The 4th International Competition for Structural Health Monitoring (IC-SHM, 2026)

Sponsored by:

- ANCRiSST
- Lab of Intelligent Civil Infrastructure, Harbin Institute of Technology, China
- Smart Structures Technology Laboratory, University of Illinois at Urbana-Champaign, USA
- Innovation Lab, Nanyang Technological University, Singapore

Welcome

Bridges and buildings are essential components of modern infrastructure, underpinning economic vitality and public safety. Over time, these structures inevitably experience deterioration and accumulated damage, making reliable inspection, monitoring, and condition assessment increasingly critical. The demand for innovative and efficient structural health monitoring (SHM) technologies has never been greater, and the research community continues to push the boundaries of what is possible in sensing, data interpretation, and digital representation of structural behavior.

Since 2020, the International Competition for Structural Health Monitoring (IC-SHM) has been successfully convened three times, serving as a dynamic platform to inspire fresh ideas and accelerate technological progress in the SHM community. The previous editions have witnessed a wealth of outstanding solutions ranging from novel sensing strategies to advanced data analytics that have opened new avenues for addressing real-world monitoring challenges.

This year, we are proud to launch the fourth edition of the competition, organized by the Asia-Pacific Network of Centers for Research in Smart Structures Technology (ANCRiSST), Harbin Institute of Technology, University of Illinois at Urbana-Champaign, and Nanyang Technological University. All interested students and young scholars from different universities are invited to participate in the competition.

The competition consists of three projects: (i) UAV-based vision displacement measurement, (ii) multi-view semantic 3D reconstruction of bridge structures, and (iii) apparent damage diagnosis of structures based on image-text multi-modal data. Certificates and cash prizes (1st prize – USD 1000; 2nd prize – USD 500; 3rd prize – USD 300) will be awarded for each of the three project competitions. Participants may take part in one or all projects. We will be publishing the IC-SHM 2026 proceedings online, which will include the papers and presentation videos from contest participants. Papers from winning entries or the other participants will be recommended for publication in the journal Intelligent Computing for Engineering, subject to the journal's peer review process.

We warmly welcome you to the competition and wish you good luck in your efforts!

Prof. Hui Li
Chair of IC-SHM, 2026
Member of Chinese Academy of Science
Member of TWAS
Professor at Civil Engineering, Mechanics and Computer Science
Harbin Institute of Technology, China

Prof. Billie F. Spencer Jr
Chair of IC-SHM, 2026
Nathan M. and Anne M. Newmark Endowed Chair in Civil Engineering
University of Illinois at Urbana-Champaign, Urbana, IL, USA

At-a-Glance Summary

Competition Name	The 4th International Competition for Structural Health Monitoring (IC-SHM, 2026)
Eligible Participants	Undergraduate students, M.S. students, PhD students, and young scholars within three years of receiving their PhD upon the submission deadline
Team Size	Individual or team of up to five people
Three Project Topics	Project 1: UAV-based Vision Displacement Measurement Project 2: Multi-view Semantic 3D Reconstruction of Bridge Structures Project 3: Apparent Damage Diagnosis of Structures Based on Image-Text Multi-modal Data
Registration Deadline	June 30, 2026
Submission Deadline	September 30, 2026
Winner Announcement Date	October 31, 2026
Required Submission Items	Submission package with code, reproducibility link, 10-minute video, slides, and 10–15-page paper. Submission checklist: · commented Python code; · a README explaining how to reproduce the results; · required datasets or a shareable Google Drive/Baidu Cloud link; · a 10-minute presentation video with both slides and speaker visible; · PowerPoint slides; · a 10–15-page paper using the IC-SHM template.
Prizes	First Prize: USD 1,000, Second Prize: USD 500, and Third Prize: USD 300 will be awarded for each of the three project competitions.
Contact Email	icshm2026@163.com

Advisory Committee

James L. Beck (USA)
Yunmin Chen (China)
Zuyu Chen (China)
Yozo Fujino (Japan)
Vincenzo Gattulli (Italy)
Mark Girolami (UK)
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Chairs: Hui Li, Billie F. Spencer Jr

