

### Implementation of coastline monitoring technology utilizing satellite images for continuous wide-area diagnosis of coastal erosion

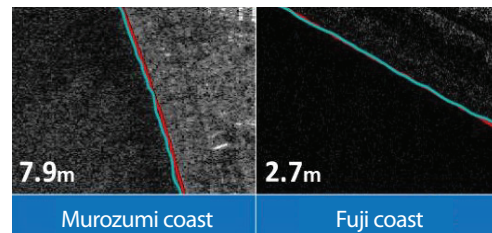
River Department, Coast Division

In order to allow early adoption of coastal erosion control measures, we are implementing a system to perform continuous wide-area diagnosis of any coastline changes due to coastal erosion, via the use of satellite images.

There is currently demand for technologies or systems to continuously and frequently monitor changes caused by coastal erosion in wide areas of the Japanese coastline, which has a total length of over 30,000 km, without the need for a large workforce or great expense. One technology that could potentially facilitate this is SAR (Synthetic Aperture Radar: a sensor that emits microwaves toward a target and then receives the backscattered signals), which is cheaper than optical satellite imaging and is not affected by the weather, thus enabling surveillance both during day and night. NILIM plans to start monitoring the coastline (initially for a length of around 400 km) in FY2019, building a system that employs SAR satellite imagery monitoring technology developed as part of river erosion control technology R&D. Besides publishing these results every year so that it is easy to understand the state of progression of coastal erosion, we also plan to use the results when considering methods of evaluating the effects of countermeasure and for clarification of the coastal erosion mechanism.

Up until now, we have been able to verify that, as long as factors such as photographing angle and sediment are satisfactory, it is possible to sample the coastline from satellite images with sufficient accuracy to grasp long-term regression tendencies, as shown in the pictures. From here on, we shall

continue providing systems necessary for monitoring, while also improving sampling methods so that coastline sampling can be performed even with images under worse conditions. We are also considering lending such systems to allow coastal inspectors to perform monitoring by themselves, if they so wish.



Comparison between sampled coastline (in blue) and coastline actually measured (in red)  
(Numbers show mean error in cross-shore direction)

**Details** Ministry of Land, Infrastructure, Transport and Tourism homepage: "River erosion control technology R&D"  
[http://www.mlit.go.jp/river/gijutsu/kaigankadai/pdf/h28\\_report\\_tajima.pdf](http://www.mlit.go.jp/river/gijutsu/kaigankadai/pdf/h28_report_tajima.pdf)

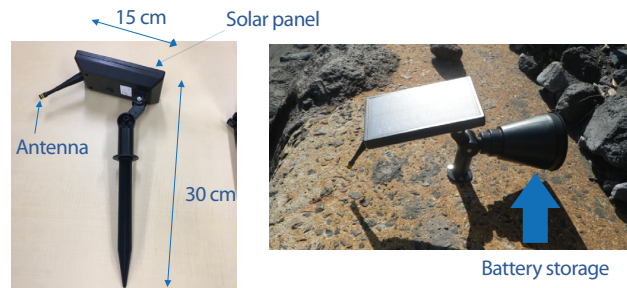
### Debris flow detection sensor utilizing AI

Sabo Department, Sabo Planning Division

A debris flow detection sensor utilizing AI was developed in collaboration with the National Institute of Advanced Industrial Science and Technology (AIST). It is hoped that this will improve detection accuracy and reduce cost.

With the wire sensors frequently used for debris flow detection, flow is detected when the wire installed across a valley is cut by passing debris. However, one major issue with this system is that debris flow cannot be detected until the wire is replaced, after having been cut once. Although there are also vibration sensors that detect debris flow from vibration, it is difficult with such sensors to properly carry out adjustment in advance to the level of vibration to be regarded as debris flow, and there is also the possibility of erroneously detecting vibrations other than from debris flow, which is why they are not widely used.

