Exponent®
Engineering & Scientific Consulting

Amin Ajdari, Ph.D., P.E.

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Professional Profile

Dr. Ajdari is a licensed professional mechanical engineer who specializes in failure analysis and design assessment of mechanical systems and industrial equipment, with an emphasis on safety and regulatory compliance. His extensive experience includes utilizing simulation methods and experimental design to evaluate product robustness, reliability, and compliance, and to determine the cause of failures when they occur during development or in the field.

Dr. Ajdari's expertise spans both litigation and non-litigation failure analyses assessing the underlying root cause of reported matters. His expertise has been applied to failure and design analyses across multiple industries including energy storage and batteries, medical devices, consumer products, defense/military applications, boilers & pressure vessels, industrial heat exchangers, oil and gas industry, railroad industry, and automotive industry. Dr. Ajdari has experience in component design compliance with relevant specifications, codes, standards, regulations, and fitness-for-service (such as API 579, ASME Boiler and Pressure Vessel Code), structural assessments including welds and bolted connections, thermal evaluations, fatigue and crack-propagation analysis, and crash impact simulations.

Prior to joining Exponent, Dr. Ajdari served as a Senior Engineer at DePuy Synthes Spine (a Johnson & Johnson Company), supporting product development, and sustaining efforts related to spine implants and surgical devices. He is also familiar with regulatory design requirements for medical devices, explicitly, verification and validation efforts. During his tenure at GE Energy Storage (2014-2017), Dr. Ajdari led design and development of GE battery products, focusing on thermal management, and cooling system for Li-ion and high temperature sodium metal battery systems. His Green Belt Six-Sigma certification recognized his work addressing premature battery cell failure due to glass seal cracks.

Dr. Ajdari holds a PhD in Mechanical Engineering and has completed postdoctoral fellowships at MIT and Northwestern University. His research covered diverse topics, including high performance nanoparticle rubber composites for tire compound, investigating instability and deformation localization in thin elastic shells, structural assessment of reinforced concrete chimneys subject to an uncontrolled fire, and designing structures with superior and tailorable mechanical properties.

Dr. Ajdari actively contributes to the fields and his scientific publications include 21 peer-reviewed journal publications with over 2,100+ citations (as of Jun 2024), and over 54+ conference proceedings and presentations, and 2 patent disclosures. He currently serves as a primary member of ASME V&V60 subcommittee on Verification and Validation of Computational Modeling in Energy Systems.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Northeastern University, 2012

M.S., Mechanical Engineering, Northeastern University, 2008

B.S., Mechanical Engineering, University of Tehran, Iran, 2004

NSF CMMI "Civil, Mechanical, and Manufacturing Innovation" Student Award, 2011

11th U.S. National Congress on Computational Mechanics Student Award, 2011

Joseph Ferretti Academic Excellence Fellowship, Northeastern University, 2010

10th U.S. National Congress on Computational Mechanics Student Award, 2009

Licenses and Certifications

Professional Engineer Mechanical, Louisiana, #0049719

Professional Engineer Mechanical, Massachusetts, #58612

Professional Engineer Mechanical, Mississippi, #35753

Professional Engineer, New York, #101283

Professional Engineer Mechanical, Texas, #150246

Six Sigma Green Belt Certification (CSSGB)

Academic Appointments

e-Instructor, Department of Mechanical Engineering, MIT, 2012

Lecturer, Department of Mechanical Engineering, Northeastern University, 2010

Prior Experience

Senior R&D Engineer, DePuy Synthes Spine, Johnson & Johnson, Raynham, MA 2017-2018

Lead Mechanical Engineer, General Electric Energy Storage, Schenectady, NY 2014-2017

Postdoctoral Research Associate, Northwestern University, Evanston, IL 2012-2014

Research Fellow, Massachusetts Institute of Technology, Cambridge, MA 2012-2013

Research Engineer, Abiomed, Danvers, MA 2008

Service Engineer, Cummins Diesel, Tehran, Iran 2004-2006

Professional Affiliations

American Society of Mechanical Engineering (ASME)

Society of Experimental Mechanics (SEM)

American Physical Society (APS)

Patents

US 2018/0062230 A1: Airflow Cooling for an Energy Storage System, 2018.