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Hongping Zhu	Huazhong University of Science and Technology, China
Daniele Zonta	University of Trento, Italy

Secretary:

Yuequan Bao	Harbin Institute of Technology, China
Jian Li	University of Kansas, USA

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Yuguang Fu	Nanyang Technological University, Singapore

Co-chairs:

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Rongrong Hou	Harbin Institute of Technology, China
Yang Xu	Harbin Institute of Technology, China

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Chia-Ming Chang	National Taiwan University, Taiwan, China
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Ye Xia	Tongji University, China
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Xiaowei Ye	Zhejiang University, China
Hyungchul Yoon	Chungbuk National University, Korea
Dongyu Zhang	Harbin Institute of Technology, China
Jian Zhang	Southeast University, China
Jiwei Zhong	China Railway Bridge Science Research Institute, Ltd.
Xinqun Zhu	University of Technology Sydney, Australia

Eligibility and Team Rules

- Participants must be full-time undergraduate students, M.S. students, PhD students, or young scholars if their PhD degree was awarded on or after June 30, 2023.
- Eligible young scholars may include postdoctoral researchers, research scientists, assistant professors, or industry researchers, provided they meet this date requirement.
- Participation can be by individuals or by teams (each team can have no more than 5 persons).
- Participants can compete in one, two, or all three projects.
- A participant may join submissions for multiple projects. However, each project submission must identify one official team, with no more than five members. Team composition may differ across projects.

Registration and Submission Instructions

- Registration forms must be submitted to icshm2026@163.com by June 30, 2026. A data download link will be opened after registration.
- Contest entries must include:
  (i) commented code that will reproduce your results with README; We accept code in Python. Corresponding dataset for reproduction should be submitted as a shareable file link on Google Drive or Baidu Cloud);
  (ii) a ten-minute presentation video with both the slides and the speaker clearly visible and associated PowerPoint slides;
  (iii) a 10–15-page paper following the downloadable template on the IC-SHM website.
- The papers and presentation videos will be included in the proceedings published on the IC-SHM 2026 website.
- All submitted materials should be in English.

Prizes and Publication Opportunities

- Winners will be selected by the Awards Committee based on the identification accuracy, the video presentation of the results, and the submitted paper (see Evaluation Metrics below).
- First Prize: USD 1,000, Second Prize: USD 500, and Third Prize: USD 300 will be awarded for each of the three project competitions.
- All participants will receive certificates.
- The IC-SHM 2026 proceedings will be published online.
- The winning teams or the other participants will have the opportunity to be invited to contribute full papers for possible publication in the journal Intelligent Computing for Engineering (EIC: Prof. Hui Li). All papers will be subject to rigorous review.

Important Dates

- June 30, 2026 — Registration, please send the registration form to icshm2026@163.com
- July 5, 2026 — Dataset links sent to registered teams
- September 30, 2026 — Submit all the items to icshm2026@163.com for each project in which your team is competing as outlined in the submission requirements
- October 15, 2026 — Reproducibility and evaluation period
- October 31, 2026 — Announcement of competition winners

Contact Information

- **Website:** https://civil.hit.edu.cn/,http://sstl.cee.illinois.edu/icshm2026/,https://www.ntu.edu.sg/cee
- **E-mail:** icshm2026@163.com

Project 1: UAV-based Vision Displacement Measurement

Task

Participants must develop an algorithm that estimates the displacement time history of the visual target from UAV video. The submitted displacement signal will be compared with the LDS reference measurement in the specified target direction.

Background

Bridges are vital components of transportation infrastructure, and reliable condition assessment during service is essential to ensure structural safety, durability, and operational efficiency. As the demand for inspection and maintenance of existing bridges continues to grow, efficient and accurate monitoring technologies have become increasingly important. Among emerging solutions, unmanned aerial vehicles (UAV) have shown significant potential for bridge engineering applications due to their flexible deployment, broad accessibility, and efficient data acquisition, particularly for locations that are difficult or costly to inspect using conventional methods [1, 2].

