

Exponent®
Engineering & Scientific Consulting

Adnan Eghtesad, Ph.D., P.E.

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Professional Profile

Dr. Eghtesad supports clients in litigation and non-litigation (proactive) matters through performance evaluation of mechanical systems, reliability assessment, and root cause analysis of reported failures. Dr. Eghtesad relies upon computer modeling and simulation using finite element analysis (FEA) supported by physical testing, experiments, and field inspections to perform engineering and failure analysis across various industry sectors, including consumer products, manufacturing, medical devices, automotive, and crashworthiness.

Consumer Products

Dr. Eghtesad performs engineering analyses of consumer products, focusing on testing, performance evaluation, engineering assessments, and failure analysis. His work addresses product safety, regulatory compliance, and recall investigations. He has worked on a diverse range of consumer products, including but not limited to blenders, French presses, glass bottles, tumblers, travel mugs, lanyards, pressure vessels, microwave-safe glass and ceramic containers, refrigerator compressors, TV Panels, PVC and industrial piping, bolted flanges, bollards, foam glass, piezo transducers in sonar applications, fuel injectors, and paper shredders..

Medical Devices

Dr. Eghtesad is experienced in assessing the mechanical and fatigue life performance of medical devices. He leverages computer simulations and finite element analysis (FEA) to better understand the mechanical response of medical devices. Dr. Eghtesad’s insights have helped clients and start-up medical device companies with cardiovascular devices (CVDs), intrauterine devices (IUDs), and skin allergy test devices during his time at Exponent.

Manufacturing

Dr. Eghtesad has extensive expertise in analyzing premature component failures across various industries, particularly in manufacturing. He has evaluated metal forming processes and assessed the mechanical integrity of metallic and composite components commonly used in the automotive and aerospace sectors. His work helps clients identify the root causes of failures and implement effective corrective actions, while taking into account the limitations of the manufacturing processes.

Automotive and Crashworthiness

Dr. Eghtesad has more than a decade of experience in understanding the impact and crashworthiness of materials and components under impact/crash loads. He leverages simulation tools and techniques such

as LS-DYNA, Abaqus, Autodyne, and ANSYS Explicit Dynamics to understand the deformation patterns and load paths in the vehicles' structures. Dr. Eghtesad has also assisted the clients in reviewing and improving their existing computer models. In addition, Dr. Eghtesad has provided insights into the structural integrity of the components used in the transportation industry, such as SkyTrain, railcar, and engine.

Computer Modeling and Finite Element Analysis (FEA)

Dr. Eghtesad has extensive experience in computer simulations using a wide range of finite element modeling (FEM) tools, including Abaqus, Ansys, and COMSOL, and provides clients with a unique perspective for addressing complex computational projects required in a wide range of industries. In addition to FEA, Dr. Eghtesad has gained skills in computational fluid dynamics (CFD) and fluid-structure-interaction (FSI) modeling and analysis using the Ansys Workbench modules. Additionally, Dr. Eghtesad leverages the cutting-edge machine learning (ML) and artificial intelligence (AI) tools and data-driven models to help clients detect design defects and offer predictive forecasts towards improving the design process and final products.

Experience Prior to Joining Exponent

Prior to joining Exponent, Dr. Eghtesad served as a postdoctoral fellow in the Sibley School of Mechanical and Aerospace Engineering at Cornell University and the Materials Science and Engineering department at the Pennsylvania State University. Dr. Eghtesad received his PhD in Mechanical Engineering from the University of New Hampshire in 2021. Dr. Eghtesad's work was conducted in collaboration with Los Alamos National Laboratory (LANL). Prior to his PhD, Dr. Eghtesad served as a design engineer in the manufacturing industry. Dr. Eghtesad's work has been used in submitting technical reports to the National Science Foundation (NSF), Department of Energy (DOE), and Air Force Office of Scientific Research (AFOSR) and has resulted in 20+ peer-reviewed journal publications and 500+ citations. Dr. Eghtesad has demonstrated the impact of his work through professional talks at international conferences, including the Minerals, Metals and Materials Society (TMS).

