



# Ran Cao

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Summary	<p>Ran Cao received his Ph.D. in Structural Engineering from the City University of New York (CUNY) in 2019. He is currently an Associate Professor and "Yuelu Scholar" at the College of Civil Engineering, Hunan University. He also serves as an Associate Editor of the ASCE Journal of Bridge Engineering. He has received several accolades from the society, including the ASCE Raymond C. Reese Research Prize (2023), the Arthur M. Wellington Prize (2020), and the ASCE O.H. Ammann Research Fellowships (2019). His primary research interests include hazard mitigation, computational simulation, and embodied intelligence (e.g. intelligent construction robots).</p>	
Experience	<b>Hunan University</b> Associate Professor	<b>Sept 2020 - present</b> Changsha, Hunan, China
	<b>The City University of New York</b> Post-doc	<b>Aug 2019 - Aug 2020</b> New York, USA
Education	<b>The City University of New York</b> Structural Engineering  Advisor : Prof. Anil K. Agrawal (CUNY) Co-Advisor: Prof. Sherif El-Tawil (University of Michigan)	<b>Jul 2015 - Jul 2019</b> PhD
	<b>Hunan University</b> Civil Engineering	<b>Sept 2011 - Jun 2015</b> Bachelor
Projects	<b>Intelligent Inspection Technology and Robotics for the Installation Quality of Urban Prefabricated Bridges</b> PI, 800,000 RMB (2023YFC3806804).	<b>2023.12-2027.11</b>
	<b>Failure Mechanisms for Bridge Piers Subject to Heavy Truck Impact</b> PI, 300,000 RMB  National Natural Science Foundation of China-Youth Science Fund Project	<b>2022.1-2024.12</b>
	<b>Seismic Performance of Prefabricated Bridge Pier Joints</b> PI, 715,000 RMB  Shenzhen Institute of Transportation and Municipal Engineering Design Co., Ltd.	<b>2023.3-2025.3</b>
Awards	<b>ASCE Raymond C. Reese Research Prize</b>	<b>2023</b>
	<b>ASCE Arthur M. Wellington Prize</b>	<b>2020</b>
	<b>ASCE O.H. Ammann Research Fellowship in Structural Engineering</b>	<b>2019</b>
	<b>ASCE Journal of Bridge Engineering, Outstanding Reviewer</b>	<b>2019</b>
	<b>First Prize of the China Highway &amp; Transportation Society Science and Technology Award</b>	<b>2023</b>
	<b>China National Scholarship</b>	<b>2012, 2013, 2014</b>

