

10/10/2024 11:40:47 am THU

11/10/2024 07:47:58 pm FRI

17/10/2024 03:40:52 pm THU



# Smart Geotechnology Laboratory

*Room Z520e, Block Z*

*Department of Civil and Environmental Engineering,*

*The Hong Kong Polytechnic University*



THE HONG KONG  
POLYTECHNIC UNIVERSITY  
香港理工大學



DEPARTMENT OF  
CIVIL AND ENVIRONMENTAL ENGINEERING  
土木及環境工程學系

Opening Minds • Shaping the Future  
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# Introduction

The Smart Geotechnology Laboratory was established in 2021, and was set up for the development, calibration and deployment of innovative sensors in geotechnical and infrastructure projects. Some of the main equipment include an ultra-high resolution distributed optical fibre sensing instrument based on optical frequency domain reflectometry (OFDR) technology, fibre Bragg grating (FBG) sensors and a deformation and load-controlled tension/compression machine for calibration of new sensors. Some recent research projects include development of a patented effective earth pressure cell, installation of various types of fibre optic sensors for the monitoring of stonewall trees, masonry retaining walls and diaphragm walls in deep excavation projects.



# Main Equipment



**MOI SM130-700**  
**OPTICAL SENSING INTERROGATOR**

For data acquisition of FBG sensors  
(4 channels, dynamic sensing in 100 Hz)



**MOI SM130-700**  
**4-CHANNEL OPTICAL SENSING**  
**INTERROGATOR**

For data acquisition of FBG sensors  
(4 channels, dynamic sensing in 100 Hz)



**MOI SM125-500**  
**4-CHANNEL OPTICAL SENSING**  
**INTERROGATOR**

For data acquisition of FBG sensors  
(4 channels, static sensing in 1 Hz)



# Main Equipment



**MOI SM041-416**  
**16-CHANNEL CHANNEL**  
**MULTIPLEXER**

Multiplex the channel of FBG interrogator from 4 Channels to 16 Channels.



**FUJIKURA FSM-60S**  
**SINGLE FIBER ARC FUSION SPLICER**  
**SYSTEM**

For optical fiber fusion and splicing



**MOI SM125-500 DEMO (SNSIA9EB)**  
**OPTICAL SENSING INTERROGATOR**

For data acquisition of FBG sensors (4 channels, static sensing in 1 Hz)

# Main Equipment



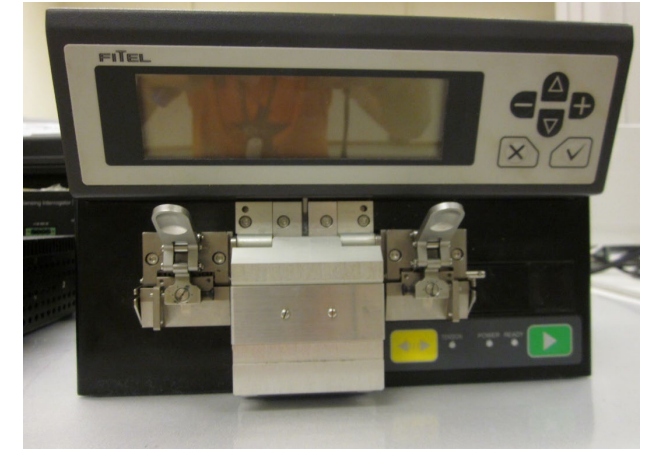
**SEMICON OSI-S DISTRIBUTED  
OPTICAL FIBRE SENSING  
INSTRUMENT**

Static distributed optical fiber sensing system, capable of sensing strain along the optical fiber (sensing length up to 85 m with the spatial resolution up to 1 mm).



**MOI SI255  
DYNAMIC OPTICAL SENSING  
INTERROGATOR**

For data acquisition of FBG sensors (16 channels, dynamic sensing in 1000 Hz)



**FURAKAWA S541A  
FIBER RECOATER**

For fiber recoating



# Main Equipment



**WINDOWS STRIPPER  
FOR 250UM FIBER**

For fiber stripping



**HICHANCE HC-CK103  
Crack width detector instrument**

For crack detection on the surface  
of concrete or rock



**Fujikura CT08  
Fiber Cleaver**

For fiber cleaving

# Main Equipment



## HS VISION MACRO VIS EOSENS HIGH-SPEED VIDEO CAMERA

Capable of taking photos with the resolution of 1024\*768 in the frequency of 1000 Hz or slow motion videos.



