

# Junliang “Julian” Tao

PhD, Associate Professor

## Curriculum Vitae

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## Education

PhD	Civil Engineering	Case Western Reserve University	Cleveland, US	2013
MS	Civil Engineering	Tongji University	Shanghai, China	2009
BS	Civil Engineering	China University of Geosciences	Wuhan, China	2006

## Academic Positions

2018–	Associate Professor	School of Sustainable Engineering and the Built Environment, Arizona State University
2013–2018	Assistant Professor	Department of Civil Engineering, University of Akron

## Select Honors and Awards

2020	The 10th Anniversary Excellent Paper Award, Journal of Rock Mechanics and Geotechnical Engineering
2017	CAREER Award, National Science Foundation
2017	Gary W. Johnson Young Civil Engineer of the Year Award, ASCE Akron-Canton Section

## Mission Statement

I am leading the research group Bio-inspired Geotechnics (BiG) in the NSF Research Center for Bio-mediated and Bio-inspired Geotechnics at Arizona State University. Our mission is to discover the fundamental mechanisms of various interactions between living things and geological materials, to abstract these mechanisms to engineering design principles, and to translate the design principles to autonomous, efficient, sustainable and intelligent geotechnics. We seek the answers at the interfaces of biology, mechanics and engineering. We achieve the BiG goals and extend the impacts from research, teaching, outreach, entrepreneurship and collaboration. Our Current research topics include: bio-inspired self-burrowing robots, bio-inspired underground sensing and communication, bio-inspired sustainable countermeasures to natural hazards.

## Professional Membership

Associate Member	American Society of Civil Engineers (ASCE) Geo-Institute
Member	International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)
Member	Society for Integrative and Comparative Biology (SICB)
Member	Institute of Electrical and Electronics Engineers (IEEE)
Member	International Society for Optical Engineering (SPIE)
Member	Transportation Research Board (TRB)

## PUBLICATIONS, INTELLECTUAL PROPERTY AND INVITED TALKS

Since 2009, I have authored **115** research publications, including **44** journal papers, **66** conference papers, and **5** technical reports, co-edited **3** books, and filed **2** patents. I also have delivered **36** invited talks to universities, local, national and international conferences. As of **November 4, 2024**, my h-index is **19** and i10-index is **34**, with total citations of **1,654**. **Only publications on bio-inspired geotechnics are included below.**

### Journal Articles on Bio-inspired Geotechnics <sup>1</sup>

1. **X Li**, L van Paassen, and J Tao<sup>\*</sup>. Effects of Sediment Densification and Strengthening on Scour around Monopiles Using Mangrove-Inspired Skirt Piles. *Acta Geotechnica* (2024). DOI: 10.1007/s11440-023-02182-y.
2. A Martinez and J Tao. Editorial for Special Issue on Bio-Inspired Geotechnics. *Acta Geotechnica* (2024). DOI: 10.1007/s11440-024-02323-x.

<sup>1</sup>**Bold:** PhD student, Underline: MS student, #: undergrad student, ∞: visiting student, ×: PostDoc, \*: corresponding

