Enrique M. del Castillo

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ACADEMIC EMPLOYMENT

- July 2026-. Tenure-track Assistant Professor in the Department of Civil and Environmental Engineering, **Northeastern University**.

- 2025-2026. Postdoctoral Research Associate at **Princeton University**. Working with Prof. Liuchi Li.

EDUCATION

- 2025. Ph.D. in Civil Engineering, Geomechanics, **Stanford University**.
  GPA: 4.10/4.0. Dissertation title: Large Deformation Modeling of Dry and Saturated Geomaterials in Geotechnics and Tectonics using Smoothed Particle Hydrodynamics. Research advisor: Prof. Ronaldo I. Borja.

- 2021. M.S., Civil Engineering, Geomechanics, **Stanford University**. **GPA: 4.09/4.0**.

- 2019. A.B., Geosciences, **Princeton University**. Graduated with Highest Honors (Summa Cum Laude). Sigma Xi. **GPA: 3.876/4.0. Major GPA: 3.93/4.0**. Senior thesis title: Numerical and Field-data Evaluation of the Critical Taper Model for Orogenic Wedge Stability. Co-advisors: Prof. Allan Rubin and Prof. Blair Schoene.

  - Materials Science and Engineering Certificate (minor)
  - Geological Engineering Certificate (minor)
  - European Cultural Studies Certificate (minor)
  - Contemporary European Politics and Society Certificate (minor).

HONORS AND AWARDS

- 2024-2025 Siebel Scholars Award in Energy Science, Stanford Doerr School of Sustainability.

- 2020 NSF GRFP Fellowship: National Science Foundation Graduate Research Fellowship Program, Engineering - Civil Engineering Award Winner. Grant no. DGE - 1656518.

- 2019 SGF: Stanford Graduate Fellowship in Science & Engineering, Stanford University.

- 2019 EDGE: Enhancing Diversity in Graduate Education Fellowship, Stanford University.

- 2019 Princeton Institute for the Science and Technology of Materials (PRISM) Best Senior Thesis Award.

- 2019 Arthur F. Buddington Award for overall excellence in the Earth Sciences, Princeton University.

- 2018 NSF funded REU for Meeting the Grand Challenges in Engineering Fellow at the Pratt School of Engineering at Duke University. Advisor: Prof. Guglielmo Scovazzi.

  - Best REU student Research Poster Award 2018

- 2017 David E. Lumley Scholarship in Energy & Environmental Science-SEG Society of Exploration Geophysicists

- 2017 Princeton University Dean's Fund for Study Abroad Scholarship

- 2016 Dr. José Castillo Award, Mexican Cultural Center of Philadelphia (Top Mexican-American student in PA, NJ, and DE)

- 2016 Marvin and Jene Hewitt Scholarship-SEG Society of Exploration Geophysicists

- 2016 PEI Princeton Environmental Institute Summer Internship and Award

- 2015 Anadarko-SEG Society of Exploration Geophysicists Award

- 2015 Hispanic Scholarship Fund: Walt Disney Company-HSF Scholarship

PUBLICATIONS

[1] **E. M. del Castillo**, R. I. Borja, & A. H. Fávero Neto. (2025) A Coupled u–p^w SPH Formulation for Hydromechanical Modeling of Retrogressive Landslides: Comparison with a Penalty-Based Approach . [In preparation].

[2] **E. M. del Castillo**, J. Geng, & E. Kuhl. (2025) A constitutive neural network-discovered transversely isotropic hyperelastic model for shale rock. [In preparation].

[3] **E. M. del Castillo**, & P. Segall. (2025) Large deformation, pressure-driven mechanistic modeling of the 2018 caldera collapse at the Kīlauea Volcano, HI. [Under review, Journal of Geophysical Research: Solid Earth].

[4] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2024) Fault rupture through stratified sand-clay deposits and engineered earth structures: a meshfree and critical-state modeling approach. *Acta Geotechnica.* https://doi.org/10.1007/s11440-024-02421-w.

[5] **E. M. del Castillo**, J. Geng, & R. I. Borja. (2024) A nonlocal kernel-based continuum damage model for compaction band formation in porous sedimentary rock. *Computational Mechanics.* https://doi.org/10.1007/s00466-024-02540-x.

[6] **E. M. del Castillo**, A. H. Fávero Neto, J. Geng, & R. I. Borja. (2024) An SPH framework for drained and undrained loading over large deformations. *International Journal for Numerical and Analytical Methods in Geomechanics.* 48(12), 3227-3257. https://doi.org/10.1002/nag.3790.