## MATEST S205-05N UNITRONIC COMPRESSION TENSILE FRAME MACHINE

Static distributed optical fiber sensing system, capable of sensing strain along the optical fiber (sensing length up to 85 m with the spatial resolution up to 1 mm)

# Academic Staff



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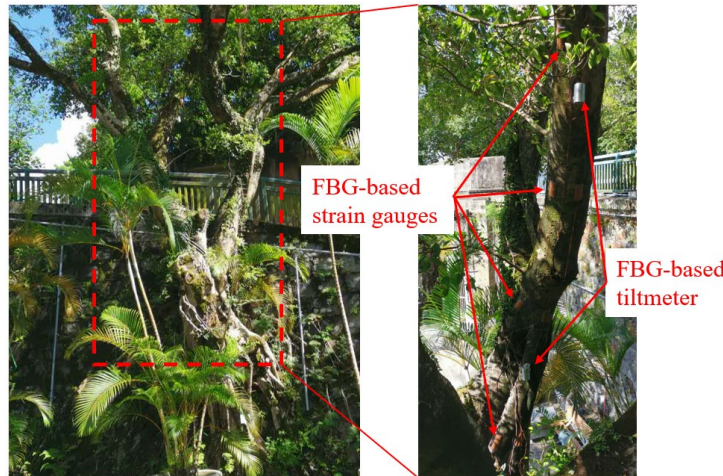


**Dr Wu, P.C.Elvis (吳沛琛)**

Research Assistant Professor

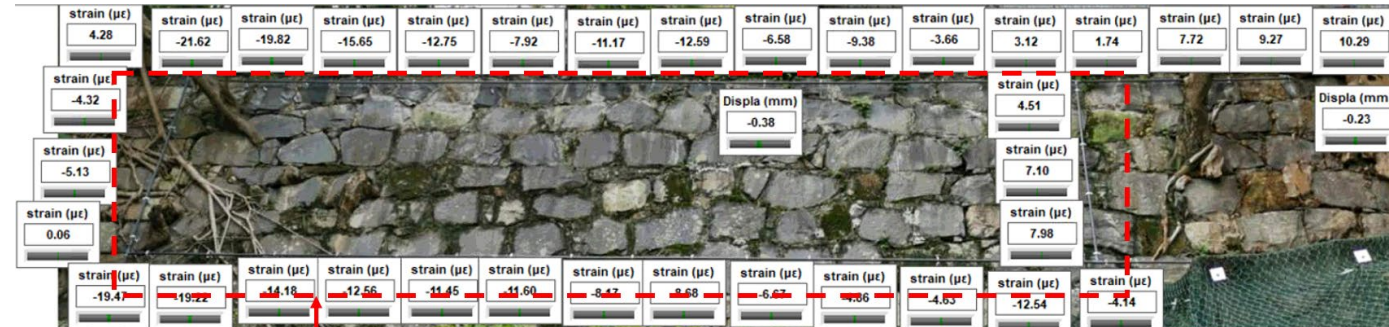
Email: [elvis.wu@polyu.edu.hk](mailto:elvis.wu@polyu.edu.hk)

# Research Spotlight



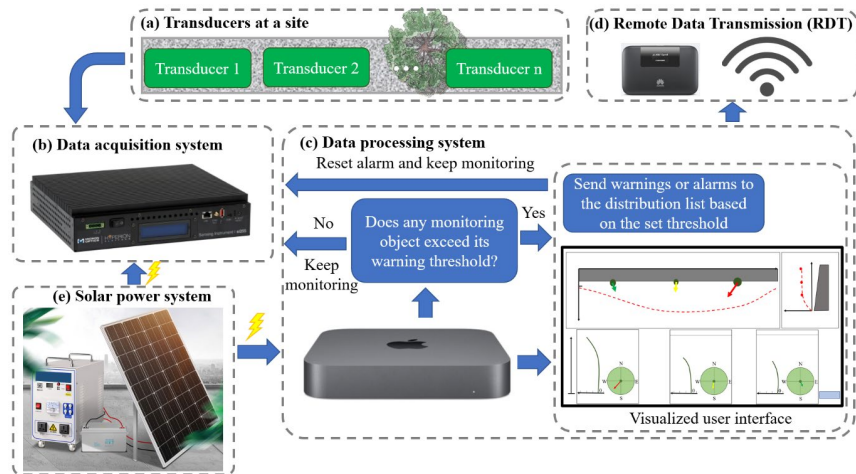
Measurement of tilt and strain of a stonewall tree

