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Engineering & Scientific Consulting

Roozbeh Rezakhani, Ph.D.

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Professional Profile

Dr. Rezakhani is an expert in using numerical methods to solve mechanical and civil engineering problems. His area of expertise includes computational mechanics, solid mechanics, finite element analysis, fracture mechanics, heat transfer analysis, and multiphysics problems. Dr. Rezakhani has extensive experience in constitutive modeling of various engineering materials such as concrete, rocks, fiber composites, and metals. Among the applications he has worked on are aging and deterioration of infrastructural materials, fracture and fragmentation of brittle materials under static and dynamic loading events, finite element modeling of contact and frictional interfaces, crack propagation in porous materials via hydraulic fracturing, simulation of shock wave lithotripsy procedure used for fracturing of kidney stones, and thermo-mechanical behavior of ceramics under cyclic thermal loadings. Dr. Rezakhani is experienced at modeling laboratory experiments to better understand and analyze the experimental measurements. In addition, he has an extensive programming background using Python, MATLAB, and C++.

Prior to joining Exponent, Dr. Rezakhani worked at Corning Inc. as a Senior Development Scientist where he was responsible for modeling thermo-mechanical behavior of ceramic substrates in vehicles' exhaust systems under severe thermal cycling events. He also managed the Mechanics Laboratory, where he performed stamp testing as well as tensile tests on ceramic samples.

During his graduate studies at Northwestern University, Dr. Rezakhani developed a multiscale framework to model crack propagation in brittle materials using a homogenization approach. After earning his Ph.D. degree, he worked as a postdoctoral researcher at EPFL in Switzerland where he led a project on modeling aging and deterioration of concrete infrastructures funded by Swiss National Science Foundation. After returning to the US, he worked at Duke University as a postdoctoral fellow where he developed a computational framework coupling fluid flow in porous materials with phase field approach to simulate hydraulic fracturing applications.

Academic Credentials & Professional Honors

Ph.D., Civil and Environmental Engineering, Northwestern University, 2016

Prior Experience

Senior Mechanical Development Scientist, Corning Inc., 2021-2022

Postdoctoral Researcher, Mechanical Engineering Department at Duke University. 2020-2021

Research Scientist, Computational Solid Mechanics Laboratory at École Polytechnique Fédérale de Lausanne (EPFL), 2017-2019

Professional Affiliations

American Society of Mechanical Engineers

American Society of Civil Engineers

American Concrete Institute

Publications

Journal papers

R. Rezakhani, V. Rubino, JF. Molinari, A. Rosakis. Three-dimensional stress state during dynamic shear rupture propagation along frictional interfaces in elastic plates. Mechanics of Materials 164, 104098; 2022.

R. Rezakhani, DA. Scott, F. Bousikhane, M. Pathirage, RD. Moser, BH. Green, G. Cusatis. Influence of steel fiber size, shape, and strength on the quasi-static properties of ultra-high performance concrete: Experimental investigation and numerical modeling. Construction and Building Materials 296, 123532; 2021.

R. Rezakhani, E. Gallyamov, JF. Molinari. Meso-scale Finite Element Modeling of Alkali-Silica-Reaction. Construction and Building Materials 278, 122244; 2021.

R. Rezakhani, F. Barras, M. Brun, JF. Molinari. Finite element modeling of dynamic frictional rupture with rate and state friction. Journal of the Mechanics and Physics of Solids 141, 103967; 2020.

M. Brun, R. Rezakhani, JF. Molinari. Explicit dynamic approach for unbounded domains in frictional contact with Rate and State laws. Finite Elements in Analysis and Design 174, 103402; 2020.

ER. Gallyamov, AIC. Ramos, M. Corrado, R. Rezakhani, JF. Molinari. Multi-scale modelling of concrete structures affected by alkali-silica reaction: Coupling the mesoscopic damage evolution and the macroscopic concrete deterioration. International Journal of Solids and Structures 207, 262-278; 2020.

R. Rezakhani, M. Alnagger, G. Cusatis. Multiscale homogenization analysis of Alkali-Silica- Reaction in concrete structures. Engineering 2019.

E. Lale, R. Rezakhani, M. Alnaggar, G. Cusatis. Homogenization-Based coarse graining framework for the analysis of reinforced concrete structural elements. Engineering Fracture Mechanics 197: 259-277; 2018.

R. Rezakhani, X. Zhou, G. Cusatis. Adaptive Multiscale Homogenization of the Lattice Discrete Particle Model for the Analysis of Damage and Fracture in Concrete. International Journal of Solids and Structures 125, 50-67; 2017.

