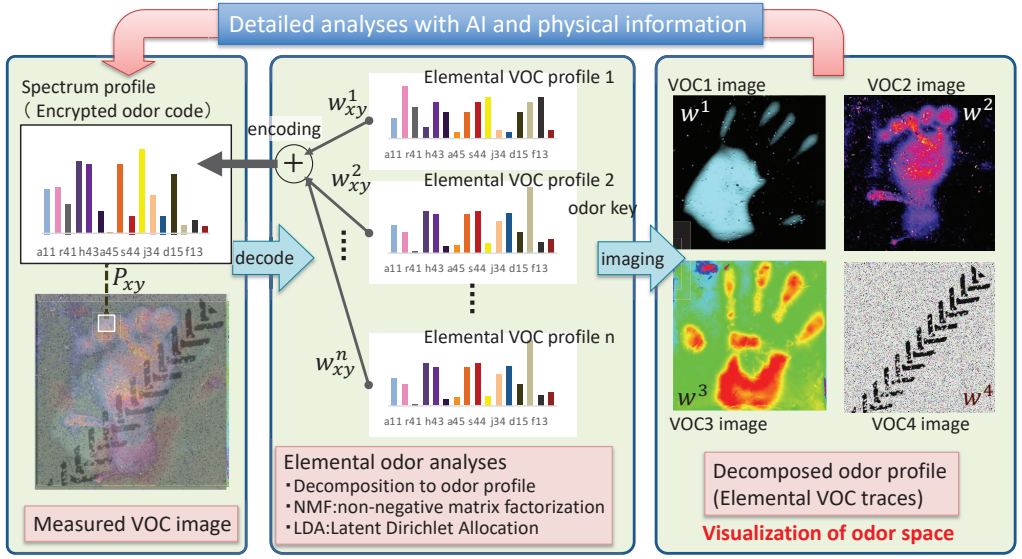

Figure 2. Comprehensive analyses of 2D odor image
(Profile analyses examples; flow and fluctuation of odor will produce spatiotemporal images)

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