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, University of New Hampshire, 2021

STAF (Summer TA Fellowship) - University of New Hampshire 2019

DYF (Dissertation Year Fellowship) - University of New Hampshire 2015

CEPS (College of Eng. and Physic. Sci. Fellowship) - University of New Hampshire 2015

IRPS (Int. Postgrad. Research Scholarship) - University of Queensland 2015

MGS (Monash Graduate Scholarship) - Monash University 2015

IGSES (Int. Grad. Scholarship) - University of Manitoba 2015

Licenses and Certifications

Professional Engineer Mechanical, California, #43145

Prior Experience

Design Engineer, National Elites Foundation, 2011-2016

Professional Affiliations

Postdoctoral Fellow, Mechanical and Aerospace Engineering, Cornell University, 2022-2023

Postdoctoral Fellow, Materials Science and Engineering, The Pennsylvania State University, 2021-2022

Member of the Minerals, Metals & Materials Society (TMS)

Publications

Eghtesad, Adnan, Qixiang Luo, Shun-Li Shang, Ricardo A Lebensohn, Marko Knezevic, Zi-Kui Liu, and Allison M Beese (2023). “Machine learning-enabled identification of micromechanical stress and strain hotspots predicted via dislocation density-based crystal plasticity simulations”. In: International Journal of Plasticity, p. 103646.

Eghtesad, Adnan and Germaschewski, Kai and Marko Knezevic (2022). “Coupling of a multi-GPU accelerated elasto-visco-plastic fast Fourier transform constitutive model with the implicit finite element method”. In: Computational Materials Science 208, p. 111348.

Eghtesad, Adnan and Shimanek, John D, Shun-Li Shang, Ricardo Lebensohn, Marko Knezevic, Zi-Kui Liu, and Allison M Beese (2022). “Density functional theory-informed dislocation density hardening within crystal plasticity: Application to modeling deformation of Ni polycrystals”. In: Computational Materials Science 215, p. 111803.

Liu, Zi-Kui, Shun-Li Shang, Allison M Beese, Yi Wang, Eghtesad, Adnan, John Shimanek, Shipin Qin, Shuang Lin, Hui Sun, and Brandon Bocklund (2022). High Throughput Computational Framework of Materials Properties for Extreme Environments. Tech. rep. Pennsylvania State Univ., University Park, PA (United States).

Eghtesad, Adnan and Knezevic, Marko (2021). “Modeling cyclic plasticity of additively manufactured alloy Mar-M-509 using a high-performance spectral based micromechanical model”. In: Applications in Engineering Science 7, p. 100065.

Eghtesad, Adnan and Germaschewski, Kai, Ricardo A Lebensohn, and Marko Knezevic (2020). “A multi-GPU implementation of a full-field crystal plasticity solver for efficient modeling of high-resolution microstructures”. In: Computer Physics Communications 254, p. 107231.

Eghtesad, Adnan and Knezevic, Marko (2020). “A full-field crystal plasticity model including the effects of precipitates: Application to monotonic, load reversal, and low-cycle fatigue behavior of Inconel 718”. In: Materials Science and Engineering: A, p. 140478.

Barrett, Timothy J., Rodney J. Eghtesad, Adnan and McCabe, Bjørn Clausen, Donald W. Brown, Sven C. Vogel, and Marko Knezevic (2019). “A generalized spherical harmonics-based procedure for the interpolation of partial datasets of orientation distributions to enable crystal mechanics-based simulations”. In: Materialia.

Cantara, Aaron M, Milovan Zecevic, Eghtesad, Adnan, Camille M Poulin, and Marko Knezevic (2019). “Predicting elastic anisotropy of dual-phase steels based on crystal mechanics and microstructure”. In: International Journal of Mechanical Sciences 151, pp. 639–649.

Eghtesad, Adnan and Knezevic, Marko (2019). “High-performance full-field crystal plasticity with

dislocation-based hardening and slip system back-stress laws: Application to modeling deformation of dual-phase steels". In: Journal of the Mechanics and Physics of Solids.

Eghtesad, Adnan, Timothy J. Barrett, Kai Germaschewski, Ricardo A. Lebensohn, Rodney J. McCabe, and Marko Knezevic (2018). "OpenMP and MPI implementations of an elasto-viscoplastic fast Fourier transform-based micromechanical solver for fast crystal plasticity modeling". In: Advances in Engineering Software 126.December 2018, pp. 46–60.

Eghtesad, Adnan and Barrett, Timothy J and Marko Knezevic (2018). "Compact reconstruction of orientation distributions using generalized spherical harmonics to advance large-scale crystal plasticity modeling: Verification using cubic, hexagonal, and orthorhombic polycrystals". In: Acta Materialia 155, pp. 418–432.