3. **Y Tang**, **Y Zhong**, and **J Tao**<sup>\*</sup>. Bio-Inspired Rotational Penetration and Horizontal Self-Burrowing Soft Robot. *Acta Geotechnica* (2024). DOI: 10.1007/s11440-023-02173-z.
4. H Bagheri, D Stockwell, B Bethke, NK Okwae, D Aukes, J Tao, and H Marvi<sup>\*</sup>. A Bio-Inspired Helically Driven Self-Burrowing Robot. *Acta Geotechnica* (2023). DOI: 10.1007/s11440-023-01882-9.
5. **Y Zhong**, S Huang<sup>×</sup>, and **J Tao**<sup>\*</sup>. Minimalistic Horizontal Burrowing Robots. *Journal of Geotechnical and Geoenvironmental Engineering* **149**(4) (2023), 02823001. DOI: 10.1061/JGGEFK.GTENG-11468.
6. **X Li**, L van Paassen, and **J Tao**<sup>\*</sup>. Investigation of Using Mangrove-Inspired Skirt Pile Group as a Scour Countermeasure. *Ocean Engineering* **266** (2022), 113133. DOI: 10.1016/j.oceaneng.2022.113133.
7. A Martinez<sup>\*</sup>, J Dejong, I Akin, A Aleali, C Arson, J Atkinson, P Bandini, T Baser, R Borela, R Boulanger, M Burrall, Y Chen, C Collins, D Cortes, S Dai, T DeJong, E Del Dottore, K Dorgan, R Fragaszy, JD Frost, R Full, M Ghayoomi, DI Goldman, N Gravish, IL Guzman, J Hambleton, E Hawkes, M Helms, D Hu, L Huang, **S Huang**, C Hunt, D Irschick, HT Lin, B Lingwall, A Marr, B Mazzolai, B McInroe, T Murthy, K O'Hara, M Porter, S Sadek, M Sanchez, C Santamarina, L Shao, J Sharp, H Stuart, HH Stutz, A Summers, **J Tao**, M Tolley, L Treers, K Turnbull, R Valdes, L von Paassen, G Viggiani, D Wilson, W Wu, X Yu, and J Zheng. Bio-Inspired Geotechnical Engineering: Principles, Current Work, Opportunities and Challenges. *Géotechnique* **72**(8) (2022), 687–705. DOI: 10.1680/jgeot.20.P.170.
8. **Y Tang** and **J Tao**<sup>\*</sup>. Multiscale Analysis of Rotational Penetration in Shallow Dry Sand and Implications for Self-Burrowing Robot Design. *Acta Geotechnica* **17** (2022), 4233–4252. DOI: 10.1007/s11440-022-01492-x.
9. **Y Zhong** and **J Tao**<sup>\*</sup>. Bio-Inspired Vibrational Wireless Underground Communication System. *Journal of Rock Mechanics and Geotechnical Engineering* **14** (2022). DOI: 10.1016/j.jrmge.2022.06.005.
10. D Li, **S Huang**, **Y Tang**, H Marvi, J Tao, and D Aukes<sup>\*</sup>. Compliant Fins for Locomotion in Granular Media. *IEEE Robotics and Automation Letters* **6**(3) (2021), 5984–5991. DOI: 10.1109/LRA.2021.3084877.
11. **S Huang**, **Y Tang**, H Bagheri, D Li, A Ardente<sup>#</sup>, D Aukes, H Marvi, and **J Tao**<sup>\*</sup>. Effects of Friction Anisotropy on Upward Burrowing Behavior of Soft Robots in Granular Materials. *Advanced Intelligent Systems* **2**(6) (2020), 1900183. DOI: 10.1002/aisy.201900183.
12. **S Huang** and **J Tao**<sup>\*</sup>. Modeling Clam-inspired Burrowing in Dry Sand Using Cavity Expansion Theory and DEM. *Acta Geotechnica* **15**(8) (2020), 2305–2326. DOI: 10.1007/s11440-020-00918-8.
13. **J Tao**<sup>\*</sup>, **S Huang**, and **Y Tang**. SBOR: A Minimalistic Soft Self-Burrowing-out Robot Inspired by Razor Clams. *Bioinspiration & Biomimetics* **15**(5) (2020), 055003. DOI: 10.1088/1748-3190/ab8754.
14. **J Tao**<sup>\*</sup>, **S Huang**, and **Y Tang**. Bioinspired Self-Burrowing-Out Robot in Dry Sand. *Journal of Geotechnical and Geoenvironmental Engineering* **145**(12) (2019), 02819002. DOI: 10.1061/(ASCE)GT.1943-5606.0002177.
15. **J Tao**<sup>\*</sup>, **J Li**, X Wang<sup>∞</sup>, and R Bao. Nature-Inspired Bridge Scour Countermeasures: Streamlining and Biocementation. *Journal of Testing and Evaluation* **46**(4) (2018), 20170517. DOI: 10.1520/JTE20170517.
16. **J Li**, **J Tao**<sup>\*</sup>, and Y Liu. DES Modeling of Erosional Forces around Streamlined Piers and Implications for Scour Countermeasures. *International Journal of Geomechanics* **17**(6) (2017), 04016139. DOI: 10.1061/(ASCE)GM.1943-5622.0000839.
17. **J Li** and **J Tao**<sup>\*</sup>. Streamlining of Bridge Piers as Scour Countermeasures: Optimization of Cross Sections. *Transportation Research Record* **2521**(1) (2015), 162–171. DOI: 10.3141/2521-17.
18. **J Tao**<sup>\*</sup> and **J Li**. Streamlining of Bridge Piers as Scour Countermeasures: Effects of Curvature of Vertical Profiles. *Transportation Research Record* **2521**(1) (2015), 172–182. DOI: 10.3141/2521-18.