## Development of FBG-based Smart Monitoring System for Masonry Retaining Walls, Stonewall Trees and Large Trees



Measurement of deformation on a masonry retaining wall

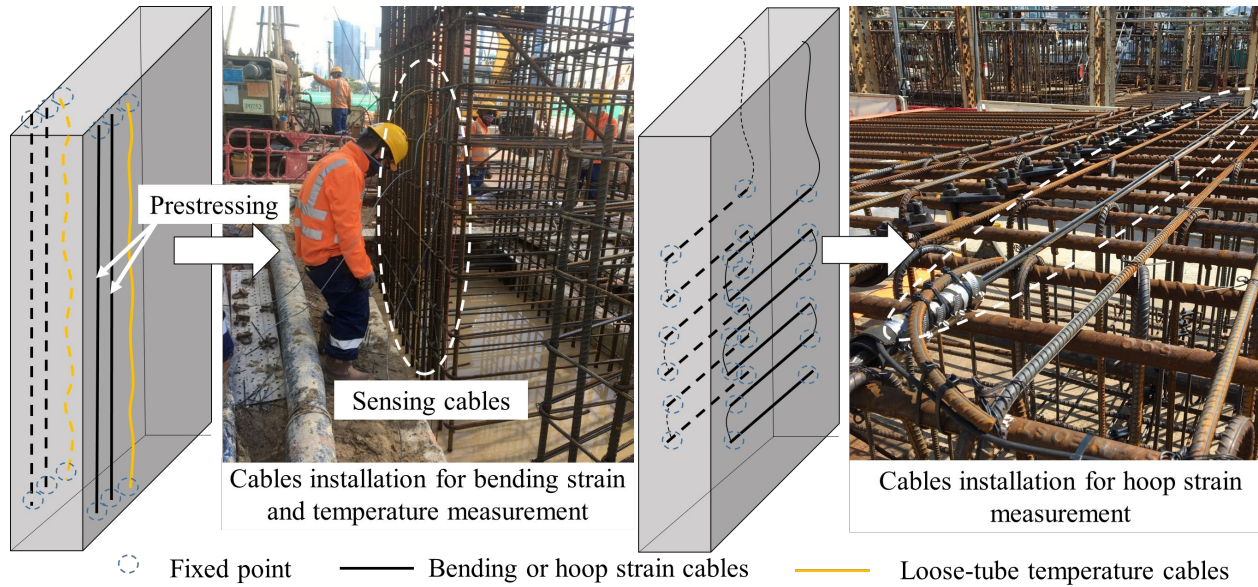
Distributed FBG sensor on wall for bulging deformation measurement



- > FBG-based transducers were developed to monitor the deflections of stonewall trees and masonry retaining walls.
- > Warning messages could be automatically sent to a pre-assigned email list if the deflections exceeded the pre-set thresholds.