For vibration monitoring tasks, however, UAV-based video measurement still faces substantial challenges. Unavoidable platform motion during hovering, including jitter, viewpoint drift, and imaging disturbances, may significantly degrade the accuracy of displacement measurement. In this project, participants are invited to develop video-based methods for vibration displacement measurement of a flexible stay cable model subjected to wind-induced vortex-induced vibration. The experimental setup is shown in Figure 1.

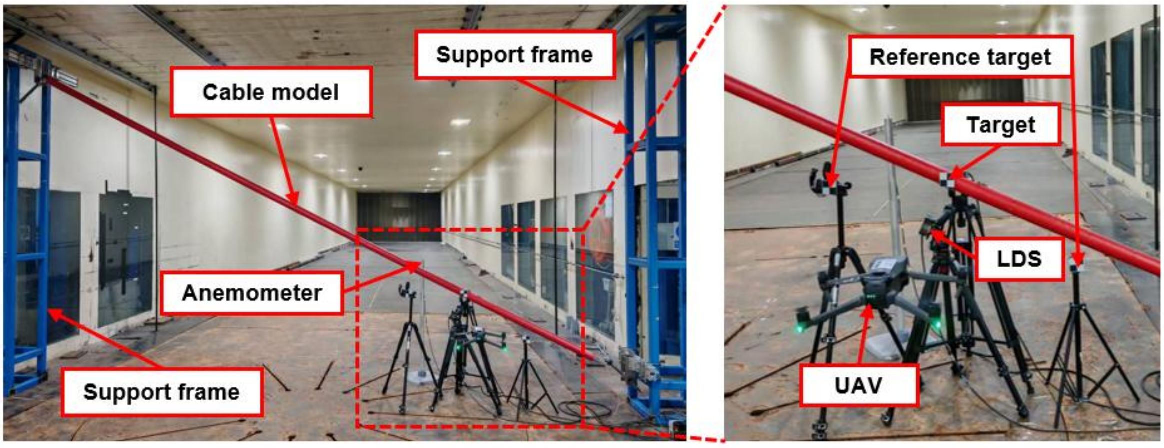


Figure 1. Wind tunnel experimental setup for vortex-induced vibration of the stay cable.

Data Description

The experiment was conducted in the Joint Laboratory of Wind Tunnel and Wave Flume (WTWF) at Harbin Institute of Technology. In this project, wind serves as the external excitation, and a flexible stay cable model is excited into vortex-induced vibration under an incoming wind speed of 3.62 m/s. The project focuses on the displacement identification of the cable's in-plane vibration, specifically the vibration response perpendicular to the cable length direction. At a location L/6 from the lower end of the cable, a high-contrast visual target and a laser displacement sensor (LDS) were installed to record the target-region video data and the reference displacement ground truth, respectively. Structural motion videos were captured by a DJI Mavic 3 Pro UAV hovering approximately 2 m from the target observation area. The video resolution is 3840×2160 pixels, the sampling frame rate is 50 FPS, and the duration of each recording is 60 s. The sampling frequency of the LDS is 10,000 Hz. The cable inclination angle is 26.95∘, and the size of the visual target is 55×55 mm.

Participants are required to estimate the vibration displacement time history of the target point in the specified direction using UAV video data. Feature tracking, optical flow estimation, phase-based analysis, template matching, deep learning, and other image-processing techniques may be adopted, together with appropriate displacement correction strategies to reduce the influence of UAV platform motion, imaging noise, and viewpoint drift.

Goal & Evaluation

The objective of this project is to achieve high-precision displacement identification of the vortex-induced vibration response of a flexible stay cable using UAV video data. The project covers key components of structural health monitoring, including vision-based measurement, signal processing, and dynamic response identification, and is intended to assess participants' overall capability in structural vibration displacement measurement under complex airborne observation conditions.

