

Onur Deniz Akan

Postdoctoral Researcher · Computational Mechanics & Earthquake Engineering

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PROFILE

Computational mechanician and earthquake engineer specialising in nonlinear finite element methods and the C++ development of constitutive models and elements for OpenSees. Doctoral work delivered new, experimentally validated numerical models for high-fidelity simulation of seismic soil–structure interaction and earthquake-induced pounding in historical masonry structures, using mixed implicit–explicit integration in OpenSees. Current work develops code-compliant ground-motion selection for base-isolated RC structures and a validated pinching RC hinge model in OpenSees, building toward a longer-term aim of experimentally grounded vibration control of architected systems. Recognised with an MSCA Postdoctoral Fellowship Seal of Excellence.

RESEARCH INTERESTS

- Bi-stable metamaterials in structural vibration control
- Applied mathematics; finite element method theory & applications
- Parallel & high-performance computing in C++
- Cyclic constitutive modelling of materials — sands, clays, masonry, reinforced concrete
- Numerical modelling of experiments — shake-table, quasi-static cyclic, centrifuge liquefaction

EDUCATION

PhD, Earthquake Engineering

Oct 2019 – Feb 2025

IUSS Pavia & University of Pavia, Italy

- *Thesis*: 3D numerical investigation of nonlinear seismic soil–structure interaction in masonry towers with mixed implicit–explicit integration for improved solution stability. Defended February 2025.
- *Selected coursework*: Advanced Constitutive Modelling (Imperial College London); Computational Mechanics and Continuum Mechanics (University of Pavia); Structural Reliability (IUSS Pavia); Non-linear Solid Mechanics (Politecnico di Milano, audited).

MSc, Earthquake Engineering & Engineering Seismology

Sep 2017 – May 2019

IUSS Pavia, Italy & Université Grenoble Alpes, France — Erasmus Mundus MEEES

- *Thesis*: Displaced shapes of infilled RC frames for displacement-based design and assessment.

BSc, Civil Engineering (with Honours)

Sep 2013 – Jun 2017

TED University, Ankara, Türkiye

EXPERIENCE

Postdoctoral Researcher

Dec 2024 – Jun 2026

University of Chieti–Pescara, Italy

- Advisors: Prof. Enrico Spacone, Prof. Guido Camata, Prof. Carlo G. Lai.
- Developing three-component, code-compliant ground-motion selection for base-isolated reinforced concrete structures.
- Publishing and extending doctoral research on seismic soil–structure interaction and structural pounding in masonry structures.
- *Training*: Summer School on architected/microstructured materials and metamaterials, Centrale Nantes (2025).

Structural Engineering Consultant (Part-time Contract)

Dec 2024 – present

Pescara, Italy — in collaboration with ASDEA S.r.l.

- Site-specific seismic hazard analysis, ground-motion selection and site response analysis for the Lisboa Oriental Hospital project.
- Automated Python workflows for ASCE 41-17/23 seismic assessment of reinforced concrete structures.

- Developing and validating a PMM (axial force–biaxial-moment) pinching hinge model for reinforced concrete in OpenSees, benchmarked against published column-test databases.

Research Assistant

May 2019 – Sep 2019

IUSS Pavia & University of Pavia, Italy

- Advisors: Prof. Ricardo Monteiro, Prof. Gerard O'Reilly.
- Developed an algorithm for simplified pushover analysis of reinforced concrete frames with masonry infills.

Structural Engineering Intern

Jun 2016 – Jul 2016

Franz Oberndorfer GmbH, Austria

- Erasmus+ internship: seismic design and production of precast RC walls (Eurocode 2/8).

Site Engineering Intern

Jul 2015 – Aug 2015

Yapı Merkezi & SK Engineering JV, Istanbul, Türkiye

- Eurasia Tunnel (Istanbul Strait road crossing): cut-and-cover, TBM and NATM tunnelling procedures.

HONORS & AWARDS

- **MSCA Postdoctoral Fellowship — Seal of Excellence** (2025). Proposal RESONATE (HORIZON-MSCA-2025-PF, 101269555); scored 88.80/100.
- **MIUR PhD Fellowship** — Italian Ministry of Universities & Research; four-year doctoral funding.
- **Erasmus Mundus Tuition Waiver** — MEEES master programme.
- **BSc with Honours**, TED University (2017) — 2nd-highest GPA in department; merit tuition waiver, 2015–2017.

PUBLICATIONS

Candidate's name in bold.

Journal Articles

- **Akan OD**, O'Reilly GJ, Monteiro R. (2022). Simplified modelling and pushover analysis of infilled frame structures accounting for strut flexibility. *Earthquake Engineering & Structural Dynamics*, 51(6), 1383–1409. doi:10.1002/eqe.3620.

Journal Articles — Under Review

- **Akan OD**, Petracca M, Camata G, Spacone E, Lai CG, Tamagnini C. IMPL-EX formulation for the seismic pounding simulation in masonry structures. *Engineering Structures*.
- **Akan OD**, Petracca M, Camata G, Lai CG, Spacone E, Tamagnini C. An efficient finite element framework for nonlinear seismic soil–foundation–structure interaction in masonry structures. *Soil Dynamics & Earthquake Engineering*.