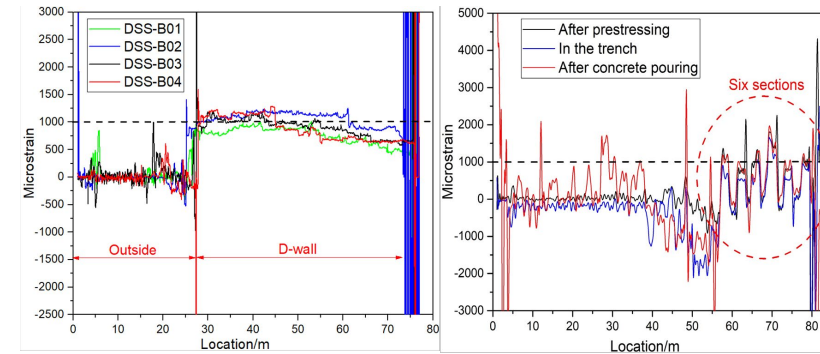


# Research Spotlight



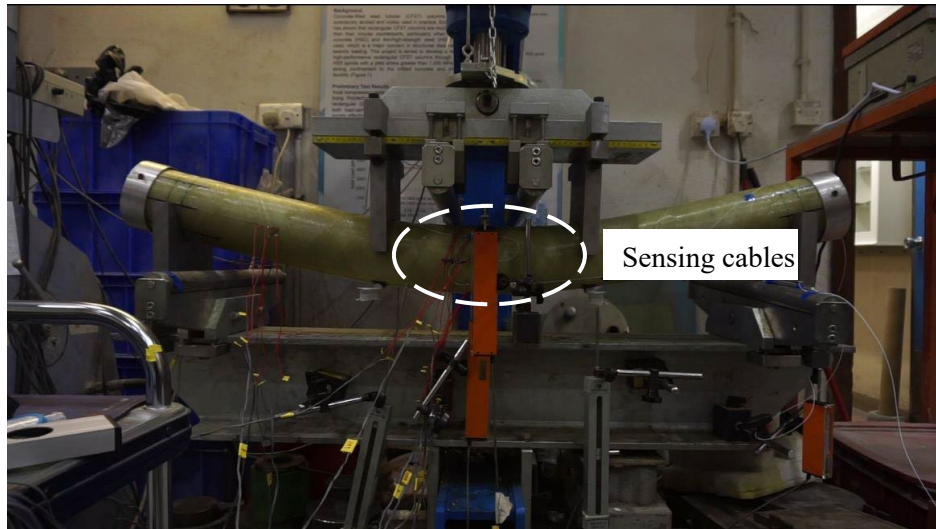
Application of OFDR in Measurement of Diaphragm Wall Deformation

- > Fibre optic sensors were installed in diaphragm wall panels in the construction of a twin-cell 'peanut-shaped' cofferdam, where both the bending strains and hoop strains were measured. The OFDR technology allows continuous measurements of strains along the entire lengths of fibre optic cables.