The displacement results submitted by participants will be evaluated against the LDS-measured displacement time history in the target direction, which serves as the reference ground truth. The root mean square error (RMSE) of displacement will be adopted as the evaluation metric. Submissions will be ranked in ascending order of RMSE, with lower RMSE indicating better agreement with the LDS-measured displacement time history. For top-ranked entries, the organizing committee will further verify the reproducibility of the submitted methods using the provided code and will also consider the quality of the accompanying project report.

Submission Requirements

Submitted Project 1 result files should be provided as a CSV file with columns time_s and displacement_mm, sampled at 50 Hz unless otherwise specified. Participants may use public datasets, open-source software, and pre-trained models, provided that all such resources are clearly cited in the paper and described in the README. Use of private or unreleased data is not permitted unless made available to the organizers for reproducibility.

References

[1] Li S, Yang Y. Super-sensitivity incoherent optical methods for full-field displacement measurements[J]. Optics Letters, 2022, 47(21), 5453-5456.
[2] Zhang H, Wu S, Luo X, Huang Y, Li H. Efficient matching of Transformer-enhanced features for accurate vision-based displacement measurement[J]. Automation in Construction, 2025, 171, 105962.

Project 2: Multi-view Semantic 3D Reconstruction of Bridge Structures

Task

Participants must develop a model that reconstructs a semantically labeled 3D representation of a bridge structure from multi-view images.

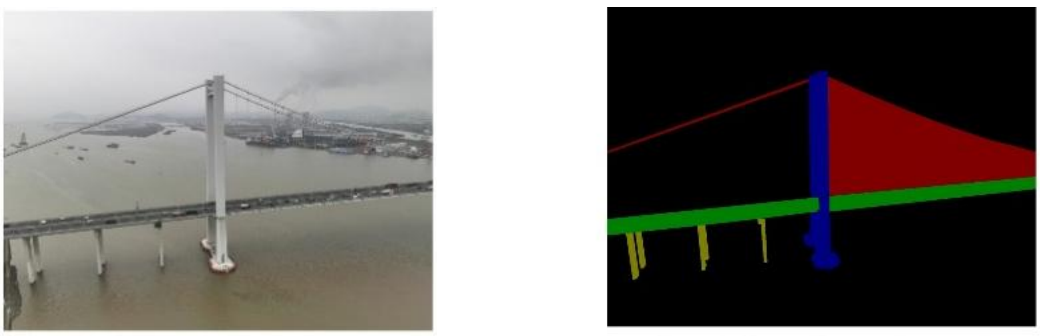
Background

With the advancement of UAVs and computer vision techniques, high-resolution multi-view images of bridge structures can now be efficiently acquired. These images provide rich geometric and semantic information, enabling the possibility of reconstructing semantically meaningful 3D models for digital twin and intelligent SHM.

Despite recent progress, most existing methods either focus on 3D reconstruction without semantic understanding, or perform only 2D image-based segmentation. For engineering applications, it is essential to integrate geometry reconstruction and semantic interpretation into a unified framework. This project aims to develop data-driven methods that reconstruct semantically labeled 3D representations of bridge structures from multi-view images, providing a foundation for automated inspection and condition assessment [1, 2].

Data Description

The dataset consists of 300 high-resolution multi-view images of a real-world bridge, accompanied by pixel-level semantic annotations for structural components (i.e., deck, main cable, tower and foundation) as shown in Figure 2. The training set provides both images and their semantic labels to allow participants to develop supervised reconstruction models. Additionally, 100 extra images without annotations are provided to facilitate data augmentation or semi-supervised learning. For all released images, camera intrinsic and extrinsic parameters are provided to facilitate reconstruction. Participants may use public datasets, open-source software, and pre-trained models to improve performance, provided that all such resources are clearly cited in the submitted paper and described in the README file. The use of private or unreleased data is not permitted unless these datasets are made available to the organizers for reproducibility.



(a) Original bridge image (b) Pixel-level semantic label

Figure 2. Example bridge image and semantic label.