US 2017/0069939 A1: Heat Flux Assembly for an Energy Storage Device, 2017.

Publications

K. Bhamidipati, J. Lindsey, A. Ajdari, J. Browell, S. Hollo, K. J. Frutschy, "Sodium Metal Halide Battery Thermal Design for Improved Reliability", J. of Electrochemical Energy Conversion and Storage, 2018.

A. Hu, X. Li, A. Ajdari, B. Jiang, L.C. Brinson, C. Burkhart, W. Chen, "Computational analysis of particle reinforced viscoelastic polymer nanocomposites", J. Mechanics and Physics of Solids, 2018.

C.D. Wood, A. Ajdari, C.W. Bukhart, K.W. Putz, L.C. Brinson, "Understanding competing mechanisms for glass transition changes in filled elastomers", Composites Sci. and Tech., 127 (2016) 88-94.

D. Mousanezhad, H. Ebrahimi, B. H. Jahromi, R. Ghosh; A. Ajdari; A. M. S. Hamouda, A. Vaziri, "Spiderweb honeycombs", Int. J. Solids and Structures, 66 (2015) 218-227.

D. Mousanezhad, R. Ghosh, A. Ajdari, A.M.S. Hamouda, H. Nayeb-Hashemi, A. Vaziri, "Impact resistance and energy absorption of regular and functionally graded hexagonal honeycombs with cell wall material strain hardening", Int. J. Mechanical Sciences, 89 (2014) 413-422.

H. Ebrahimi, A. Ajdari, D. Vella, A. , A. Vaziri, "Anisotropic Blistering Instability of Highly Ellipsoidal Shells", Physical Rev Letters, 112 (2014) 094302.

A. Nasto, A. Ajdari, A. Lazarus, A. Vaziri, P.M. Reis, "Localization of deformation in thin shells under indentation", Soft Matter, 9 (2013) 6796-6803. [Special Themes Issue on "Emerging Investigators in Soft Matter"]

D. Vella, A. Ajdari, A. Vaziri, A. Boudaoud, "Indentation of ellipsoidal and cylindrical elastic shells", Physical Rev Letters, 109 (2012) 144302. [Press reports: InsideScience.org, LeMonde.fr, slate.com, and Scientific American blog]

A. Ajdari, B. H. Jahromi, J. Papadopoulos, H. Nayeb-Hashemi, A. Vaziri, "Hierarchical honeycombs with tailorable properties", Int. J. Solids Structure, 49 (2012) 1413-1419.

S. Babaee, B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, "Mechanical properties of open-cell rhombic dodecahedron cellular structures", Acta Materialia., 60 (2012) 2873-2885.

D. Vella, A. Ajdari, A. Vaziri, A. Boudaoud, "The indentation of pressurized elastic shells: From polymeric capsules to yeast cells", J Royal Society Interface, 9 (2012) 448-455.

M. Ashrafi, A. Ajdari, N. Rahbar, J. Papadopoulos, H. Nayeb-Hashemi, A. Vaziri, "Single lap adhesively bonded joints with non-flat interfaces", Int. J. Adhesion & Adhesives, 32 (2012) 46-52.

D. Vella, A. Ajdari, A. Vaziri, A. Boudaoud, "Wrinkling of pressurized elastic shells", Physical Rev Letters, 107 (2011) 174301.

Press reports: Physics World and physicsworld.com; College of Engineering, Northeastern University.

A. Vaziri, A. Ajdari, A. A. Twohig, H. Ali, "Structural reliability of reinforced concrete chimneys subjected to uncontrolled fire", Engineering Structure, 33 (2011) 2888-2889.

A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, "Dynamic crushing and energy absorption of regular, irregular

and functionally graded cellular structures", Int. J. Solids Structure, 48 (2011) 506-516.