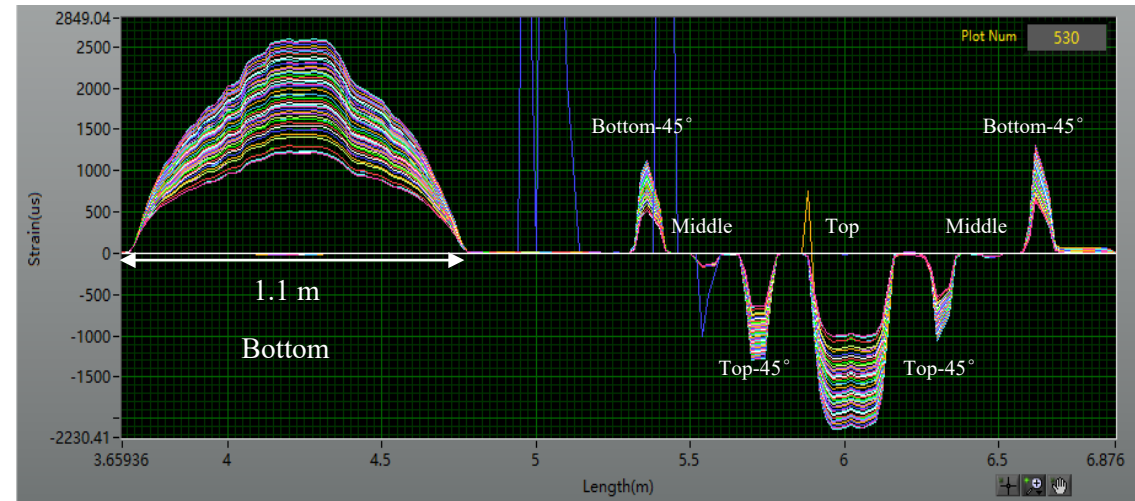


Distributed strain data along the wall obtained by fibre optic sensing cables

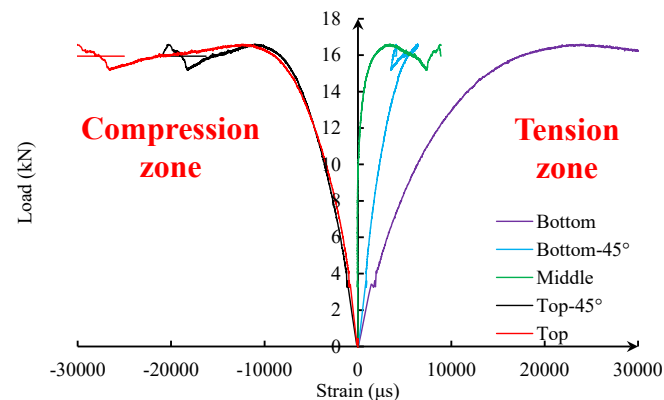
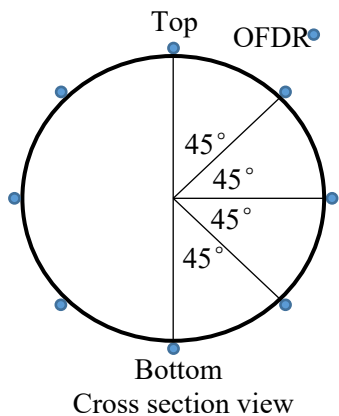
# Research Spotlight



## Application of OFDR in Measurement of FRP Tube Strain Distribution



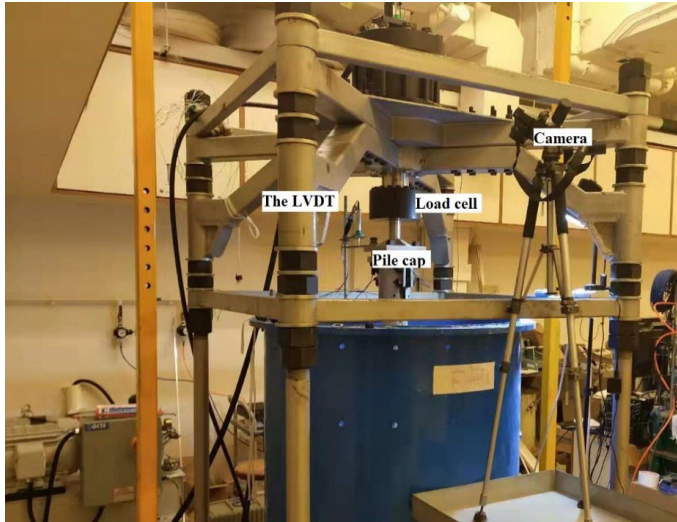
Distributed strain data obtained by fibre optic sensing cables.



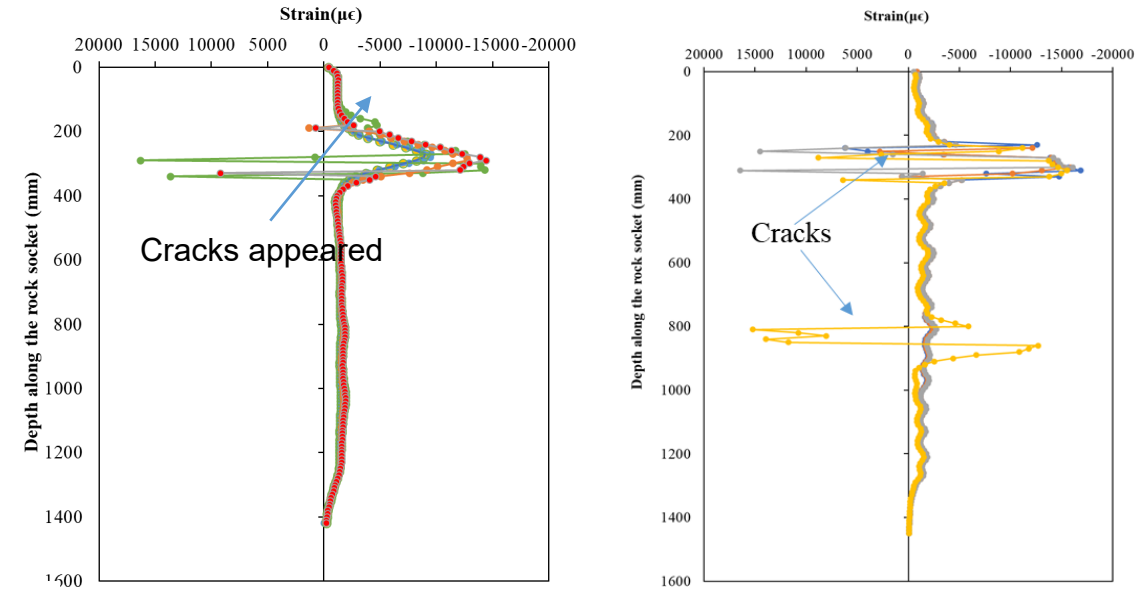
- > Fibre optic sensors were installed on the surface of FRP tube. In the four-point flexural test, the strain distribution in the tension zone and the compression zone was monitored.