### Editorial or Opinion Articles on Bio-inspired Geotechnics

1. A Martinez and J Tao. Editorial for Special Issue on Bio-Inspired Geotechnics. *Acta Geotechnica* (2024). DOI: 10.1007/s11440-024-02323-x.
2. J Tao. Burrowing Soft Robots Break New Ground. *Science Robotics* **6**(55) (2021). DOI: 10.1126/scirobotics.abj3615.

### Conference Papers on Bio-inspired Geotechnics <sup>2</sup>

1. Z Xue, C Zhao, and J Tao. Reducing Penetration Resistance through Bio-Inspired Head Oscillation. In: *IOP Conference Series: Earth and Environmental Science*. GeoShanghai 2024. Vol. 1337. Shanghai, China: IOP Publishing, 2024, pp.012040. DOI: 10.1088/1755-1315/1337/1/012040.
2. **X Li**<sup>~</sup>, **J Tao**<sup>\*</sup>, and L van Paassen. Effects of the Submerged Height of Mangrove-Inspired Skirt-Pile Group on Scour Mitigation around a Monopile Foundation. In: *Geo-Congress 2023*. Geo-Congress 2023. Los Angeles, California: ASCE, 2023, pp.442–450. DOI: 10.1061/9780784484708.041.

<sup>2</sup>**Bold**: PhD student, Underline: MS student, <sup>#</sup>: undergrad student, <sup>∞</sup>: visiting student, <sup>×</sup>: PostDoc, <sup>\*</sup>: corresponding, <sup>~</sup>: presenter