**Journal Publications**

1. **Cao, R.**, El-Tawil, S., Agrawal, A.K., Waider, W. (2024). "Demand Model for Concrete Barriers Subject to Tractor Tanker-Trailer Impact." *International Journal of Bridge Engineering and Management Research*. (accepted)
2. **Cao, R.**, El-Tawil, S., Agrawal, A.K., Waider, W., Zhu Q. (2024). "Concrete Bridge Barriers: State-of-the-art and Design Implementation" *ASCE Journal of Bridge Engineering*. <https://doi.org/10.1061/JBENF2.BEENG-657>
3. **Cao, R.**, Xun Z., El-Tawil, S., Agrawal, A.K., Waider, W. (2023). "Evaluating the Performance of Protection Beams subject to Over-Height Vehicular Impacts using Analytical and Machine Learning-Based Methods", *Journal of Bridge Engineering*, ASCE. DOI: <https://doi.org/10.1061/JBENF2.BEENG-598>
4. Yingkai Liu, Dayong Han, Ran Cao, Jingjing Guo, Lu Deng. Automated vehicle wheelbase measurement using computer vision and view geometry. *Measurement Science and Technology*, 2023, 34(12): 125051.
5. Liu, Huan, Dayong Han, Lu Deng, and Ran Cao. "Analytical model for measurement of stresses using two-hole drilling." *International Journal of Pressure Vessels and Piping* 206 (2023): 105019.
6. Xiang, C., Guo, J., Cao, R. and Deng, L., (2023). "A crack-segmentation algorithm fusing transformers and convolutional neural networks for complex detection scenarios". *Automation in Construction*, 152, p.104894.
7. Deng, L., Sun, T., Yang, Liang., **Cao, R.\*** (2023). "Binocular Video-based Crack 3D Reconstruction and Quantification for Concrete Bridges". *Automation in Construction*, Elsevier, <https://doi.org/10.1016/j.autcon.2023.104743>
8. Zou, S., Han, D., Wang, W., and Cao, R. (2022). "Effect of Autonomous Vehicles on Fatigue Life of Orthotropic Steel Decks". *Sensors*, 22(23), p.9353.
9. Deng Lu, Chu Honghu, Long Lizhi, Wang Wei\*, Kong Xuan, Cao Ran. (2022) "A Review of Crack Detection in Civil Infrastructure Based on Deep Learning." *China Journal of Highway and Transport*. (In Chinese)
10. Ling, T., Cao, R., Deng, L., He, W., Wu, X., Zhong, W. (2022). "Dynamic impact of automated truck platooning on highway bridges". *Engineering Structures*, 262, Elsevier.
11. Zou, S., Cao, R., Deng, L\*, and Wang, W. (2022). "Effect of stress reversals on fatigue life evaluation of OSD considering the transverse distribution of vehicle loads". *Engineering Structures*, 265, Elsevier.
12. Deng Lu, Xiang Chao, Wang Wei, **Cao Ran.\*** (2022). "Fatigue Crack Segmentation of Steel Box Girders Based on an Improved Encoder-Decoder Network." *Journal of Huazhong University of Science and Technology (Natural Science Edition)*. <https://doi.org/10.13245/j.hust.220807>.
13. **Cao, R.**, Agrawal, A.K., El-Tawil, S.(2021). "Data Filtering in Vehicle-Bridge Impact Simulations: Evaluation of Different Force Filtering Methods and Recommendations". *Journal of Bridge Engineering*, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001806
14. Agrawal, A.K., Washer, G., Alampalli, S., Gong, X., and **Cao, R.\*** (2021), "Evaluation of the Consistency of Bridge Inspection Quality in New York State", *Journal of Civil Structural Health Monitoring*. DOI 10.1007/s13349-021-00517-5

15. **Cao, R.**, El-Tawil, S., Agrawal, A.K., Waider, W.(2021). “Performance and Capacity Assessment of Concrete Barriers subject to Lateral Loading”, Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001789
16. **Cao, R.**, Agrawal, A.K., El-Tawil, S., and Wong, W. (2021). “Performance-Based Framework for Concrete Barriers Subjected to Truck Collision”. Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001751 (*Raymond C. Reese Research Prize, ASCE 2023*)
17. **Cao, R.**, Agrawal, A.K., El-Tawil, S., and Wong, W. (2021). “Overheight Impact on Bridges: A Computational Case Study of the Skagit River Bridge Collapse”. Engineering Structures, Elsevier.
18. Agrawal, A.K., Washer, G., Alampalli, S., Gong, X., and **Cao, R.\*** (2021), “Evaluation of the Consistency of Bridge Inspection Ratings in New York State”, Journal of Infrastructure Systems, ASCE. DOI: 10.1061/(ASCE)IS.1943-555X.0000622
19. **Cao, R.**, Agrawal, A.K., El-Tawil, S., and Wong, W. (2020). “A Performance-Based Framework for Evaluating Truck Collision Risk for Bridge Piers”. Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001618
20. **Cao, R.**, Agrawal, A.K., El-Tawil, S., and Wong, W. (2020). “Numerical studies on Concrete Barriers Subjected to MASH Truck Impact”. Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001570
21. **Cao, R.**, El-Tawil, S., Agrawal, A.K., (2019). “Miami Pedestrian Bridge Collapse: A Computational Forensic Analysis” Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001532 (ASCE smartbrief) 12/5/2019)
22. **Cao, R.**, Agrawal, A.K., El-Tawil, S., Xu, X., and Wong, W. (2019). “Performance-based design framework for bridge piers subjected to truck collision” Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001423
23. **Cao, R.**, Agrawal, A.K., El-Tawil, S., Xu, X., and Wong, W. (2019). " Heavy Truck Collision with Bridge Piers: Computational Simulation Study." Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001398 (*Arthur M. Wellington Prize, ASCE*)
24. **Cao, R.**, El-Tawil, S., Agrawal, A.K., Xu, X., and Wong, W. (2019). " Behavior and design of bridge piers subjected to heavy truck collision." Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001414 (the most downloaded paper in the field of structural engineering by ASCE, ranked first, July 2019)
25. Xu, X., **Cao, R.\***, El-Tawil, S., Agrawal, A.K., and Wong, W. (2019). " Loading definition and design of bridge piers impacted by medium weight trucks." Journal of Bridge Engineering, ASCE. DOI: 10.1061/(ASCE)BE.1943-5592.0001397
26. Chen, X., Agrawal, A.K., El-Tawil, S., Xu, X., Cao, R. and Wong, W. (2019), “Inelastic behavior of a bridge bent subjected to truck impact: experimental and computational study.” Engineering Structures, 199 (2019): 109543, Elsevier.
27. Deng L., Cao R., Wang W., and Xinfeng Yin (2016). “A multi-point tire model for studying bridge-vehicle coupled vibration.” International Journal of Structural Stability and Dynamics, 16(8).