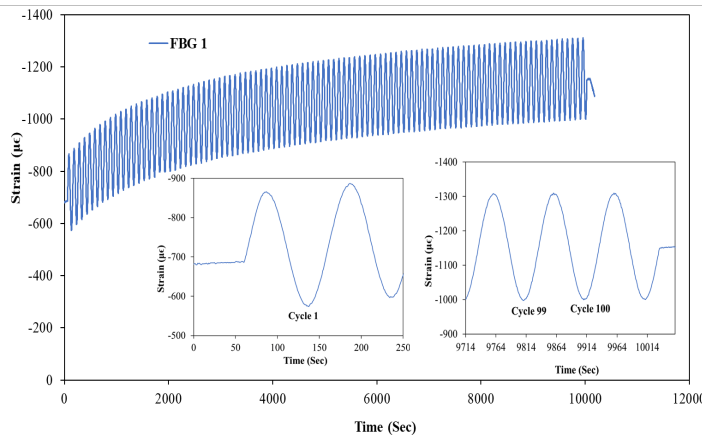
# Research Spotlight



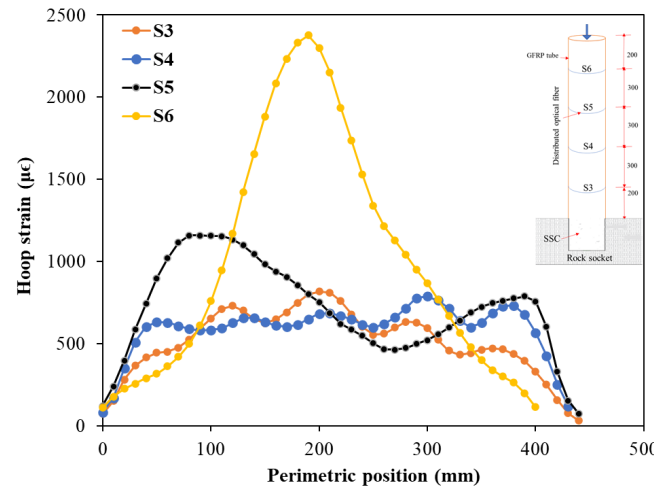
## Application of OFDR for monitoring the behavior of FRP-SSC piles



Strain monitored at higher loads near failure



Behavior of the model pile under cyclic loading at pile head



Hoop strain along circumference of pile

- > OFDR sensing technology was used for detecting cracks inside the concrete and debonding between FRP and concrete.
- > The strain distribution along the depth of the pile was monitored by OFDR and FBG sensors under static and cyclic loadings.

# Lab-in-charge and Technical Staff

## Lab-in-Charge



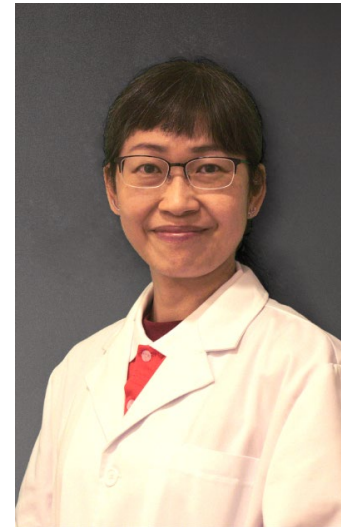
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Tuesday to Friday 8:45am – 12:30pm, 1:30pm – 5:30pm  
(excluding Saturday, Sunday & public holidays)