3. MR Shaharear~, Y Tang\*, X Li, and J Tao. Penetration Forces of a Rotating Helical Penetrator in Granular Media: Experiments and Insights into the Design of a Burrowing Robot. In: *Geo-Congress 2023*. Geo-Congress 2023. Los Angeles, California: ASCE, 2023, pp.230–238. DOI: 10.1061/9780784484708.021.
4. S Shahhosseini~, M Parekh#, and J Tao\*. DEM-MBD Coupled Simulation of a Burrowing Robot in Dry Sand. In: *Geo-Congress 2023*. Geo-Congress 2023. Los Angeles, California: ASCE, 2023, pp.309–317. DOI: 10.1061/9780784484692.032.
5. Y Tang~ and J Tao\*. Experimental Study on Continuous and Oscillatory Rotational Penetration. In: *Geo-Congress 2023*. Geo-Congress 2023. Los Angeles, California: ASCE, 2023, pp.303–311. DOI: 10.1061/9780784484708.028.
6. Y Tang~ and J Tao\*. Penetration Effect of Penetrator Geometry and Interface Friction on Rotational Penetration Resistance. In: *Geo-Congress 2023*. Geo-Congress 2023. Los Angeles, California: ASCE, 2023, pp.257–265. DOI: 10.1061/9780784484708.024.
7. Y Zhong~ and J Tao\*. Comparative Analysis of Horizontal Self-Burrowing Strategies Using Full-Scale DEM-MBD Co-Simulations. In: *Geo-Congress 2023*. Geo-Congress 2023. Los Angeles, California: ASCE, 2023, pp.106–114. DOI: 10.1061/9780784484692.011.
8. S Huang~, N Mahabadi, and J Tao\*. Penetration and Relaxation in Dry Granular Materials: Insights from Photoelasticity. In: *Geo-Congress 2022*. Geo-Congress 2022. Charlotte, North Carolina: American Society of Civil Engineers, 2022, pp.130–139. DOI: 10.1061/9780784484043.013.
9. S Huang~ and J Tao\*. Bioinspired Horizontal Self-Burrowing Robot. In: *Geo-Congress 2022*. Geo-Congress 2022. Charlotte, North Carolina: American Society of Civil Engineers, 2022, pp.223–231. DOI: 10.1061/9780784484036.023.
10. X Li~, J Tao, and L van Paassen\*. Numerical Simulations of Mangrove-Inspired Sacrificial Pile Group for Scour Mitigation. In: *Geo-Congress 2022*. Geo-Congress 2022. Charlotte, North Carolina: American Society of Civil Engineers, 2022, pp.385–394. DOI: 10.1061/9780784484050.040.
11. Y Tang~ and J Tao\*. Effect of Rotational Cone on Penetration Resistance and Its Implication to the Design of a Bio-Inspired Self-Burrowing Robots. In: *Geo-Congress 2022*. Geo-Congress 2022. Charlotte, North Carolina: American Society of Civil Engineers, 2022, pp.214–222. DOI: 10.1061/9780784484036.022.
12. Y Zhong~ and J Tao\*. Bio-Inspired Vibrational Transmitters for Wireless Underground Communication. In: *Geo-Congress 2022*. Geo-Congress 2022. Charlotte, North Carolina: American Society of Civil Engineers, 2022, pp.43–52. DOI: 10.1061/9780784484067.005.
13. S Huang~, N Mahabadi, and J Tao\*. Visualization of a Model Razor Clam Interacting with Dry Granular Materials Using Photoelasticity. In: *American Physical Society March Meeting 2021*. American Physical Society March Meeting 2021. Zoom, 2021.
14. Y Tang~ and J Tao\*. Effect of Rotation on Penetration: Toward a Seed Awn-Inspired Self-Burrowing Probe. In: *IFCEE 2021*. The International Foundations Congress & Equipment Expo (IFCEE). Dallas, TX: American Society of Civil Engineers, 2021, pp.149–159. DOI: 10.1061/9780784483428.016.
15. Y Zhong~, Y Gao~, and J Tao\*. Bio-Inspired Underground Communication Using Seismic Waves. In: *IFCEE 2021*. The International Foundations Congress & Equipment Expo (IFCEE). Dallas, TX: American Society of Civil Engineers, 2021, pp.139–148. DOI: 10.1061/9780784483428.015.
16. S Huang~, N Mahabadi, and J Tao\*. Impact of Shell Opening of a Model Razor Clam on the Evolution of Force Chains in Granular Media. In: *Geo-Congress 2021: Biogeotechnics*. Geo-Congress 2020. Minneapolis, Minnesota: ASCE, 2020, pp.272–281. DOI: 10.1061/9780784482834.030.
17. S Huang~ and J Tao\*. Bio-Inspired Dual-Anchor Burrowing: Effect of Vertical Curvature of the Shell. In: *Geo-Congress 2020*. Geo-Congress 2020. Minneapolis, Minnesota: ASCE, 2020, pp.282–292. DOI: 10.1061/9780784482834.031.
18. Y Tang~, S Huang, and J Tao\*. Effect of Rotation on Seeds’ Self-Burial Process: Insights from DEM Simulations. In: *Geo-Congress 2020*. Geo-Congress 2020. Minneapolis, Minnesota: ASCE, 2020, pp.293–301. DOI: 10.1061/9780784482834.032.
19. S Huang~ and J Tao\*. Modeling of the Burrowing Mechanism by Razor Clam: Role of Penetration Kinematics. In: *IFCEE 2018*. IFCEE 2018. Orlando, Florida: ASCE, 2018, pp.547–556. DOI: 10.1061/9780784481585.053.
20. S Huang and J Tao~. The Interplay between Shell Opening and Foot Penetration of a Model Razor Clam: Insights from DEM Simulation. In: *B2G Atlanta 2018 Bio-mediated and Bio-inspired Geotechnics*. B2G Atlanta 2018 Bio-mediated and Bio-inspired Geotechnics. Atlanta, GA, 2018. <https://par.nsf.gov/servlets/purl/10061092>.
21. Pandey, G and J Tao~. Moisture Sensitive Polymer-Modified Enzyme-Induced Carbonate Precipitation for Soil Improvement. In: *B2G Atlanta 2018 Bio-mediated and Bio-inspired Geotechnics*. B2G Atlanta 2018 Bio-mediated and Bio-inspired Geotechnics. Atlanta, GA, 2018.