1. Wang, Huiguang; Deng, Lu; **Cao, Ran**; Guo, Jingjing; (2024). “Fast-Pixel-Matching Algorithm for Automated Shear Stud Welding Based on the Integration of 2D Drawings and Structured Light Cameras”. ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction, V41, P168-176.
2. Wang, Songyue; Deng, Lu; Guo, Jingjing; Liu, Mi; **Cao, Ran** (2024). “Automatic Quality Inspection of Rebar Spacing Using Vision-Based Deep Learning with RGBD Camera”. ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction, V41, P57-64.
3. Kumar, Deepak; Agrawal, Anil K; **Cao, Ran**; Zhan, Lihan; Wei, Jie. (2022). “Damage Detection in Concrete Slab Using Smart Sounding”, European Workshop on Structural Health Monitoring, P97-105, Springer International Publishing Cham.
4. Chu, HH; **Cao, R**; Deng, L. (2023). “A collaborative inspection system composed of quadruped and flying robot for crack segmentation in tunnel environment”, Expanding Underground-Knowledge and Passion to Make a Positive Impact on the World, CRC Press.
5. **Cao, R. (2020)**. “Numerical FE Crash Simulations of Concrete MASH TL-5 Barriers to Verify Impact Forces”, TRB 99th Annual Meeting-Workshop 1776, Modeling and Simulation for Design and Evaluation of Roadside Safety Hardware, Washington, DC. Jan. 16, 2020. *(Presenter)*
6. Agrawal, A. K. and **Cao, R.** (2019). “Miami Pedestrian Bridge Collapse: A Computational Forensic Analysis”, New York City Department of Transportation, Oct. 30, 2019. *(Co-presenter)*.
7. Agrawal, A. K. and **Cao, R.** (2019). “Miami Pedestrian Bridge Collapse: A Computational Forensic Analysis”, 21st Annual NJDOT Research Showcase, West Windsor, NJ. Oct. 23, 2019. *(Co-presenter)*.
8. **Cao, R.**, El-Tawil, S., Agrawal, A.K., and Wong, W. (2019). “Numerical Studies on Concrete Barriers Subject to MASH Truck Impact”, 10th New York City Bridge Conference, August 26-27, 2019, New York, NY, USA. *(Presenter)*
9. **Cao, R.**, Agrawal, A.K., El-Tawil, S., and Wong, W. (2019). “Performance-Based Design Framework for Bridge Piers Subjected to Truck Collision”, 10th New York City Bridge Conference, August 26-27, 2019, New York, NY, USA. *(Presenter)*
10. **Cao, R.** and Agrawal, A. K. (2019). “Defect Detection of Concrete Structures through Sounding Data Analytics”, Submitted for Publication in 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure, August 4-7, 2019, St. Louis, Missouri, USA. *(Presenter)*
11. **Cao, R. (2019)**. “Computational Simulation of Truck Collisions with Concrete Bridge Piers and Barriers”, TRB 98th Annual Meeting-Workshop 1793, Modeling and Simulation for the Design and Evaluation of Roadside Safety Hardware, Washington, DC. Jan. 17, 2019. *(Presenter)*
12. Agrawal, A.K., El-Tawil, S., **Cao, R.** and Wong, W. (2018). “Implementation of Crash Simulation Technology to Validate the Design Impact Loads for Concrete Bridge Railings under ‘MASH’”, AASHTO T-7 presentation, AASHTO 2018 annual meeting, Burlington, VT, June 2018. *(Presenter)*
13. Agrawal, A.K., El-Tawil, S., **Cao, R.**, Xu, X., and Wong, W. (2018). “Performance Based Design for Bridge Piers Impacted by Heavy Trucks”, AASHTO T-5 presentation, AASHTO 2018 annual meeting, Burlington, VT, June 2018.
14. Agrawal, A.K., El-Tawil, S., **Cao, R.**, Xu, X., and Wong, W. (2017). “Performance Based Design for Bridge Piers Impacted by Heavy Trucks”, 19th Annual NJDOT Research Showcase, West Windsor, NJ. Oct. 25, 2017.