[7] **E. M. del Castillo**, B. Ferdowsi, A. Rubin, & B. Schoene. (2023) Strain localization patterns and thrust propagation in 3-D discrete element method (DEM) models of accretionary wedges. *Tectonics.* 42(8), e2022TC007707. https://doi.org/10.1029/2022TC007707.

[8] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2023). Modeling Fault Rupture Through Layered Geomaterials with SPH. In: Pasternak, E., Dyskin, A. (eds) Multiscale Processes of Instability, Deformation and Fracturing in Geomaterials. IWBDG 2022. Springer Series in Geomechanics and Geoengineering. Springer, Cham. https://doi.org/10.1007/978-3-031-22213-9_16.

[9] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2021) A continuum meshfree method for sandbox-style numerical modeling of accretionary and doubly vergent wedges. *Journal of Structural Geology.* 153, 104466. https://doi.org/10.1016/j.jsg.2021.104466.

[10] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2021) Fault propagation and surface rupture in geologic materials with a meshfree continuum method. *Acta Geotechnica* 16(8), 2463-2486. https://doi.org/10.1007/s11440-021-01233-6.

[11] G. Scovazzi, O. Colomés, N. Abboud, M. Veveakis, **E. M. del Castillo**, D. Valiveti, & H. Huang. (2021) A blended transient/quasistatic Lagrangian framework for salt tectonics simulations with stabilized tetrahedral finite elements. *International Journal for Numerical Methods in Engineering*, 122,14: 3489-3524. https://doi.org/10.1002/nme.6671.

CONFERENCES AND ABSTRACTS

[1] Paul Segall, Taiyi Wang, Josh Allen Crozier, Mark V Matthews, Kyle R Anderson, & **Enrique M. del Castillo**. (2025) "Insights into Caldera Collapse Mechanics and Outstanding Questions from the 2018 Kīlauea Event." IAVCEI 2025 Scientific Assembly, Geneva, Switzerland. (Poster).

[2] Paul Segall, Taiyi Wang, Josh Allen Crozier, Kyle R Anderson, Mark V Matthews, & **Enrique M. del Castillo**. (2025) "Insights into Caldera Collapse Mechanics and Outstanding Questions from the 2018 Kīlauea Event." AGU Chapman Conference on Caldera-Forming Eruptions at Basaltic Volcanoes: Insights and Puzzles from Kīlauea and Beyond, Hilo, HI. (Oral presentation).

[3] **Enrique M. del Castillo** & Ronaldo I. Borja. (2024) "Modeling large deformation soil loading and failure under undrained conditions using a meshfree approach." EMI/PMC 2024 Conference, Engineering Mechanics Institute Conference and Probabilistic Mechanics & Reliability Conference in Chicago, Illinois. (Oral presentation).

[4] **Enrique M. del Castillo** & Ronaldo I. Borja. (2023) "Fault Rupture Orientation under Diverse Loading Conditions in SPH Simulations." Complas 2023, XVII International Conference on Computational Plasticity in Barcelona, Spain. (Oral presentation).

[5] **Enrique M. del Castillo**. (2023) "Fault rupture through layered sand-clay deposits: a meshfree modeling approach." PEER 2023 Annual Meeting, Pacific Earthquake Engineering Research Center at UC Berkeley. (Lightning talk and poster).

[6] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2022) "Modeling Fault Rupture Through Layered Geomaterials with SPH." IWBDG 2022, 12th International Workshop on Bifurcation and Degradation in Geomaterials in Perth, Australia. (Oral presentation).

[7] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2021) "A Novel Meshfree Approach for Numerical Sandbox-style Modeling of Fold-and-Thrust Belts". AGU 2021 Fall Meeting (American Geophysical Union). In the T51B: Fold-and-Thrust Belts and Associated Basins: Evolution and Dynamics at All Spatiotemporal Scales section. (Oral presentation).

[8] **E. M. del Castillo**, A. H. Fávero Neto, & R. I. Borja. (2021) "Shear Banding, Fault Propagation, and Tectonic Modeling with a Meshfree Continuum Method." EMI 2021 Conference (Engineering Mechanics Institute of the American Society of Civil Engineers-ASCE). (Oral presentation).