Goal & Evaluation

The goal of this project is to develop a model that reconstructs a semantically labeled 3D representation of a bridge structure from multi-view images. Submitted models will be evaluated on a separate blind test set using two complementary criteria:

1. Visual fidelity: The reconstructed 3D model is rendered from the test viewpoints, and the resulting RGB images are compared with the original ones using PSNR, SSIM, and LPIPS metrics;
2. Semantic accuracy: The reconstructed 3D model is rendered into semantic maps from the test viewpoints, and the mean Intersection-over-Union (mIoU) over the predefined semantic classes is computed against the ground-truth semantic labels.

The final ranking will be determined based on a weighted combination of visual fidelity and semantic mIoU, and the accuracy score is defined as:

$$\text{Accuracy Score} = 0.50 \times \text{Visual Fidelity Score} + 0.50 \times \text{Semantic mIoU Score}.$$

Submission Requirements

Participants are free to adopt any reconstruction methodology, including but not limited to point-based, mesh-based, implicit neural representations, or 3D Gaussian splatting. However, the submitted model or script must be capable of generating both RGB images and semantic maps from the provided test viewpoints using official class IDs for the semantic maps, ensuring that the organizers can consistently and automatically evaluate both visual and semantic reconstruction performance.

References

[1] Hou J, Hou R, Bao Y. Regularized three-dimensional Gaussians for large-scale building reconstruction with spatial prior[J]. Engineering Applications of Artificial Intelligence, 2025, 158: 111445.

[2] Yang X, Hou R, Bao Y. Multi-view stereo 3D building reconstruction with sparse depth and edge location priors[J]. Automation in Construction, 2025, 177: 106365.

Project 3: Apparent Damage Diagnosis of Structures Based on Image-Text Multi-modal Data

Task

Participants must develop a model that identifies all visible damage types in each image and generates a natural-language description of the damage characteristics.

Background

Existing computer vision-based methods for diagnosing damage in civil engineering structures typically recognize only a limited set of damage categories and are unable to provide natural language descriptions of damage morphology, distribution, severity, or other characteristics. This limitation prevents them from meeting the requirements of fine-grained assessment and automatic report generation in complex damage scenarios. To address this gap, this project proposes an apparent damage recognition task based on image-text multi-modal data. The objective is to develop encoding and alignment methods between visual features of structural damage and textual descriptions, enabling automatic generation of text descriptions for structural damage images. Participants must develop a model that identifies all visible damage types in each image and generates a natural-language description of the damage characteristics. By covering typical damage types such as cracks, voids, spalling, corrosion, and exposed rebar across various structural forms including concrete components, steel components, and asphalt pavements, this project can thoroughly evaluate the accuracy and generalization capability of models for multitype damage diagnosis in complex environments [1, 2].

Data Description

The dataset contains 1,200 damage images (*.jpg) and their corresponding text descriptions (*.json). The damage images shown in Figure 1 contain only one type of damage per image, such as concrete cracks, voids, looseness, honeycomb, etc. The images shown in Figure 3 contain multiple types of damage per image, for example, concrete spalling leading to exposed and corroded rebar. Participants are required not only to enable the model to output damage categories but also to generate natural language descriptions of damage characteristics, including crack orientation, corrosion severity, void size, etc. Each folder provides corresponding text description examples, as shown in Figure 3, which can also serve as a reference for constructing image-text multi-modal datasets. It is recommended that participants consider methods such as combining open-source multi-modal datasets for training to improve cross-modal alignment, or using an open-source multi-modal pre-trained model as a backbone and fine-tuning it with the provided datasets.

img	./image/kong_0161.jpg
prompt	Based on the picture, determine whether there is damage to the structure in the picture.
label	There are holes in the concrete surface.

img	./image/xiu_049.jpg
prompt	Question: Based on the image, determine whether the structure in the image has any defect?\nAnswer: Yes, the component in the image has corrosion.\nQuestion: Please describe the characteristics of the defect based on the image?
label	The protective layer on the component's surface has peeled off, causing the component to be exposed and suffer severe corrosion defect.

Figure 3. Examples of single-category damage, multi-category damage, and text descriptions.