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**Publications****Conference Proceedings (continued)**

15. Agrawal, A.K., El-Tawil, S., **Cao, R.** and Wong, W. (2017). “Numerical Simulation of Overheight Impact on Bridges and Tunnels”, 19th Annual NJDOT Research Showcase, West Windsor, NJ. Oct. 25, 2017. (Poster)
  16. Agrawal, A.K., El-Tawil, S., **Cao, R.**, Xu, X., and Wong, W. (2017). “Performance Based Design for Bridge Piers Impacted by Trucks”, 96th Annual Meeting of the Transportation Research Board, Washington, DC. Jan. 12, 2017 (*Presenter*).
  17. Agrawal, A.K., **Cao, R.** (2016). “A Performance Based Approach for Loading Definition of Heavy Vehicle Impact Events”, 95th Annual Meeting of the Transportation Research Board, Washington, DC. Jan. 13-14, 2016 (*Co-presenter*).
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**Patents**

- **Cao Ran**, Yuan Yujin, Chu Honghu, Automatic tunnel crack repair method, device, and system, CN115182747B (Authorization date: 2023.02.03).
  - **Cao Ran**, Zhu Qi, Chu Honghu, Overheight impact protection method for bridges based on computer vision and actuators, CN115897435B (Authorization date: 2023.5.12).
  - **Cao Ran**, Chu Honghu, Deng Lu, Internal non-destructive testing method and system of bridge girder bottom based on local vibration response, CN113791140A (Authorization date: 2022.01.18).
  - Chu Honghu, **Cao Ran**, Deng Lu, Methods and related components for quadruped robots to cooperate with drones to detect structural damage, CN114820595B (Authorization date: 2022.09.02).
  - Deng Lu, Wang Huiguang, **Cao Ran**, Zuo Xun, A steel-concrete composite structure connector welding method and system, CN117102725B (Authorization date: 2024.1.9).
  - Deng Lu, Xiang Chao, **Cao Ran**, Shi Peng, A structural apparent crack detection method, device and system, CN114049356B (Authorization date: 2022.04.12).
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**Teaching****Courses**

2021-2022-1 Mechanics of materials (Chinese) , Rating by Student Rank 1st  
2022-2023-1 Mechanics of materials (English) , Rating by Student Rank 3rd  
2023-2024-1 Mechanics of materials (English) , Rating by Student Rank 2nd

**Award**

2023 Teaching Excellence Award, College of Civil Engineering, Hunan University.