Eghtesad, Adnan and Germaschewski, Kai, Irene J Beyerlein, Abigail Hunter, and Marko Knezevic (2018). "Graphics processing unit accelerated phase field dislocation dynamics: Application to bi-metallic interfaces". In: Advances in Engineering Software 115, pp. 248–267.

Eghtesad, Adnan and Zecevic, Miroslav, Ricardo A Lebensohn, Rodney J McCabe, and Marko Knezevic (2018). "Spectral database constitutive representation within a spectral micromechanical solver for computationally e□icient polycrystal plasticity modelling". In: Computational Mechanics 61.1, pp. 89–104.

Eghtesad, Adnan and Knezevic, Marko (2017). "A new approach to fluid–structure interaction within graphics hardware accelerated smooth particle hydrodynamics considering heterogeneous particle size distribution". In: Computational Particle Mechanics.

Eghtesad, Adnan and Alireza Shafiei (2012). "Study of dynamic behavior of ceramic–metal FGM under high velocity impact conditions using CSPM method". In: International journal of crashworthiness 17.4, pp. 384–400.

Eghtesad, Adnan and Shafiei, Alireza (2012). "Body deformation study in a Formula One race car crashing into a rigid barrier at different crash angles". In: International journal of crashworthiness 17.4, pp. 384–400.

Eghtesad, Adnan and Shafiei, Alireza and Mojtaba Mahzoon (2012). "A new fluid–solid interface algorithm for simulating fluid structure problems in FGM plates". In: Journal of Fluids and Structures 30, pp. 141–158.

Eghtesad, Adnan, Alireza Shafiei, and Mojtaba Mahzoon (2011). "Predicting fracture and fragmentation in ceramic using a thermo-mechanical basis". In: Theoretical and Applied Fracture Mechanics 56.2, pp. 68–78.

Presentations

Lavanya, Raman, Ahn Marcia, Debnath Arindam, Lin Shuang, Eghtesad, Adnan, Krajewski Adam, Shang Shunli, Reinhart Wesley, Beese Allison, Poudel Bed, Liu Zi-Kui, Li Wenjie, and Priya Shashank (2022). "The Phase, Microstructure and Mechanical Properties of High Entropy Mo-Nb-Ti-V-W-Zr Ultrahigh Temperature Refractory Alloy"". In: 152th Annual Meeting Exhibition, San Diego Convention Center Hilton San Diego Bayfront. TMS.

Eghtesad, Adnan, Kai Germaschewski, R.A. Lebensohn, and Marko Knezevic (2020). "A Multi-GPU Implementation of a Full-field Crystal Plasticity Solver for Efficient Modeling of Highresolution Microstructures". In: 149th Annual Meeting Exhibition, San Diego, California. TMS.

Eghtesad, Adnan and Marko Knezevic (2020). "High-performance Full-field Crystal Plasticity with Dislocation based Hardening and Slip System Backstress Laws: Application to Modeling Deformation of Dual-phase Steels". In: 149th Annual Meeting Exhibition,San Diego, California. TMS.

Barrett, Timothy J, Eghtesad, Adnan, Rodney J McCabe, Vogel Sven C, and Marko Knezevic (2019). “Procedures for the Interpolation of Orientation Distributions from Coarse Grid Experimental Measurements to Fine Grid Finite Element Meshes”. In: 148th Annual Meeting Exhibition, San Antonio, Texas. TMS.

Eghtesad, Adnan, Kai Germaschewski, I.J. Beyerlein, A. Hunter, and Marko Knezevic (2018). “GPU Accelerated Phase Field Dislocation Dynamics: Application to Bi-metallic Interfaces”. In: 147th Annual Meeting Exhibition, Phoenix, Arizona. TMS.

Eghtesad, Adnan, Kai Germaschewski, Ricardo Lebensohn, Rodney J McCabe, and Marko Knezevic (2018). “Coupled elasto-plastic Fast Fourier Transform Micromechanical Solver with Spectral Database Constitutive Representation”. In: 147th Annual Meeting Exhibition, Phoenix, Arizona. TMS.

