Zhengshou Lai

Curriculum Vitae

Associate professor
School of Civil Engineering, Sun Yat-sen University
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Education

- 2015.01 – 2018.12, **Ph.D.**, Civil Engineering, Clemson University
  Dissertation: *Discrete element modeling of the grading- and shape- dependent behavior of granular materials*
- 2012.09 – 2014.06, **Ph.D. candidate**, Engineering Mechanics, Sun Yat-sen University
- 2008.09 – 2012.06, **B.Sc.**, Civil Transportation Engineering, Sun Yat-sen University

Research Interests

1. Grading- and shape-dependent discrete element modeling of granular materials
2. Material microscopic morphology and structure characterization with computed tomography
3. Computational hydromechanics of porous materials (with dynamics, random field, uncertainty)
4. Numerical bifurcation analysis of material instability

Work and Research Experience

- 2019.02 – present, **Postdoc Research Fellow**, Sun Yat-sen University, China
  Discrete element modeling of granular materials.
- 2018.06 – 2018.11, **Research Intern**, Idaho National Laboratory, USA
  Performing discrete element modeling of biomass in cyclic compression test, hopper flow test, etc.
  Investigating the effects of particle deformability.

- 2015.01 – 2018.12, **Research Assistant**, Clemson University, USA
  Dissertation title is *Discrete element modeling of the grading- and shape- dependent behavior of granular materials*.
- 2016.08 – 2018.05, **Creative Inquiry Assistant Mentor**, Clemson University, USA
  Coordinate and participate in the Creative Inquiry research for undergraduate students. Research topic is *Martian Soil Simulants - Mechanical Properties and Feasibility as Building Blocks*.
- 2016.01 – 2018.05, **Lab Assistant**, Clemson University, USA
  Instructor of Soil Mechanics Lab for undergraduate students.
- 2014.03 – 2014.09, **Research Intern**, Architectural Design and Research Institute of Guangdong Province, China
  Develop a C# program to design and analyze the bearing capacity of reinforced concrete column.
- 2013.03 – 2013.09, **Teaching Assistant**, Sun Yat-sen University, China
  Grader and Q&A of Theoretical Mechanics for undergraduate students.
- 2011.09 – 2012.07, **Undergraduate Graduation Project**, Sun Yat-sen University, China
  Develop a C++ program to visualize and monitor the construction process of underground infrastructure.

Grants and Contracts

1. Title: Fourier series-based discrete element method for computational mechanics of irregular-shaped particles
   Funding Agency: China Postdoctoral Science Foundation, No. 2019M663240
   Duration: 2020.01 – 2021.06
   Amount: RMB 80,000
   PI: **Z. Lai**

2. Title: Defects Detection and Health Assessment of Traffic Infrastructures based on Radar Computed Tomography and Deep Learning
   Funding Agency: Fundamental Research Funds for the Central Universities, Ministry of Education, No. 19lgpy289
   Duration: 2020.01 – 2022.12
   Amount: RMB 150,000
   PI: **Z. Lai**

3. Title: Computed Tomography and Machine Learning based Mechanical Testing and Multiscale Discrete Element Modeling of Calcareous Sand
   Funding Agency: National Natural Science Foundation of China (NSFC), No. 51909289
   Duration: 2020.01 – 2022.12
   Amount: RMB 250,000

PI: **Z. Lai**

Services

Reviewer for Journal and Conferences

- GeoShanghai International Conference 2018, Shanghai
- Tunnelling and Underground Space Technology

Services to University and Society Community

- 2016.07, Instructor, Clemson Summer Program Research Intern (mentoring senior high school students from South Carolina Governor's School for Science & Mathematics)
- 2016.06, Volunteer, Death Valley Open Water Meet
- 2016.03, Volunteer, Clemson Girl Scouts Day
- 2015.06, Volunteer, Women in Science and Engineering (WISE) summer workshop

Honors and Awards

- 2017.04, Aniket Shrikhande Memorial Graduate Fellowship (USD 1,500), Clemson University
- 2015.01, Aniket Shrikhande Memorial Graduate Assistantship (USD ~20,000), Clemson University

Publications

Journal Articles

1. **Lai, Z.** & Huang, L. (2021). A polybezier-based particle model for the DEM modeling of granular media. *Computers and Geotechnics*, 134, 104052.
2. **Lai, Z.**, Chen, Q., & Huang, L. (2021). A semianalytical Hertzian frictional contact model in 2D. *Applied Mathematical Modelling*, 92, 546-564.
3. **Lai, Z.**, Chen, Q., & Huang, L. (2020). Fourier series-based discrete element method for computational mechanics of irregular-shaped particles. *Computer Methods in Applied Mechanics and Engineering*, 362, 112873.
4. Huang, L., Huang, S., & **Lai, Z.**# (2020). On the optimization of site investigation programs using centroidal Voronoi tessellation and random field theory. *Computers and Geotechnics*, 118, 103331.
5. Huang, L., Huang, S., & **Lai, Z.**# (2019). On an energy-based criterion for defining slope failure considering spatially varying soil properties. *Engineering Geology*, 264, 105323.
6. Gleaton, J., **Lai, Z.**, Xiao, R., Chen, Q., & Zheng, Y. (2019). Microalga-induced biocementation of martian regolith simulant: Effects of biogrouting methods and calcium sources. *Construction and*

Building Materials, 339, 1–12.

