International Advanced School
Soil-Structure Interaction in OpenSees (SSI-OS)
strategies, applications and perspectives
9-11 September 2024

Motivation and goal

OpenSees is an open-source, evolving numerical framework for assessment of civil engineering structures against natural hazards, in which soil-structure interaction can be simulated through multiple levels of complexity.

In SSI-OS we explore soil-structure interaction modelling in OpenSees, focussing on critical issues of the implementation. After an introduction to OpenSees, the development of nonlinear dynamic analyses is the main goal of this path. New-generation approaches for assessing the dynamic performance of soil-structure systems will be described and techniques to implement new features in OpenSees will be discussed, of interest for both Users and Developers.

With respect to 2023 SSI-OS, in the present edition the discussion of the numerical strategies to soil-structure interaction will be extended to the use of tools for regional analysis and artificial intelligence-based assessment. Several example applications will be provided, supported by hands-on experience and working groups.

2024 SSI-OS takes place over two and a half days. It is composed of five sessions, three interacting lectures and a conclusive round table.

Organising Committee



Davide Noè Gorini
Sapienza University of Rome, Italy



Pedro Arduino
University of Washington, United States



Guido Camata
University of G. D'Annunzio Chieti-Pescara, Italy



Domenico Gallese
ARUP, United Kingdom



Massimo Petracca
ASDEA Software Technology, Italy

Invited Speakers



Frank McKenna

University of California, Berkeley

United States



Yu-Wei Hwang

National Taiwan University

Taiwan



Silvia Mazzoni

NHERI DesignSafe

United States



Faisal Nissar Malik

University of Lehigh

United States



Jose Abell

University of the Andes

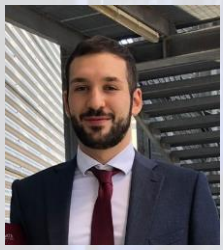
Chile



Tony Fierro

University of Molise

Italy



Giuseppe Lombardi

Sapienza University of Rome

Italy

With the support of

SIMSG ISSMGE

- Technical Committee 203 *Earthquake Geotechnical Engineering and Associated Problems* of the International Society for Soil Mechanics and Geotechnical Engineering (website)
- Technical Committee 204 *Geotechnical Aspects of Underground Construction in Soft Ground* of the International Society for Soil Mechanics and Geotechnical Engineering (website)
- Technical Committee 209 *Offshore Geotechnics* of the International Society for Soil Mechanics and Geotechnical Engineering (website)
- Technical Committee 309 *Machine Learning and Big Data* of the International Society for Soil Mechanics and Geotechnical Engineering (website)

- ASDEA Software Technology (website)

- NHERI SimCenter – Center for Computation Modeling & Simulation (website)

- Associazione Geotecnica Italiana (website)

- DESIGNSAFE-CI (website)

- Associazione Nazionale Italiana di Ingegneria Sismica (website)

- NHERI Lehigh Facility (website)

- Advanced Technology for Large Structural Systems Engineering Research Center (website)

- Event organised in collaboration with Ordine degli Ingegneri della Provincia di Perugia (website)

- MASTER Association – Materials and Structures Testing and Research (website)

Venue and accomodation

2024 SSI-OS will be held at Hotel Domus Pacis (https://domuspacis.it/), which has a privileged location in the heart of Umbria (centre of Italy). It is located 900 m from Assisi railway station S. Maria degli Angeli and 3 kilometres from the famous historical town of Assisi, which can be reached by shuttle bus or via a 30-minute walk.

Hotel Domus Pacis provides full board service at € 88 or 73 per day for the single or shared room, respectively. People interested in reserving a room at Hotel Domus Pacis are kindly invited to communicate it to compdssi2024@gmail.com, with a copy to davideno.gorini@uniroma1.it (please, consider that rooms are subject to availability).

An additional fee will be required to people not staying at Hotel Domus Pacis to take part in the lunches/dinners (€ 25 per meal) during the Workshop's Days.

How to get to Assisi

By plane

The closest major airports to Assisi are: Umbria International Airport S. Francesco d'Assisi (Perugia), Peretola Airport (Florence), Fiumicino Airport Leonardo da Vinci (Rome), Galileo Galilei Airport (Pisa). All these airports are roughly the same distance away, but the transport links from Rome and Florence (via train) will be the easiest.

By train

Assisi railway station is located in S. Maria degli Angeli, from which Hotel Domus Pacis can be straightforwardly reached on foot or via a local bus service (line C) running from outside the railway station.

Ticket Office Hours: 1:00 p.m. to 7:35 p.m.