Eghtesad, Adnan, Barrett Timothy, and Marko Knezevic (2018). “Compact reconstruction of orientation distributions using generalized spherical harmonics to advance large-scale crystal plasticity modeling: Verification using cubic, hexagonal, and orthorhombic polycrystals”. In: Graduate Research Conference, University of New Hampshire, New Hampshire, Durham. GRC.

Eghtesad, Adnan and AR Shafiei (2011). “A general comparetive study in long rod penetration using corrective smoothed particle method”. In: PARTICLES II: proceedings of the II International Conference on Particle-Based Methods: fundamentals and applications. CIMNE, pp. 930–941.

Project Experience

While the project experience is comprehensive, a selected project experience is summarized below:

Consumer Products and Consumer Electronics

-Root cause investigation of glass fracture in French press using finite element analysis

-Design review of Microwave-safe glass and ceramic containers

-Drop analysis of electronic devices, and structural integrity evaluation of the printed circuit boards (PCB)

-Failure investigation of street bollards under crash

-Analysis of interlocking mechanisms and safeguarding in paper shredders

-Acoustic performance evaluation of Piezoelectric transducers in sonar applications

-Finite element analysis and evaluation of design parameters in a refrigerator compressor

Medical Devices

-Mechanical and material testing and performance assessment of cardiovascular devices utilized in the heart

-Modeling the crimp and deploy procedure of medical devices used in the brain aneurysms

-Deformation and failure assessment of an intrauterine device (IUD)

-Mechanical response and load transfer analysis of a skin allergy test device

-Finite element analysis of mechanical deformation in medical devices and evaluating the corresponding peak strain and stress under cyclic and fatigue loading

Manufacturing

- Leveraging Microstructure-property-linkage to understand the relationship between the microstructure and macroscopic properties in a wide range of metals and alloys, including but not limited to advanced high-strength steel (AHSS), dual phase ferritic-martensitic steels, nickel and cobalt-based superalloys

- Analysis of the effects of precipitates on the fatigue behavior of Inconel 718 nickel superalloy and additively manufactured Mar-M-509 cobalt superalloy

- Evaluation of plastic deformation and strain hardening in a wide range of high-entropy alloys (HEAs)

- Structural integrity assessment of metals, ceramics, and functionally graded composites under high velocity impact loads

- Large deformation response of laminate composites under high-velocity impact loads

Utilities, Oil, and Gas

-Engineering assessment and finite element analysis of an LNG tank and its structural foundation, including the foam glass

-Failure analysis of pipes, flanges, bolts, piping structures, and welds in power plants

-Flow-induced vibration and modal analysis of piping systems using finite element analysis

-Structural integrity assessment of LNG tank foundation under vibrations caused by excavation and boring

-Finite element analysis of mechanical stress and deformation of PVC piping under soil heave

-Review and technical analysis of industrial hose assemblies and couplings used in water transfer applications

Renewable energy

-Engineering assessments and technical analyses pertaining to Industrial arbitration matters, involving wind turbine generators (WTG)

Automotive and Transportation

-Finite element analysis of automotive crashworthiness

-Critical review and examination of the computer models created by the clients, and propose improvements

-Finite element analysis of the mechanical system, and force-displacement response of pistons inside a piezoelectric diesel fuel injector

-Finite element analysis of thermo-mechanical stress and wear of the brush used inside the engine's alternator

-Design review of the rail structures used in the sky trains

-Litigation support of a helicopter crash matter

-Control software review of a diesel engine and mapping the behavior of the software functions (injection timing, dosing rates, fueling quantity, etc.) using MATLAB Simulink

Industrial Machinery

-Engineering assessment and litigation support of injury caused by operating cranes and forklifts

-Engineering assessment and litigation support of injury caused by boom concrete pump trucks

-Engineering assessment and litigation support of injury caused by belt conveyors

-Litigation support of building maintenance units (BMU) and the engineering assessment of emergency and mechanical brakes

Intellectual Property

-Trade dress infringement of a sidewalk scaffolding structure

-Patent infringement of a skin allergy test device

-Patent infringement of LED TVs

Peer Reviews

Journal of Failure Analysis and Prevention (Springer)

Computational Materials Science (Elsevier)

International Journal of Plasticity (Elsevier)

Computer Methods in Applied Mechanics and Engineering (Elsevier)

Theoretical and Applied Fracture Mechanics (Elsevier)

International Journal of Material Forming (Springer)

JOM (Springer)