S.C. Corbett, A. Ajdari, A.U. Coskun, H. Nayeb-Hashemi, "Effect of pulsatile blood flow on thrombosis potential with a step wall transition", ASAIO, 56 (2010) 290-295.

B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, "Autofrettage of layered and functionally graded metal-ceramic composite vessels", Composite Structures, 92 (2010) 1813-1822.

S.C. Corbett, A. Ajdari, A.U. Coskun, H. Nayeb-Hashemi, "In vitro and computational thrombosis on artificial surfaces with shear stress", Artificial Organs, 34 (2010) 561-569.

A. Ajdari, P.K. Canavan, H. Nayeb-Hashemi, G. Warner, "Mechanical properties of functionally graded 2-D cellular structures: A finite element study", J of Material Science and Engineering, A 499 (2009) 434-439.

A. Ajdari, H. Nayeb-Hashemi, P.K. Canavan, G. Warner "Effect of defect on elastic-plastic behavior of cellular materials", J of Material Science and Engineering, A 487 (2008) 558-567.

Conference Proceedings and Presentations

B. Davies, A. Ajdari, Z. Owens, I.Y. Hur, V. Nirankari, M. Levine, D. Datta, A. Vytiniotis, “Vibrational Assessment of Injection Well Tubing”, SPE, AAPG, SEG: Carbon Capture, Utilization, and Storage, March 2024, Houston, TX.

A. Ajdari, K. Frutschy, “Optimizing Residual Thermal Stresses in Sodium Metal Halide Batteries”, Conference on Advancing Analysis and Simulation in Engineering, CAASE20, June 2020.

A. Vaziri, B. H. Jahromi, A. Ajdari, H. Ebrahimi, P. Papadopoulos, H. Nayeb-Hashemi, "Plastic-Limit analysis of hierarchical honeycombs", Plasticity, Bahamas 2013.

A. Ajdari, B. H. Jahromi, A. M. Hamouda, A. Vaziri, " Hierarchical honeycombs with enhanced mechanical properties", 7th International Conference Supply on the Wings, Frankfurt, Germany 2012.

R. Oftadeh, B. H. Jahromi, A. Ajdari, A. Vaziri, "Fractal-Appearing hierarchical honeycombs", MRS Fall meeting, Boston 2012.

A. Ajdari, A. Nasto, A. Lazarus, A. Vaziri, P.M. Reis, "Localized deformation and instability of thin elastic shells upon indentation", Proc. ASME IMECE2012-88308, Houston, TX 2012.

M. Ashrafi, A. Ajdari, B. H. Jahromi, M. Olia, H. Nayeb-Hashemi, A. Vaziri, "Adhesively bonded joints with non-flat interfaces", Proc. ASME IMECE2012-88007, Houston, TX 2012.

B. H. Jahromi, A. Ajdari, R. Oftadeh, J. Papadopoulos, H. Nayeb-Hashemi, A. Vaziri, "Honeycombs with structural hierarchy", Proc. ASME IMECE2012-88120, Houston, TX 2012.

B. H. Jahromi, A. Ajdari, R. Oftadeh, H. Ebrahimi & A. Vaziri, "Mechanics of hierarchical honeycombs", NSF CMMI Research and Innovation Conference, Boston, MA, 2012.

B. H. Jahromi, A. Ajdari, A. Vaziri, "Intricate mechanics of hierarchical honeycombs", Society of Engineering Sceinces (SES2012), Atlanta, GA 2012.

A. Nasto, A. Ajdari, A. Lazarus, A. Vaziri, P.M. Reis, "Localization (s-cones) in thin shells under indentation", Society of Engineering Sceinces (SES2012), Atlanta, GA 2012.

A. Ajdari, B. H. Jahromi, H. Nayeb-Hashemi, A. Vaziri, "Hierarchical honeycombs with enhanced mechanical properties", XXIII International Congress of Theoretical and Applied Mechanics (ICTAM2012),

Beijing, China 2012.