Website of the Italian Railways (FS): http://www.trenitalia.com/

By car

Coming from the North

a) Highway 14 – Autostrada Adriatica: exit at Cesena (150 km from Assisi) and continue to Perugia (E45) until Assisi exit.

b) Highway Autostrada del Sole A1: Exit Valdichiana until you reach Perugia, continue towards Cesena (E45) until Assisi exit.

Coming from the South

a) Highway 14 – Autostrada Adriatica: exit Civitanova Marche towards Foligno – Perugia until the Assisi exit.

b) Highway Autostrada del Sole A1: exit Orte, continue on the E45 towards Perugia – Cesena until the Assisi exit.

By bus

Bus service: Bus Italia, website http://www.fsbusitalia.it, office phone +39.075 9637637, e-mail clienti.perugia@fsbusitalia.it

Registration and fees

Registration to 2024 SSI-OS is mandatory through this ***form***. Registrations will be accepted subject to availability (maximum number of attendees = 100).

The payment of the fees for School attendance (in-person only) can be made after the acceptance of registration through bank transfer (bank coordinates are communicated upon acceptance). Fees include School attendance and coffee breaks.

School fees - attendance

payment	Delegate	Student
by June 30, 2024	230 euros	190 euros
from July 1 on	270 euros	210 euros

Scientific programme

Day 1 - Monday, September 9

8.30-9.00 **Registration**

9.00-9.30 **Opening**

Session 1 - Basics of modelling soil-structure interaction in OpenSees

9.30-10.15 *Fundamentals in geotechnical engineering applications using OpenSees*, P. Arduino

10.30-11.15 *Modelling the main components of a simple soil-structure system*, D. N. Gorini

11.30-12.00 **Coffee break**

12.00-12.30 *Connecting Matlab and GiD to OpenSees*, D. Gallese

12.45-13.15 *Collaborative use of OpenSees with STKO*, M. Petracca

13.15-14.15 **Lunch**

Session 2 - Coupled modelling: from theory to practice

14.15-14.45 *Coupled modelling of soil-structure domains: from theory to practice*, D. N. Gorini

15.00-15.30 *Domain Reduction Method*, J. Abell

15.45-16.15 **Coffee break**

16.15-16.45 *Modal analysis of soil-structure systems*, D. Gallese

17.00-17.30 *Coupled modelling of adjacent structures: from theory to practice*, Y. W. Hwang

17.45-19.00 *Interacting lecture – Implementing the static and seismic analysis of a coupled soil-structure system*, D. N. Gorini *

20.00 **Dinner**

* a template Tcl/Py script will be provided to participants, that will be completed and run in class

Day 2 - Tuesday, September 10

Session 3 - Parallel computing: general settings and optimisation

9.00-9.30 *Parallel computing and hardware optimisation*, D. N. Gorini

9.45-10.15 *Domain decomposition and parallel analyses: strategies and applications*, J. Abell

10.30-11.00 **Coffee break**

11.00-11.30 *Leveraging OpenSees and the HPC resources at DesignSafe to develop practical SFSI models for engineering practice*, S. Mazzoni

11.45-13.15 *Interacting lecture – Working groups: advanced features of coupled modelling*, J. Abell, G. Lombardi **

13.15-14.15 **Lunch**

** peculiar cases concerning coupled soil-structure interaction modelling will be discussed and implemented in class.

Session 4 – New-generation decoupled modelling: from theory to practice

14.15-15.00 *p-y models for dynamic soil-foundation interaction*, P. Arduino

15.15-16.00 *Structural analysis with coupled macroelements: the TIM approach, from the basics to new insights*, D. N. Gorini

16.15-16.45 **Coffee break**

16.45-17.15 *Artificial intelligence for assessing soil-structure interaction problems*, F. N. Malik

17.30-19.00 *Interacting lecture – Application of new-generation, practice-oriented approaches to a soil-structure system*, P. Arduino (p-y method), D. N. Gorini (decoupled and coupled lumped macroelements)

20.00 **Dinner**

Day 3 - Wednesday, September 11

Session 5 – Developing OpenSees and advanced applications

9.00-9.30 *Implementing an advanced multiaxial material*, T. Fierro

9.45-10.15 *Embedded finite elements for soil-pile interaction*, P. Arduino

10.30-11.00 **Coffee break**

11.00-11.30 *Advanced application – Seismic analysis of a soil-piles-bridge model using the direct approach and Domain Reduction Method*, M. Petracca

11.45-12.15 *SimCenter scientific workflow systems and connection to DesignSafe infrastructure*, F. McKenna

12.30-13.00 *Round table: applications, strategies and new trends in OpenSees* ***

13.00-13.15 **Closing**

13.15-14.30 **Lunch**

*** a slot dedicated to doubts and insights about topics discussed during the School days and issues raised by participants.