With this in mind, in 2016 NILIM and AIST began collaborative research to develop a new debris flow detection sensor utilizing AI and IoT. This sensor can detect debris flow by having its AI learn the peculiarities of vibrations caused by debris. After installing a prototype sensor in Sakurajima, Kagoshima, where there is frequent debris flow, and performing continuous inspections based on the AI's machine learning, it became possible to detect debris flow with high accuracy. Also, the sensor body uses fine processing technology with a semiconductor silicon board, which compared with conventional sensors is much smaller, less expensive and easier to install, making it possible to install multiple sensors in the same location. Thus, by performing detection with



Overview of the sensor prototype

multiple sensors instead of a single one, we can expect improved detection accuracy and ensure a fail-safe system in case of sensors being damaged or washed away. Going forwards, we are aiming to put the sensor to practical use, and we plan to inspect its real-time detection accuracy using debris flow software, as well as its durability under the harsh natural environments of mountain streams.

In the future, if this new sensor becomes widely accepted, we can look forward to precise assessment of the conditions of sediment disasters, leading to prompt provision of surveillance systems and evacuation measures.

## Report on research with Indonesia in field of road engineering

Planning and Research Administration Department, International Research Division

Here we introduce a journey that we have been taking for around 10 years in collaborative research performed with the Indonesian Institute of Road Engineering (IRE).

Based on the needs of the Institute of Road Engineering (IRE) in the Republic of Indonesia, NILIM signed a memorandum of understanding in 2009, and since then has conducted collaborative research also involving the Public Works Research Institute. The memorandum revised in 2014 targeted six fields – “roadside stations”, “traffic volume measurement”, “traffic safety”, “road environment”, “paving”, and “tunnels and underground structures” – and it has functioned to allow researchers of both countries to attain broader knowledge via inspection of construction sites or infrastructure facilities, in addition to facilitating discussions in collaborative workshops.

The main results obtained are presented below.

[Roadside stations] In Indonesia there is a shortage of rest stop areas for drivers. Moreover, in order to address the expanding regional disparities that follow the country’s economical growth, regional development of rural areas has become a pressing matter. As one possible solution for such issues, we have performed collaborative investigation and research, as well as written guidelines, aiming to build facilities akin to Japan’s roadside stations.

[Traffic volume measurement] In Indonesia, although underground sensors were common in traffic volume measurement, damage to devices was frequent, and inaccurate measurement of two-wheeled vehicles was also an issue. As a solution, research was conducted regarding the possibility of improving the



Workshop



On-site inspection

measurement accuracy of traffic volume based on image analysis, which made it possible to obtain knowledge regarding the best methods for installing cameras, for example.

Aside from this, we have also conducted repeated research and created guidelines for paving technologies using “Asbuton”, a natural asphalt produced in Indonesia, and for supplementary construction methods of tunnels in poor quality bedrock. After the revision of the agreement planned for this year, we expect to begin tackling new issues while also contributing to reinforcement of the cooperation between our two countries.

**Details** • NILIM website: “International activities”  
[http://www.mlit.go.jp/river/gijutsu/kaigankadai/pdf/h28\\_report\\_tajima.pdf](http://www.mlit.go.jp/river/gijutsu/kaigankadai/pdf/h28_report_tajima.pdf)

## “Cardboard bridge building contest” - an outreach activity that has lasted a quarter-century

Planning and Research Administration Department, Planning Division

We held the 25th “Cardboard bridge building contest”. This time, we implemented new initiatives celebrating the quarter-century history of the contest.

NILIM has been holding the “Cardboard bridge building contest” for elementary school children from 4th and 5th grades in the city of Tsukuba since 1994, with the objective of teaching about the importance of civil engineering infrastructure in our daily lives through handicrafts.

Although the conditions for project creation are strict, requiring two sheets (B3 size) of handcraft cardboard to be used in making a 30 cm bridge that can support 1 kg of weight, the contest normally sees the participation of over 700 children (around 20% of the eligible students in the city).