Journal Articles — In Preparation

- **Akan OD**, Petracca M, Camata G, Spacone E, Lai CG, Tamagnini C. High-fidelity nonlinear dynamic analysis of masonry structures: seismic assessment, energy dissipation, and modelling implications. *Bulletin of Earthquake Engineering*.
- **Akan OD**, Camata G, Lai CG, Spacone E, Tamagnini C. Seismic pounding and soil–structure interaction of heritage masonry towers: effects of structural tying on settlements and masonry damage. *International Journal of Architectural Heritage*.

Conference Contributions

- **Akan OD**, Camata G, Spacone E, Lai CG, Tamagnini C. (2026). Impact of 3D seismic soil–foundation–structure interaction on damage and settlement patterns of a masonry tower in southern Italy. *21st International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE)*, Vienna, Austria.
- Kallioras S, **Akan OD**, Graziotti F, Penna A. (2026). Sustainable mass-timber retrofit for heritage masonry structures. *18th European Conference on Earthquake Engineering (ECEE)*, Berlin, Germany.
- **Akan OD**, Petracca M, Camata G, Lai CG, Spacone E, Tamagnini C. (2024). 3D modelling of masonry tower soil–structure interaction in OpenSees using mixed implicit–explicit material integration. *CompDSSI 2024*, Assisi, Italy.

- **Akan OD**, Camata G, Lai CG, Spacone E. (2023). Micro-mechanically enhanced multi-yield surface modelling of drained sand behaviour in dynamic boundary value problems. *34th ALERT Geomaterials Workshop*, Aussois, France. (poster)
- **Akan OD**, Bilgin G, Ertuğrul Z. (2018). Advantages of industry–academia partnerships for the development of professional competences in civil engineering. *PAEE/ALE 2018*, Brasília, Brazil.

SOFTWARE & CODE

OpenSees Contributions (C++)

- **ZeroLengthContactASDimplex** — contact-mechanics element for seismic pounding; makes pounding analysis tractable where implicit integration fails to converge, and at least halves runtime versus explicit integration. Co-developed with M. Petracca; in the official OpenSees distribution since v3.3. documentation.
- **PIMYimplex & PDMY02implex** — implicit–explicit formulations of the multi-yield-surface soil constitutive models (extending the UCSD models by Z. Yang); implemented 2023; public release pending the corresponding journal publication.

Open-Source Software (Python)

- **ops-post** — interactive 3D post-processor for OpenSees masonry-wall results; GPL-3.0. GitHub.
- **ops-hpc** — controller for large-model OpenSeesMP runs on HPC and cloud; minimises cloud idle time and optimises compute-resource use, with automatic cost tracking; GPL-3.0. GitHub.
- **gmXYZ** — multi-component ground-motion record selection (spectral matching and conditional spectrum) and signal-processing toolkit; GPL-3.0. GitHub.

TEACHING & OUTREACH

Invited Talks & Tutorials

- **Seminar** — “The Good, the Bad, and the IMPL-EX: finite element modelling of seismic pounding in masonry,” University of Chieti–Pescara, Pescara, Apr 2026.
- **Presentation** — “Impact of seismic input selection criteria (UHS vs. CMS) on the nonlinear response of reinforced concrete structures with emphasis on vertical motion,” ReLUIS WP.18, INGV Milan, Mar 2026.
- **Tutorial** — “Beam-column element integration in OpenSees: modelling of a cyclic column experiment,” with Prof. E. Spacone, University of Chieti–Pescara, Pescara, Jul 2025.
- **Webinar** — “Modelling of bolted steel connections and local buckling in STKO for OpenSees,” ASDEA, Jun 2025 (international online audience; recording on ASDEA Software’s YouTube channel).

Teaching

- **Teaching Assistant**, NHERI-SimCenter Programming Bootcamp, Jul 2022 — Python, C/C++, MPI, OpenMP, Unix.
- **Teaching Assistant**, IUSS Pavia, Nov 2019 — Reinforced Concrete Structures (Prof. G. Özcebe).
- **Teaching Assistant**, IUSS Pavia, Apr 2019 — Seismic Hazard & Engineering Seismology (Prof. V. Poggi).
- **Tutor & Lab Assistant**, TED University, Sep 2014 – Jan 2017 — undergraduate physics; hydromechanics laboratory.

TECHNICAL SKILLS

- **Programming & development:** C++, Python, C, MATLAB; Git.
- **AI-assisted development:** agentic coding workflows (Claude Code), Model Context Protocol (MCP) servers, prompt and context optimisation.
- **FE & simulation:** OpenSees (Tcl / Python / C++ APIs), STKO.
- **HPC & cloud:** MPI, OpenMP, cluster computing, Unix/Linux, Google Cloud.
- **Seismic hazard & ground motion:** Eurocode 7/8, NTC 2018, ASCE 41; OpenQuake; ground-motion record selection and signal processing.

LANGUAGES

Turkish (native) · English (C2) · Italian (A2).