INVITED TALKS

- Distinguished Seminar Series, Department of Civil and Environmental Engineering, Northeastern University 2025.

- Department Seminar, Department of Civil, Construction and Environmental Engineering, University of Alabama 2025.

RESEARCH INTERESTS

Localization and failure in granular materials, fracture, Smoothed Particle Hydrodynamics, landslides and debris flows, seismic loading and soil liquefaction, infrastructure resilience in the wake of geologic hazards, fault rupture and propagation, Discrete Element Method, compaction bands, accretionary wedges, numerical modeling of tectonic processes, mechanics of geomaterials (soil, rock, ice, and snow) and other granular materials, mechanistically-grounded data-driven modeling.

ONGOING RESEARCH PROJECTS

1. 2022-Present. Developing fully-coupled hydromechanical formulations for the smoothed particle hydrodynamics method, designed for post-failure and large deformation modeling of fluid saturated geomaterials involving a diverse set of applications including debris and mud flows, landslides, embankment and levee stability and failure, as well as earthquake-triggered events such as fault rupture deformation or soil liquefaction. Dissertation topic, under advisor Prof. Ronaldo I. Borja (Dept. of Civil and Environmental Engineering, Stanford University).

2. 2024-Present. Surrogate modeling of granular flows and landslides, including estimating impact forces on baffles and barriers by way of graph neural networks. In collaboration with Prof. Alomir Fávero Neto (Dept. of Civil and Environmental Engineering, Bucknell University) and Daniel Zhou (Stanford University).

3. 2024-Present. Understanding the pressure-driven caldera collapse mechanism during the 2018 Kīlauea eruption using smoothed particle hydrodynamics numerical simulations and geodetic field data, with Prof. Paul Segall (Dept. of Geophysics Stanford University).

4. 2023-Present. Modeling tunnel face and alcove collapse in coal mine tunnels using smoothed particle hydrodynamics, with Jung Geng (Dept. of Civil and Environmental Engineering Stanford University), and Dr. Souheil Ezzedine (Lawrence Livermore Natl. Laboratory).

5. 2024-Present. Developing constitutive neural networks for automatically discovering a transversely isotropic hyperelastic model for shale rock, with Prof. Ellen Kuhl (Dept. of Mechanical Engineering, Stanford University).

6. 2024-Present. Modeling tailing dam collapses under static liquefaction using SPH alongside Prof. Alomir Fávero Neto (Dept. of Civil and Environmental Engineering, Bucknell University) and industry contacts at the Brazilian mining company Vale. The research plan relies on the implementation of a critical state model appropriate for mine tailings, such as the NorSand or CASM models. To account for soil liquefaction under pore-pressure buildup we will be comparing the performance of my undrained loading SPH formulation with other fully coupled formulations derived from the Biot-Zienkiewicz equations.

PROFESSIONAL ACTIVITIES, SERVICE, AND OUTREACH

- Reviewer for leading technical journals including *Acta Geotechnica*, *Computers and Geotechnics*, the *International Journal for Numerical and Analytical Methods in Geomechanics*, the *KSCE Journal of Civil Engineering*, and the *Springer Series in Geomechanics and Geoengineering* "Multiscale Processes of Instability, Deformation and Fracturing in Geomaterials."

- Member of the American Society of Civil Engineers and the American Geophysical Union.

- EDGE: Enhancing Diversity in Graduate Education member and peer mentor at Stanford University. Participate in discussions and activities focused on the graduate experiences of new students from diverse and marginalized backgrounds.

- Graduate student mentor and event organizer at Stanford Engineering Research Introductions Organization SERIO seeking to support and augment the participation of underrepresented undergraduate students in graduate-level STEM education.

- Earthquake Engineering Research Institute (EERI) Stanford University Chapter Peer mentor. Mentored two first year Masters students in the Structural Engineering and Mechanics and Computation (SEM) program regarding their academic interests and career goals.

TEACHING EXPERIENCE

- Teaching Assistant, Stanford University, Graduate course (PhD level), CEE 315: Plasticity Modeling and Computation. Spring 2023.
  - Held biweekly office hours, graded the class problem sets, conducted additional tutorials augmenting and further explaining class material, and helped students design their final projects, implementing different constitutive models at the stress point level. Office hours consisted of first working on additional example problems and then opening the floor to questions.
  - Student reviews: In the question "overall, how effective was the instruction you received from this instructor?" out of 7 respondents (12 students total) I scored the highest "extremely effective" as the median score. Students also commented that I was "very helpful in the homework and the project," "Enrique was good at helping with the homework," and that as an instructor my teaching demonstrated the following characteristics, "knowledge on the subject," "quick and effective feedback," and "patience."