7. Xia, Y., **Lai, Z.**, Westover, T., Klinger, J., Huang, H., & Chen, Q. (2019). Discrete element modeling of deformable pinewood chips in cyclic loading test. *Powder Technology*, 345, 1–14.
8. **Lai, Z.** & Chen, Q. Reconstructing granular particles from X-ray computed tomography using the TWS machine learning tool and the level set method. *Acta Geotechnica*, 14(1), 1–18.
9. **Lai, Z.**, Chen, Q., Wang, C., & Zhou, X. (2019). Modeling dynamic responses of heterogeneous seabed with embedded pipeline through multiresolution random field and coupled hydromechanical simulations. *Ocean Engineering*, 173, 556–570.
10. Chen, Q. & **Lai, Z.** (2018). Hydromechanical modeling of CO2 sequestration using a component-based multiphysics code. *Environmental Geotechnics*. 1–17.
11. Liang, Y., Zhang, J., **Lai, Z.**, Huang, Q., & Huang, L. (2017). Temporal and spatial distribution of the grout pressure and its effects on lining segments during synchronous grouting in shield tunnelling. *European Journal of Environmental and Civil Engineering*, 1–18.
12. **Lai, Z.** & Chen, Q. (2017). Characterization and discrete element simulation of grading and shape-dependent behavior of JSC-1A Martian regolith simulant. Granular Matter, 19(4), 69.
13. **Lai, Z.** & Chen, Q. (2017). Particle swarm optimization for numerical bifurcation analysis in computational inelasticity. *International Journal for Numerical and Analytical Methods in Geomechanics*, 41(3), 442–468.
14. Mota, A., Chen, Q., Foulk, J., Ostien, J., & **Lai, Z.** (2016). A Cartesian parametrization for the numerical analysis of material instability. *International Journal for Numerical Methods in Engineering*, 108(2), 156–180.

Conference Proceedings

1. Chen, Q., **Lai, Z.**, Moysey, S., & Shen, M. (2018). Image-based shape characterization and three-dimensional discrete element modeling of a granular Martian regolith simulant. In *GeoShanghai International Conference 2018*. Shanghai, China.
2. Chen, Q., Wang, C., **Lai, Z.**, & Juang, C. (2018). Integration of heterogeneous data for multiscale regional liquefaction settlement mapping. In *Proceedings of the Geotechnical Earthquake Engineering and Soil Dynamics V 2018*. Austin, Texas, USA.
3. Gleaton, J., Xiao, R., **Lai, Z.**, McDaniel, N., Johnstone, C.A., Burden, B., Chen, Q., & Zheng, Y. (2018). Biocementation of Martian Regolith with In-Situ Resources. In *2018 ASCE Earth and Space Conference*. Cleveland, Ohio, USA.
4. **Lai, Z.** & Chen, Q. (2018). Discrete element modeling of Martian regolith simulants accounting for realistic particle shapes and particle size distributions. In *2018 ASCE Earth and Space Conference*. Cleveland, Ohio, USA.
5. Shukla, S., Agnihotri1, S., **Lai, Z.**, Kousaalya, A., Pilla, S., & Chen, Q. (2018). Creation and characterization of regolith-based functional blocks with simulated in-situ Martian materials. In *2018 ASCE Earth and Space Conference*. Cleveland, Ohio, USA.

Presentations and Posters

1. **Lai, Z.**, Xia, Y., Huang, H., Westover, T., & Chen, Q. (2018, August). Numerical characterization of biomass flowability in biorefinery. *INL's Annual intern expo & poster session*, Idaho Falls, ID, USA.
2. **Lai, Z.** & Chen, Q. (2018, May). Fourier series-based discrete element method for computational mechanics of irregular particles. *Engineering Mechanics Institute Conference 2018*, Cambridge, Massachusetts, USA.
3. **Lai, Z.** (2018, February). From X-ray CT images to numerical models: capturing the grading and shape- dependent behavior of granular materials. Graduate Student Research seminar, Clemson University, SC, USA.
4. Chen, Q. & **Lai, Z.** (2017, May). Martian soil simulants – Mechanical properties and feasibility as building blocks. *Clemson University Research Symposium: Moving Clemson Forward Through Research*, Clemson University, SC, USA.
5. **Lai, Z.** & Chen, Q. (2016, May). Numerical bifurcation analysis of an anisotropic fuel cladding damage model. *The Joint 2016 Engineering Mechanics Institute Conference and the Probabilistic Mechanics & Reliability Conference*, Nashville, TN, USA.