Upon inviting applications, many schools set the project as a summer holiday assignment with the cooperation of Tsukuba city’s Board of Education. Each year all submitted projects are exhibited on Civil Engineer’s Day, when the institute opens its doors to the public, and we believe this continuous effort held for 25 years contributes to the strong interest shown by children and to the large number of applications received.

Up until now this contest has seen around 8,000 project applications, handcrafted by more than 10,000 children. This time, two new initiatives were introduced to celebrate the quarter-century history of the contest and to express

our gratitude to all participants.

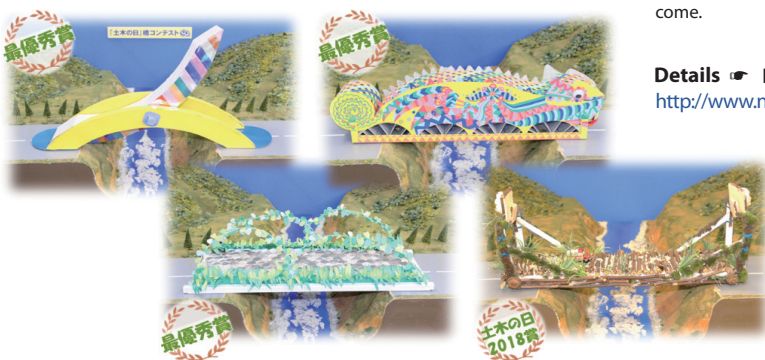
The first of these is the summer break course “Let’s build a bridge”, aimed at children. This course was composed of both theory and practical lessons from paper craft experts regarding the basics of paper modeling (how to cut, fold and paste paper), together with researchers from the NILIM introducing topics on bridge building, including practical experiments.

The 60-student capacity was filled immediately after applications were opened, and many of those who took the course also participated in the contest.

The second initiative was a popularity poll held among visitors to the exhibition of all the submitted projects on Civil Engineer’s Day, when the institute opens its doors to the public. As a result of the poll, in addition to the prizes handed out based on the decisions of the panel (18 projects were given awards, including a Grand Prize and a Structure Design Prize), the project with the largest number of votes also received the Civil Engineer’s Day 2018 Prize”. Children could be seen with their eyes fixated on the exhibits, trying to discover each project’s strengths in order to vote in the poll, which led to the selection of an outstanding project with a different flavor than those chosen by the panel of experts.

The “Cardboard bridge building contest” is formed through the collaboration of many children and all the people involved. We hope the children who participated in this contest will continue to be involved in infrastructure facilities projects in the next generation, and we would like to continue making efforts to further develop the contest so that it can last for 50, 100, or many more years to come.

**Details** • NILIM website: “Cardboard bridge building contest”  
<http://www.nilim.go.jp/lab/bbg/event/buridgecontest/2018/2018bridge.html>



Projects that received awards (Grand Prize and Civil Engineer’s Day 2018 Prize)

## ■“The 19th Tokyo Bay Symposium: New technologies & approaches to improve the coastal area environment”

Coastal, Marine and Disaster Prevention Department Marine Environment and Emergency Management Division

The 19th edition of this event was held on October 18, 2018 at the Osanbashi International Passenger Terminal of Yokohama Port.

The Tokyo Bay Symposium is held every year with the aim of fostering thought both for a better Tokyo Bay environment and a better future, gathering the most up-to-date knowledge from research institutions, private companies, and NPOs, and divulging such information to a wide range of people.

This time the event's themes were “new technologies” (such as IT) that could be employed to improve the coastal area environment, and “new approaches” that will become key in thinking about environment improvement going forwards, and there were a total of 273 participants. Lectures were given by nine different speakers on the topics of blue carbon (carbon captured by living organisms in oceans), environmental DNA, image analysis, artificial satellites, parasitic worms, matters related to the Tokyo Olympic and Paralympic Games, soil originated inland, use of IT in the fishing industry, SDGs for coastal areas, and other new technologies and approaches. A poster session was organized during the interval, in which students, researchers, enterprises, administrative bodies, and NPOs, etc. carried out lively exchanges of ideas about posters related to research,