A. Ajdari, B. H. Jahromi, A. Vaziri, "Stiff honeycombs with structural hierarchy", European Congress on Computational Methods in Applied Sciences and Engineering, Vienna, Austria, 2012.

B. H. Jahromi, A. Ajdari, R. Oftadeh, A. Vaziri, "Hierarchical and fractal honeycombs with tailorable properties", Research, Innovation and Scholarship Expo (RISE 2012), Boston 2012.

A. Ajdari, B. H. Jahromi, J. Papadopoulos, A. Vaziri, "Honeycombs with hierarchical organization", APS March Meeting, Boston, MA 2012.

A. Nasto, A. Ajdari, A. Lazarus, A. Vaziri, P.M. Reis "S-cones in this shells under indentation", APS March Meeting, Boston, MA 2012.

A. Ajdari, B. H. Jahromi, A. Vaziri, "Mechanics of hierarchical honeycombs", Plasticity, San Juan, PR 2012.

A. Ajdari, B. H. Jahromi, A. M. Hamouda, A. Vaziri, "Hierarchical cellular structures with tailorable properties", Qatar Foundation Annual Research Forum, Doha, Qatar, 2011.

A. Ajdari, B. H. Jahromi, A. Vaziri, "Fractal and hierarchical honeycombs", 48th Annual Technical Meeting of the Society of Engineering Science (SES2011), Evanston, IL 2011.

A. Vaziri, A. Ajdari, "Localized features and patterns of strongly-deformed elastic shells", 48th Annual Technical Meeting of the Society of Engineering Science (SES2011), Evanston, IL 2011.

A. Ajdari, A. Vaziri, "Multi-Scale mechanics of thin elastic shells upon point indentation", USNCCM 11, Minneapolis, MN 2011.

A. Ajdari, B. H. Jahromi, A. Vaziri, "Structural stiffness of honeycombs with hierarchical organization", USNCCM 11, Minneapolis, MN 2011.

A. Ajdari, A. Vaziri, "Mechanical properties and energy absorption of heterogeneous and functionally graded cellular structures", International Conference on the Mechanical Behavior of Materials (ICM11), Como Lake, Italy, 2011.

S. Babaee, B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, " Energy absorption of heterogeneous and functionally graded cellular structures ", Sixth MIT Conference on Computational Fluid and Solid Mechanics, Cambridge, MA 2011.

A. Ajdari, S. Babaee, H. Nayeb-Hashemi, A. Vaziri, "Cellular structures with irregular structural organization", Engineering Mechanics Institute (EMI2011) Conference, Boston, MA, 2011.

A. Vaziri, A. Ajdari, "Global and localized features of shell deformation and instability", Engineering Mechanics Institute (EMI2011) Conference, Boston, MA, 2011.

S. Babaee, A. Ajdari, A. Vaziri, "Heterogeneous and functionally graded three-dimensional cellular materials", SEM Ann. Conf. on Exp. Appl. Mech., Uncasville, CT, 2011.

A. Ajdari, A. Vaziri, "Multi-scale and cross disciplinary aspects of thin elastic shells", NSF CMII Research and Innovation Conference, Atlanta, GA, 2011.

B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, "Extended Variable Materials Property (X-VMP) method for elasto-plasto analysis of functionally graded materials and structures", NSF CMII Research and Innovation Conference, Atlanta, GA, 2011.

A. Vaziri, S. Babaee, B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, "Elasto-plasto properties and energy absorption of 3D tessellated cellular structures", Plasticity, 2011.

A. Vaziri, B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, "Extended variable materials property (X-VMP) method for elasto-plasto analysis", Plasticity, 2011.

A. Ajdari, A. Vaziri, "Curvature-driven instability and wrinkling in elastic shells", MRS Fall Meeting, 2010.

A. Ajdari, L. Mahadevan, A. Vaziri, "Localization and curvature-driven wrinkling in elastic shells", New England Workshop on the Mechanics of Materials and Structures, 2010.