- Teaching Assistant, Stanford University, Graduate course (Master's level), CEE 281: Mechanics and Finite Elements. Winter 2025.

– Taught the class when professor was traveling, held biweekly office hours, graded the class problem sets, conducted additional classes to help students with their computing assignments, implementation of 2D FEM code to solve Poisson's equation over a unit square, as well as more involved 2D BVPs including fluid seepage around a pile, and cantilever beam bending considering different element types in the incompressible limit, and how to avoid volumetric locking.

– Student reviews: In the question "overall, how effective was the instruction you received from this instructor?" out of 9 respondents (13 students total) I scored the "very effective" as the median score. In the question "How much did you learn from this instructor?" I scored "A lot" as the median score.

PAST RESEARCH, INTERNSHIPS AND WORK EXPERIENCE

- 2018-19: As an undergraduate Geosciences student at Princeton University, I performed 3-D numerical simulations of accretionary wedges using the discrete element method for my senior thesis advised by Prof. Blair Schoene, Prof. Allan Rubin, and Dr. Behrooz Ferdowsi (now Prof. at U. of Houston). This research resulted in publication [6] above.

- Summer 2018: REU intern for Meeting the Grand Challenges in Engineering at Duke University, supervised by Prof. Guglielmo Scovazzi (Dept. of Civil Engineering). Studied salt tectonics and modeled salt diapirism using the finite element method. This work resulted in paper [10] above.

- Summer 2017: Under the supervision of Prof. Blair Schoene, Dept. of Geosciences, Princeton University, I helped to analyze crystal size distributions in pumice clasts to characterize the temporal nature of the volcanic super-eruption that occurred in the Bishop Tuff, California.

- Summer and Fall 2016, Spring 2017: Lab Assistant at Maloof Lab and Grinder Lab, Dept. of Geosciences, Princeton University. Assisted in the reconstruction process of Cloudina, one of the earliest biomineralizer organisms, using destructive tomography methods.

  1. Trained in the operation of the FEI Quanta 200 FEG Environmental-Scanning Electron Microscope (SEM) and in element mapping.
  2. Trained in the operation of an Isotope Ratio Mass Spectrometer.
  3. Trained in the operation of a Camsizer machine to sieve and characterize different sand grain sizes.

RELEVANT FIELD WORK

- At Stanford University:

  – Spring 2022 GEOPHYS 214 Tectonics Field Trip (Prof. Simon Klemperer) to Crater Lake, Mt. Lassen, Lava Beds Natl. Monument, Hat Creek, and Klamath Lake Fault Zones.

- At Princeton University:

  – Fall 2017 Field Trip GEO 373 (Prof. Blair Schoene) to the Diligencia Basin near the Salton Sea CA, as part of my Structural Geology Class. Spent a week creating a geological map of the area dominated by a large plunging inclined syncline.

  – Spring 2017 Field Trip GEO 372 (Prof. Blair Schoene) to Marble Canyon Death Valley CA, Bishop Tuff CA, and the Searchlight Pluton NV, as part of my Metamorphic and Igneous Petrology Class.

  – Summer 2016 Trip to the Forteau Formation of southern Labrador, Canada with the Maloof Group with the objective of temporally constraining Archaeocyath patch reefs from the Cambrian.

  – Fall 2015 Field Trip FRS 135, Dune du Pilat SW France, Zumaia Spain (carbonate turbidites). Studied sand dune formation and aeolian transport processes at the Dune du Pilat.

RELEVANT SKILLS

- C++, Python, MATLAB, Paraview, LaTeX, ArcGIS, ANSYS, PLAXIS, MPI, OpenMP, Excel.

- Languages Spoken: English (Native), Spanish (Native), Portuguese (Fluent), Italian (conversational), French (conversational).

EXTRACURRICULAR ACTIVITIES AND INTERESTS

- Society of Hispanic Professional Engineers (SHPE)

- Princeton Undergraduate Geosciences Society (PUGS)

- Princeton Club Soccer, Club Tennis.

PERSONAL DATA

- Birthplace: Arlington, TX, (prior to college, lived in State College, PA).

- Other interests: Playing chess and classical guitar, reading about historical and contemporary international events.