(Press Release)

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NTT Corporation
NTT EAST Corporation
NEC Corporation

World's first vibration sensing technology using telecommunication optical networks for making road snow removal decisions in heavy snowfall areas

Aiming to solve regional issues using environmental information obtained from communications infrastructure

Tokyo, November 10, 2023 – NTT Corporation (NTT), NTT EAST Corporation (NTT EAST), and NEC Corporation (NEC) have jointly applied optical fiber vibration sensing technology to construct a machine learning model that estimates road surface conditions from vibration characteristics transmitted through communication optical fibers [1] already installed underground. (A demonstration experiment was conducted in Aomori City from November 2022 to March 2023 and is scheduled to continue this winter.) As a result, we can expect the digital transformation (DX) of urban patrol work and snow removal decisions before road snow removal, which are major regional issues in heavy snowfall areas. In the future, using this technology, we will promote the generalization of machine learning models to deal with all snow conditions in heavy snowfall areas. We will also use optical fiber sensing technology to acquire environmental information about the city, aiming to solve various local issues. These results will be exhibited at the NTT R&D Forum - IOWN ACCELERATION [2], which will be held from November 14th to 17th, 2023.

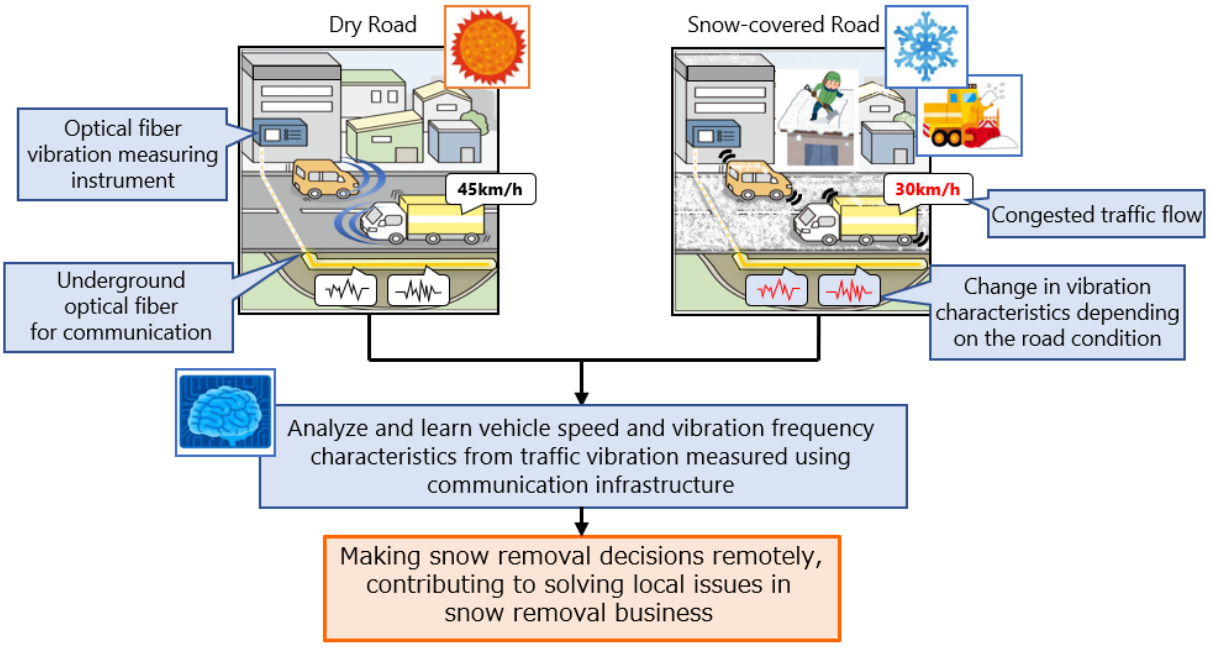

Figure 1 *Overview of Snow Removal Decisions by Vibration Sensing Technology Using Telecommunication Optical Networks*

1. Background and purpose

In heavy snowfall areas, snow removal measures are important to maintain urban functions and ensure smooth traffic so as not to interfere with the daily lives of residents. Road snow removal work is mainly carried out during overnight hours. To maximize the effectiveness of snow removal operations within a limited time, city patrols are conducted during the daytime, and snow removal decisions are made daily for an area called a snow removal zone based on the amount of snow, snowfall forecast, and investigator's rules of thumb. However, as the population ages and declines in rural areas, there is a shortage of snow removal operators to make road snow removal decisions [3]. Improving efficiency through DX is an urgent issue. In response to this regional challenge, the three companies conducted a demonstration experiment to determine the implementation of snow removal. First, they combined NEC's vehicle speed detection algorithm with NTT's proposed correlation analysis method of snow removal necessity and traffic vibration characteristics. This was further combined with traffic vibration data of city roads in Aomori City obtained using unused underground optical fiber installed by NTT EAST and optical fiber sensing technology provided by NEC.

2. Features of this technology

(1) By collecting vibration data sensed by existing telecommunication underground optical fibers, it is possible to remotely make snow removal decisions at multiple points in a snow removal zone.

(2) Maintenance-free optical fiber with excellent weather resistance can be used as a sensor as it

is, and installation of a new sensor device is unnecessary.
(3) By utilizing a snow removal necessity decision model that consists of vehicle speed information, which is an indicator of traffic flow smoothness, and response characteristics of vibration frequencies correlated with road surface conditions as features, it is possible to make appropriate snow removal decisions regardless of an investigator's rules of thumb.
(4) Snow removal can be determined in real time from data acquired for each road.