A. Ajdari, S. Babaee, A. Vaziri, "Heterogeneous and functionally graded cellular structures", New England Workshop on the Mechanics of Materials and Structures, 2010.

Jonathan Hammel, A. Ajdari, A. Vaziri, "2D Inplane cylindrical impact on regular hexagonal honeycomb structure: a finite element study", Research, Innovation and Scholarship Expo (RISE 2010), Boston 2010.

A. Vaziri, B. Haghpanah Jahromi, A. Ajdari, "Failure and fracture of shock-loaded metal sandwich panels", Proc. ASME IMECE2010-39923, Vancouver, BC, 2010.

S. Babaee, B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, "Mechanical properties of open-cell cellular structures with rhombic dodecahedron cells", Proc. ASME IMECE2010-39924, Vancouver, BC, 2010.

B.H. Jahromi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, " Linear buckling analysis of cracked cylindrical shell under axial compression ", Proc. ASME IMECE2010-39794, Vancouver, BC, 2010.

A. Vaziri, A. Ajdari, "Homogenization and failure of metal sandwich panels subjected to air shocks", IMPLAST 2010, Providence, RI.

A. Ajdari, S. Babaee, A. Vaziri, "Dynamic crushing and energy absorption of cellular structures", IMPLAST 2010, Providence, RI.

A. Ajdari, B. H. Jahromi, A. Vaziri, "Heterogeneous cellular structures for energy absorption and impact applications", Int. Symp. Plasticity, St. Thomas, Virgin Islands, 2010.

A. Vaziri, A. Ajdari, "Mechanics and dynamics of instability and deformation localization in elastic shells", Proc. ASME IMECE2009-11716, Lake Buena Vista, FL, 2009.

A. Ajdari, B. H. Jahromi, H. Nayeb-Hashemi, A. Vaziri, "Energy absorbance and dynamic strength of regular, irregular and functionally graded cellular structures", Proc. ASME IMECE2009-10539, Lake Buena Vista, FL, 2009.

M.-W. Moon, A. Ajdari, A. Vaziri, "Sculpting on polymers with ion beam/plasma treatment: mechanics and mechanisms", Proc. ASME IMECE2009-10539, Lake Buena Vista, FL, 2009.

A. Ajdari, B.H. Jahromi, H. Nayeb-Hashemi, A. Vaziri, "Dynamic crushing of regular and functionally graded cellular structures", RICC 2009, Northeastern University, Boston, MA 2009.

B.H. Jahromi, A. Ajdari, A. Vaziri, "A numerical method for predicting elasto-plastic response of functionally graded materials", COMPLAS X (Int. Conf. Computational Plasticity), Barcelona, Spain, 2009.

A. Ajdari, B.H. Jahromi, H. Nayeb-Hashemi, A. Vaziri, "Dynamic crushing of regular and functionally graded cellular materials", USNCCM X, Columbus, OH 2009.

B.H. Jahromi, G. H. Farrahi, A. Ajdari, H. Nayeb-Hashemi, A. Vaziri, "Variable materials property method

for functionally graded materials", USNCCM X, Columbus, OH 2009.

S.C. Corbett, A. Ajdari, A.U. Coskun, H. Nayeb-Hashemi, "Effect of blood viscosity on thrombosis potential near a step wall transition", Proc. ASME SBC2009-205647, Lake Tahoe, CA, 2009.

A. Ajdari, H. Nayeb-Hashemi, P.K. Canavan, "Mechanical behavior of functionally graded 2-d cellular structures: A finite element study", Proc. ASME IMECE2008-66206, Boston, MA 2008.

A. Ajdari, P.K. Canavan, H. Nayeb-Hashemi, G. Warner, "Effect of defect on elastic/plastic and creep behavior of bone: a finite element study", Proc. ASME SBC2007-175843, Keystone, CO, 2007.