G. Cusatis, R. Rezakhani, E. Shauffert. Discontinuous Cell Method (DCM) for the Simulation of Cohesive Fracture and Fragmentation of Continuous Media. Engineering Fracture Mechanics 170: 1–22; 2017.

W. Li, R. Rezakhani, C. Jin, X. Zhou, G. Cusatis. A multiscale framework for the simulation of the anisotropic mechanical behavior of shale. International journal of numerical and analytical methods in geomechanics. DOI: 10.1002/nag.2684; 2017.

R. Rezakhani, G. Cusatis. Asymptotic expansion homogenization of discrete fine-scale models with rotational degrees of freedom for the simulation of quasi-brittle materials. Journal of the Mechanics and Physics of Solids 88, 320-345; 2016.

Conference papers

F. Bousikhane, R. Rezakhani, J. Smith, G. Cusatis. Calibration and Validation of Concrete Model for the Simulation of the Quasi-Static and Dynamic Response of Concrete Structures. 9th International Conference on Fracture Mechanics of Concrete and Concrete Structures (FraMCoS-9), Berkeley, USA, May 29-June 1, 2016.

R. Rezakhani, M. Alnagger, G. Cusatis. Multiscale Analysis of Alkali Silica Reaction in Concrete: A Homogenization Approach. 9th International Conference on Fracture Mechanics of Concrete and Concrete Structures (FraMCoS-9), Berkeley, USA, May 29-June 1, 2016.

G. Cusatis, M. Alnaggar, R. Rezakhani, Multiscale Modeling of Alkali Silica Reaction Degradation of Concrete. International Symposium on Concrete Modeling (CONMOD), Beijing, China, Oct 12-14, 2014.

G. Cusatis, R. Rezakhani, M. Alnaggar, X. Zhou, D. Pelessone, Multiscale Computational Models for the Simulation of Concrete Materials and Structures, Computational Modeling of Concrete and Concrete Structures (Euro-C), March 24-27, 2014.

R. Rezakhani, G. Cusatis, Generalized Mathematical Homogenization of the Lattice Discrete Particle Model. 8th International Conference on Fracture Mechanics of Concrete and Concrete Structures proceedings (FraMCoS-8), Toledo, Spain, March 10-14, 2013.

Presentations

Rezakhani R, Molinari JF. Meso-scale finite element modeling of Alkali-Silica-Reaction (ASR) effect in concrete. International Association of Fracture Mechanics for Concrete and Concrete Structures, Bayonne, France. 2019.

Rezakhani R, Molinari JF. Finite element simulation of shear rupture propagation on frictional interfaces. Society of Engineering Science, Madrid, Spain, 2018.

Rezakhani R, Zhou X, Cusatis G. Adaptive multiscale homogenization of discrete models to continuum with application to concrete. Engineering Mechanics Institute, San Diego, USA, 2017.

Rezakhani R, Alnagger M, Cusatis G. Homogenization of Alkali Silica Reaction effect in concrete. Cements, Northwestern University, USA, 2016.

Rezakhani R, Bousikhane F, Cusatis G. Calibration and Validation of Concrete Model for the Simulation of the Quasi-Static and Dynamic Response of Concrete Structures. International Association of Fracture Mechanics for Concrete and Concrete Structures, Berkeley, USA, 2016.

Rezakhani R, Cusatis G. Multiscale Analysis of Alkali Silica Reaction in Concrete: A Homogenization Approach. International Association of Fracture Mechanics for Concrete and Concrete Structures, Berkeley, USA, 2016.

Rezakhani R, Cusatis G. Calibration and Validation of Concrete Models for the Simulation of the Dynamic Response of Concrete Structures. Spring American Concrete Institute convention, Milwaukee, USA, 2016.

Rezakhani R, Cusatis G. Homogenization of discrete concrete models into continuum. Seventh M.I.T. Conference on Computational Fluid and Solid Mechanics, M.I.T, USA, 2014.

Rezakhani R, Cusatis G. Multiscale Homogenization of discrete models with rotational degrees of freedom. Engineering Mechanics Institute, Northwestern University, USA, 2013.

Rezakhani R, Cusatis G. Mathematical Homogenization of discrete models. Engineering Mechanics Institute, University of Notre Dame, USA, 2012.

Editorships & Editorial Review Boards

Guest Editor for a special issue of the journal Advances in Materials Science and Engineering named “Aging of Concrete

Structures and Infrastructures: Causes, Consequences, and Cures”; 2019.

Peer Reviews

International Journal of Solids Structures

International Journal of Damage Mechanics

Computer Methods in Applied Mechanics and Engineering

Engineering Fracture Mechanics Journal