3. Overview of demonstration experiments

(1) From November 2022 to March 2023, traffic vibration on city roads in 3 snow removal zones was sensed by connecting a sensing instrument to the upper end of a telecommunication optical fiber deployed underground in Aomori City.
(2) Acquisition of vehicle speed information and statistical data of response characteristics of vibration frequency from traffic vibration, construction of a snow removal necessity decision model, and evaluation of accuracy (Through demonstration experiments, we newly discovered that the characteristics of vehicle speed and vibration frequency change due to changes in road conditions caused by snow cover, and modeled them.)

4. Results of demonstration experiments

Taking advantage of the fact that optical fiber for telecommunication is installed in the underground of city roads in snow removal zones, we succeeded in determining snow removal in multiple snow removal zones by analyzing traffic vibration data obtained by optical fiber vibration sensing technology.

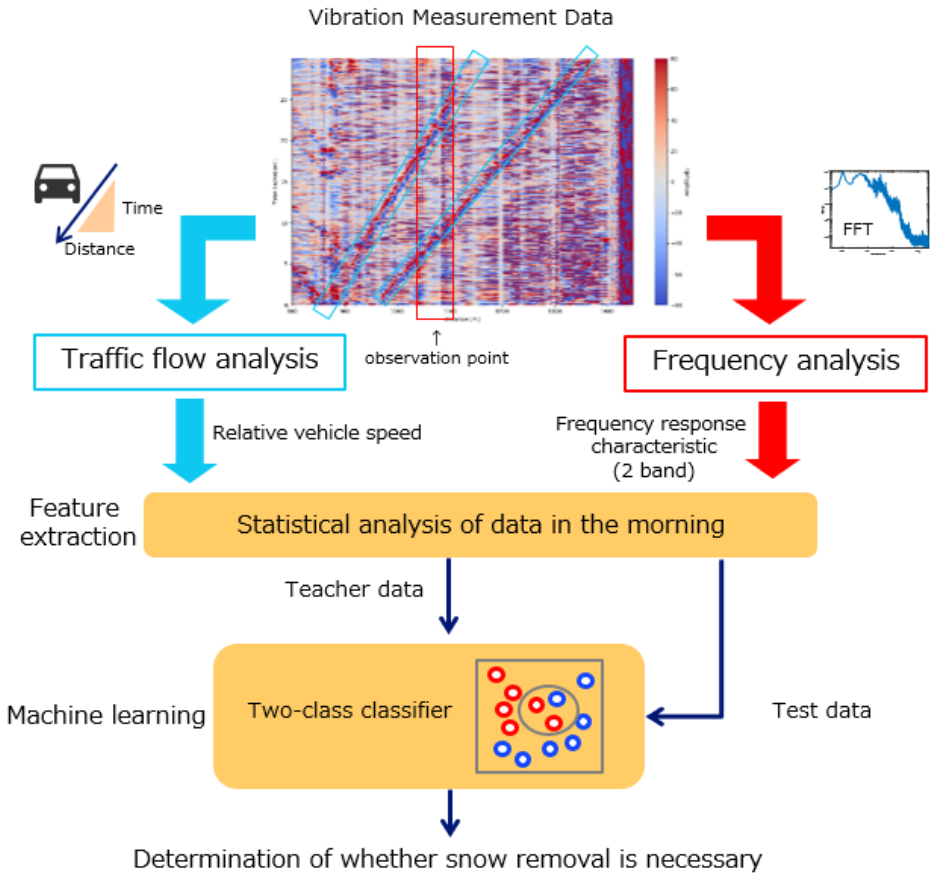

Figure 2 *Snow removal necessity decision model*

5. Roles of each company

NTT	Proposal and demonstration of snow removal decision method using sensing data analysis and machine learning
NTT EAST	Selection and provision of equipment used for observation of road surface conditions and demonstration experiments
NEC	Implementation of optical fiber sensing measurement, and provision of vehicle speed calculation algorithm

6. Outlook

Based on these results, the three companies will continue to conduct experiments in areas with different regional conditions to demonstrate the versatility of the snow removal necessity decision model, and will aim to solve problems in areas with heavy snowfall, such as maintaining a sustainable road snow removal system by making real-time snow removal decision DX. In addition, we will promote co-creation activities toward the establishment of optical fiber sensing application technologies that can solve local issues by analyzing urban vibration data and environmental information that can be collected using communications infrastructure.

< Glossary >

[1] Unused and inactive core wires in a communication optical fiber line

[2] "NTT R&D FORUM 2023 -IOWN ACCELERATION" Official Website
https://www.rd.ntt/e/forum/2023/

[3] Reference: Request for measures against snowy and cold areas concerning the government budget for FY 2024 http://www.sekkankyo.org/R50602youbou.pdf

About NTT

NTT contributes to a sustainable society through the power of innovation. We are a leading global technology company providing services to consumers and business as a mobile operator, infrastructure, networks, applications, and consulting provider. Our offerings include digital business consulting, managed application services, workplace and cloud solutions, data center and edge computing, all supported by our deep global industry expertise. We are over $95B in revenue and 330,000 employees, with $3.6B in annual R&D investments. Our operations span across 80+ countries and regions, allowing us to serve clients in over 190 of them. We serve over 75% of Fortune Global 100 companies, thousands of other enterprise and government clients and millions of consumers.

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