A. Ajdari, H. Nayeb-Hashemi, P.K. Canavan, "Effect of defect on elastic-plastic and creep behavior of cellular materials", Proc. ASME IMECE2007-42056, Seattle, WA 2007.

A. Ajdari, P.K. Canavan, H. Nayeb-Hashemi, " Effect of defect on elastic/plastic and creep behavior of bone: a finite element study", Research, Innovation and Scholarship Expo (RISE 2006), Boston 2006.

A. Marzban, A. Ajdari, G.M. Warner, P.K. Canavan, H. Nayeb-Hashemi, "The influence of muscle loadings on the density distribution of the proximal femur", Proc. ASME IMECE2006-14996, Chicago, Il, 2006.

Project Experience

Selected project experience is summarized below:

Billboard Fire Investigation

- Conducted a comprehensive structural assessment of an electronic display structure subject to fire. A combination of heat transfer model and structural analysis was performed to evaluate the structural integrity of a digital billboard due to an isolated fire in a single section. Analysis findings helped client with risk assessment and provided design change recommendations to mitigate the risk.

Railroad/Automotive

- Investigation of the derailment of a passenger train.

- Evaluation of the as-built configuration including the welds and bolted connections to identify the gaps compared to design specifications.

- Accident reconstruction using detailed finite element model and validating the results using the physical evidence.

Medical Device

- Fatigue life assessment of variety of medical devices by subjecting them to physiological loadings.

- Understand device failures and design margins and support clients with regulatory submission.

Oil and Gas / Industrial Equipment

- Fitness-for-service analysis

o Large-scale international arbitration involving numerous mechanical and materials claims related to a natural gas pipeline with excessive vibration due to design flaws. Work included analysis of the ASME Boiler and Pressure Vessel Code to determine design compliance.

- Portable pressure equipment:

o Review and assess of the mechanical design in accordance with applicable codes and industry standards. Specifically, engineering guidelines and requirements for safe design and construction of pressure equipment outlined in ASME Boilers and Pressure Vessel Code (BPVC) was considered. Additionally, related American Welding Society code (AWS D1.1) for steel structural welding and International Institute of Welding (IIW) recommendations for fatigue design of welded joints and components (IIW-1823-07) was considered.

- LNG Container:

o Large-scale international arbitration involving numerous mechanical and materials claims related to an LNG container.

o Evaluated the performance of the insulation panels in cryogenic condition and explored the failure modes of plywood sandwich panels.

o Engineering analysis to understand the root cause of crack formation in the insulation panels.

- Power Plant cooling system failure:

o Investigating the deformation and stresses of the coil assembly during a temperature surge and verifying the results with physical evidence post incident.

o Examined and studied the welds quality and showed the component performance with updated weld geometry.

- Turbomachinery:

o Large-scale international arbitration involving numerous mechanical and materials claims related to a fractured blade in turbomachinery component.

o Engineering analysis of the subject blade to evaluate the stresses and identify the weak spots in the design (crack initiation region).

Intellectual Property

- Participated in a patent infringement litigation related to multiple medical devices and consumer products.

Consumer Electronics

- Helped clients with mechanical modeling to improve product design:

o Root cause analysis

o DOE analysis / Sensitivity analysis

o Design evaluation and optimization

o Material selection

o Fracture modeling: material failure and damage propagation

Personal Injury

- Incident investigation.

- Identify the gaps in the workplace safety according to the applicable safety regulations.

- Engineering calculations to understand the underlying reason of the incident and identify the root cause.

Consumer Products

- Investigate the mechanical failure of variety of products including water heaters, expansion tanks, threaded pipe connection, air handler coils, PVC pipe connections, water meters, hoses with knitted reinforcements.

- Work involved inspection and examination of the subject product, optical microscopy, SEM and CT imaging and performing engineering analysis to form an opinion on the root cause of the product failure.

Peer Reviews

International Journal of Solids Structures

Journal of Diabetes Science Technology

Journal of Experimental Mechanics

International Journal of Mechanical Sciences

International Journal of Damage Mechanics

International Journal of Mechanics of Materials