22.

X Wang<sup>∞</sup> and J Tao<sup>\*~</sup>. Polymer-Modified Microbially-Induced Carbonate Precipitation Treatment Method for Surface Erosion Prevention. In: *Transportation Research Board 97th Annual Meeting*. Transportation Research Board 97th Annual Meeting. Washington DC, United States, 2018, pp.16p. <https://trid.trb.org/view/1496755>.

23.

R Bao, J Li, L Li, TJ Cutright, L Chen, J Zhu, and J Tao<sup>\*~</sup>. Bio-Inspired Bridge Scour Countermeasures: Streamlining and Biocementation. In: *DEStech Transactions on Materials Science and Engineering*. The 2017 International Conference on Transportation Infrastructure and Materials (ICTIM). Shandong, China, 2017. DOI: 10.12783/dtmse/ictim2017/10180.

24.

S Huang<sup>~</sup> and J Tao<sup>\*</sup>. A DEM Study of Penetrating in Granular Materials with Changing Shape. In: *TRB 96th Annual Meeting Compendium of Papers*. Transportation Research Board 96th Annual Meeting. Washington, DC, 2017, pp.14. <https://trid.trb.org/view/1439217>.

25.

S Huang<sup>~</sup> and J Tao<sup>\*</sup>. Penetrating in Granular Materials: Effects of Penetrator Dynamics. In: *Geotechnical Frontiers 2017*. Geotechnical Frontiers 2017. Orlando, Florida: ASCE, 2017, pp.604–613. DOI: 10.1061/9780784480441.063.

Patents on Bio-inspired Geotechnics

1.

J Tao, S Huang, Y Tang, and Y Zhong. “Bioinspired Horizontal Self-Burrowing Device”. U.S. pat. req. 18409006. Individual. 2024. <https://patents.google.com/patent/US20240254839A1/en>. Pending.

2.

J Tao and Y Zhong. “Bio-Inspired Underground Vibrational Communication”. U.S. pat. req. 18419899. Individual. 2024. <https://patents.google.com/patent/US20240250758A1/en>. Pending.

PROFESSIONAL ACTIVITIES AND SERVICE

I served as an Editor or Guest Editor for **3** peer-reviewed journals or journal special issues and currently serving on an Editorial Board for **1** journal. I chaired **2** international/national conferences and **12** conference sessions, reviewed for **32** journals, numerous conferences and multiple funding agencies.

Externally, I served on **12** professional committees; and internally, I also served on **1** university-level committees, **3** Engineering School-level committees and **9** unit-level committees.

Conference Organization in the Past 3 Years

2025	Leading Member of Organizing Committee @International Conference on Biomediated and Bioinspired Geotechnics	Tempe, USA
2024	Co-chair of Technical Committee @GeoShanghai International Conference 2024 (GeoShanghai 2024)	Shanghai, China
2023	Session Chair of Session on Bioinspired Geotechnics @Engineering Mechanics Institute Conference	Atlanta, GA
2022	Co-chair of Organizing Committee @ASCE Web Conference on Bio-inspired Geotechnics	Virtual

Editorial Services

2022–	Associate Editor	Biogeotechnics
2022–2023	Co-editor	Special Issue on "Bio-inspired Geotechnics" by Acta Geotechnica
2022–2024	Co-editor	Special Issue on "Bio-inspired Burrowing Robots" by Frontiers in Robotics and AI
2017–	Editorial Board Member	Journal of Testing and Evaluation

MENTORING AND TEACHING

As of **November, 2024**, I have mentored **2** PostDoc, **6** graduated PhDs, **1** ongoing PhD students, **14** MS students, **24** undergraduate research students, **7** high school researchers, and **2** high school teacher researchers.

I have taught **5** undergraduate-level courses with a mean score of **4.4/5**, and **4** graduate-level courses with a mean score of **4.7/5**.

RESEARCH SUPPORT

The awards in which Dr. Tao served as an investigator total **\$18,762,247**; Dr. Tao’s recognitions in all awards total **\$2,605,460**; the total amount of all awards in which Dr. Tao is the leading PI is **\$1,837,519**.