Goal & Evaluation

The objective of this project is to achieve automatic recognition of multi-type apparent damage in civil structures based on image-text multi-modal data. Specifically, given input structural damage images, the model is required to output the following using natural language: 1) determine the damage categories present in the image, such as cracks, voids, corrosion, etc.; and 2) provide damage characteristic descriptions, including fine-grained information such as crack orientation, corrosion severity, void size, etc. This project aims to assess participants' overall capabilities in multi-modal perception, fine-grained classification, and natural language generation under complex structural damage scenarios.

The results submitted by participants must be JSON files containing image_id, damage_categories, and description. The results will be evaluated in the following two aspects: 1) the **ACCURACY** and **F1 score** of damage category classification will be computed by comparing the model's output damage categories with the ground-truth labels of the image; and 2) the semantic similarity of the damage characteristic descriptions will be evaluated using the **METEOR** (Metric for Evaluation of Translation with Explicit ORdering), which compares the model-generated text descriptions with manually annotated reference descriptions. For top-ranked entries, the organizing committee will further verify the reproducibility of the submitted methods using the provided code and will also consider the quality of the accompanying project report.

References:

[1] Zhang Y, Wei S, Huang Y, Su Y, Lu S, Li H. SDIGLM: leveraging large language models and multimodal chain of thought for structural damage identification[J]. Structural Health Monitoring-An International Journal, 2025, 14759217251348275.

[2] Xu Y, Zhang C, Li H. Transformer-based large vision model for universal structural damage segmentation[J]. Automation in Construction, 2025, 106256.

Evaluation Metrics

The work submitted by participants will be evaluated by the committee according to **"Identification Accuracy", "Video Presentation"**, and **"Submitted Paper"**. The weights associated with these three parts are shown in Table 2. Final Score = 0.35 × Accuracy Score + 0.25 × Video Score + 0.40 × Paper Score. There will be two stages in the evaluation. The first stage is the preliminary evaluation by the organizing committee. The second stage is the final evaluation by the awards committee.

Table 2. Evaluation Metrics.

Item	Descriptions	Weighting
Identification Accuracy	The model accuracy score will be determined as follows: (1) For Project 1, participants' submitted displacement results will be ranked in ascending order of RMSE, with lower RMSE indicating better agreement with the LDS-measured displacement time history. (2) For Project 2, reconstruction accuracy will be evaluated on a separate blind test set using visual fidelity and semantic mIoU as metrics. (3) For Project 3, the performance of structural damage diagnosis is evaluated using damage classification accuracy and semantic similarity (METEOR) as metrics.	35%
Video Presentation	The presentation will be evaluated based on: (i) originality and creativity, (ii) organization of content, (iii) oral delivery, (iv) understanding of research methodology, and (v) clarity of artwork (charts, graphs, slides).	25%
Submitted Paper	The paper will be evaluated based on: (i) adequacy of literature review, (ii) organization of content, (iii) innovation and creativity, (iv) research methodology, (v) clarity of figures and tables, (vi) technical conclusions, and (vii) language usage.	40%

Appendix / FAQ

Q: Can one person join more than one team?
A: Yes. A participant may join submissions for multiple projects. However, each project submission must identify one official team, with no more than five members. Team composition may differ across projects.

Q: Can a team submit to more than one project?
A: Yes.

Q: Are pre-trained models allowed? Are commercial software packages allowed?
A: Yes. Participants may use public datasets, open-source software, and pre-trained models, provided that all such resources are clearly cited in the paper and described in the README. Use of private or unreleased data is not permitted unless made available to the organizers for reproducibility.

Q: What happens if the code cannot be reproduced?
A: The accuracy score would be recognized as zero.

Q: Will the test data be released after the competition?
A: The test data could be released after the competition upon request.

Q: Can submitted papers be revised before online proceedings publication?
A: No. The submitted papers could only be updated no later than September 30, 2026.

Q: Are cash prizes awarded to teams or individuals?
A: Cash prizes are awarded to each group by individuals or by teams.