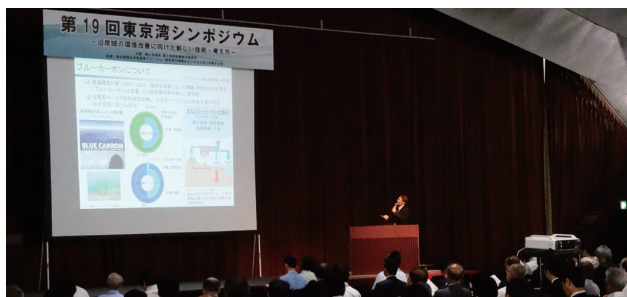
technology, and activities for the revitalization of Tokyo Bay.

Also, on October 20 and 21, in order to generate greater interest in Tokyo Bay the Tokyo Bay Great Thanks Festival was held by The Public-Private Cooperation Forum for Tokyo Bay Restoration in places such as the Yokohama Red Brick Warehouse, under the theme “Let's start doing good actions for the ocean!” The festival was attended by 105,000 visitors, including many families.

As many visitors were able to enjoy discovering and experiencing the appeal and blessings of Tokyo Bay through the Tokyo Bay Symposium and the Tokyo Bay Great Thanks Festival, we believe this provided a great opportunity for actions that will improve the Tokyo Bay environment. We hope to continue our efforts to generate greater interest in the Tokyo Bay environment in the future.

**Details** ☛ NILIM website: “Tokyo Bay Symposium”  
<http://www.ysk.nilim.go.jp/kakubu/engan/kaiyou/kenkyu/tokyobay-sympo.html>

**Details** ☛ Tokyo Bay Great Thanks Festival website:  
<http://tbsaisei.com/fes/>



A lecture at Tokyo Bay Symposium



Tokyo Bay Great Thanks Festival  
 (Source: Tokyo Bay Great Thanks Festival Board Secretariat)

## ■“Compact and smart urban planning” lecture held at the 16th Environmental Research Symposium

Urban Planning Department, Urban Planning Division

We delivered a lecture at the 16th Environmental Research Symposium regarding research to achieve urban sustainability currently being carried out at NILIM.

In Japan, whose society is rushing into a fully-fledged population decline, making cities that have spread due to low population density more compact (consolidating urban structures) has become an urgent matter. On the other hand, as urban planning based on the provision of efficient urban services (making the city smarter) that make use of rapidly developing ICT becomes more feasible, the fusion of compactness and smartness can be promising as a way of making sustainable cities a reality.

As one of the efforts in the Environmental Research Promotion Headquarters activities, NILIM participated in the 16th Environmental Research Symposium, an event that facilitates the exchange of information on research results between national research institutes and other bodies involved in environmental research. This event (held on November 13) adopted the title “Smart Society and Environment: Aiming for Consideration of Both Rich Life and Environment”, and we delivered a lecture on the related research that we are currently conducting.

In the lecture, as an example of studies on urban compactness, we introduced on-going research on urban planning, such as for provision of livelihood services and redevelopment of districts based on the results of objectively measuring the city's future image (future population, cost of infrastructure, etc.) at a district level.

Also, as an example of studies of urban smartness, we introduced survey technology that makes use of mobile phones to ascertain the flow of people

within a city, as well as survey technology to three-dimensionally grasp a city's green areas via airborne laser measurements.

Attended by various researchers and government officials, as well as other citizens, the event was a good opportunity to fully introduce NILIM and to gather opinions, via the lectures and other means.

**Details** ☛ The website of the 16th Environmental Research Symposium  
[http://kankyorenrakukai.org/symposium\\_16/index.html](http://kankyorenrakukai.org/symposium_16/index.html)

**Details** ☛ NILIM website: “Environmental Research Promotion Headquarters”  
[http://www.nilim.go.jp/japanese/organization/k\\_honbu/indexkankyou.htm](http://www.nilim.go.jp/japanese/organization/k_honbu/indexkankyou.htm)



A lecture at the Environmental Research Symposium

## ● Publications (research achievements)

Download here <http://www.nilim.go.jp/lab/bcg/siryou/index.htm>



### NILIM Materials

No.	Title	Department/Division
1011	B-DASH Project No. 19 Guidelines for introducing an advanced reclaimed water system using ultrafiltration membranes and ultraviolet disinfection (Proposal)	Wastewater and Sludge Management Division
1012	B-DASH Project No. 20 Guideline for Introducing an Efficient Survey Technology for Force Mains Damaged by Sulfuric Acid Corrosion (Proposal)	Wastewater System Division
1014	Materials on technologies concerning the use of greening with native wild grass	Landscape and Ecology Division
1015	Collaborative research concerning the application to traffic planning of statistical data on people movement based on operational data of mobile phone base stations	Coastal, Marine and Disaster Prevention Department
1016	Organization of the state of reconstruction/restoration since the Great East Japan Earthquake judged from the state of harbor/coastal areas and facilities	Port Planning Division
1017	Analysis of worldwide container ship conditions and container freight flow (2017)	Port Planning Division
1018	Trend analysis and estimation of the actual conditions of OD freight flow for transshipment containers in major ports of Japan and South Korea	Port Planning Division
1019	Organization of fundamental data on mooring facilities, such as structural types	Port Planning Division
1020	Basic research concerning simplified calculation method of seismic intensity for inspection of vertical pile-type piers	Port Planning Division
1021	Inspection of consideration of improvement methods based on depth increase and improvement of gravity-type quay walls (Part 1)	Port Planning Division
1022	Consideration of simplification of construction documents to raise productivity	Port Construction Systems and Management Division
1023	Analysis of deterioration tendencies in port facilities	Port Construction Systems and Management Division
1024	Consideration of application of 3D data and other methods to promote i-Construction in ports	Port Construction Systems and Management Division
1025	Basic analysis of transition in the number of foreigners visiting Japan in recent years	Airport Planning Division
1026	Design guide for reorganization of downtown road space	Landscape and Ecology Division
1027	Report on the subcommittee meeting of the National Institute for Land and Infrastructure Management Committee for Research Evaluation in the fiscal year of 2017	Research Administration and Evaluation Division
1028	Materials concerning the inspection of dam operation regulations and other items to introduce flood control methods that utilize dams to their maximum functionality	Water Cycle Division
1030	Collaborative research concerning the applicability of measurement and non-destructive inspection techniques to improve inspection efficiency of highway bridges, etc. (III)	Bridge and Structures Division
1031	Research into methods for setting the state of design of highway bridges	Bridge and Structures Division
1032	Collection of annual reports on investigative research related to sewage systems in FY2016	Wastewater System Division
1033	The 2017 report on development of sewage system technologies	Wastewater System Division
1034	Considerations of factors influencing liquefaction damage on flat sections of roads	Pavement and Earthworks Division
1035	Main points regarding resilient structures in coastal dikes against tidal wave overflow	Coast Division
1036	Materials on technologies concerning planning methods for green spaces in disaster prevention systems - Handbook regarding decisions on basic planning for green spaces to improve disaster prevention capabilities of cities and other topics -	Landscape and Ecology Division
1037	The 2017 annual report on road survey costs and other topics	Road Traffic Department, Road Structures Department Social Capital Management Research

## ● Receive information on research performed at NILIM

### • NILIM email service

Twice a month, we deliver the latest information introducing various research activities conducted by NILIM and lecture meetings, etc. Register here (URL and QR code) <http://www.nilim.go.jp/lab/bcg/mailmag/index.html>



### • 2018 Annual Report of NILIM

This website introduces NILIM research activities and achievements, as well as details of the latest research activities to be formally initiated in the future. Go to this website: <http://www.nilim.go.jp/lab/bcg/siryou/2018report/index.htm>

Please take our reader survey: <http://www.nilim.go.jp/lab/bcg/siryou/newsletter/nwsltr.htm>



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