Curriculum Vitae – Christopher J. Earls

a) Educational Background

Ph.D. in C.E. (Structural Engineering), 1995, University of Minnesota
Thesis Title: *"On the Use of Nonlinear Finite Element Analysis Techniques to Model Steel Angle Response"*
Advisor: Theodore V. Galambos
M.S.C.E. (Structural Engineering), 1992, Virginia Polytechnic Institute and State University
Thesis Title: *"Comparison of Nonlinear Finite Element Formulations: Applications to Trusses and Beams"*
Advisor: Siegfried M. Holzer
B.S.C.E., 1990, Virginia Polytechnic Institute and State University

b) Professional Positions Held

7/13 – present: Professor in the Department of Civil and Environmental Engineering, Cornell University, Ithaca, New York.

Graduate field membership: *Applied Mathematics, Theoretical and Applied Mechanics, Civil & Environmental Engineering.*

Graduate minor field membership: *Computational Science and Engineering, Applied Information Systems.*

7/13 – 6/14: Visiting Associate Professor in the Department of Mechanical Engineering, Johns Hopkins University, Baltimore, Maryland.

7/06 – 7/13: Associate Professor in the Department of Civil and Environmental Engineering, Cornell University, Ithaca, New York.

3/04 – 4/06: Chairman of the Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

9/02 – 7/06: Associate Professor in the Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

8/99 – 9/02: Assistant Professor in the Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

6/96 – 7/99: Assistant Professor in the Department of Civil and Mechanical Engineering, United States Military Academy, West Point, New York.

3/96 - 6/96: Structural Engineer / Finite Element Specialist, performing fatigue analyses, stability analyses, stress analyses, and thermal analyses of machine components utilized in state of the art silicone wafer processing equipment both in production and in development. FSI International, Chaska, Minnesota.

9/95 - 12/95: Instructor teaching senior level construction materials course at the University of Minnesota, Minneapolis, Minnesota.

6/95 - 3/96: Structural Engineer, designing crane systems, performing forensic engineering studies, evaluating and rehabilitating existing structures such as manufacturing plants and sign structures. AEC Engineering, Minneapolis, Minnesota.

Summer 1994: Stress analyst on underground fiber-reinforced plastic storage tanks and pressure vessels. Xerxes Corp., Bloomington, Minnesota.

c) Publications

Books and Chapters

i) Book Chapters

Earls, C.J. (2010) "Chapter 20 – Stability Analysis by the Finite Element Method," Guide to Stability Design Criteria for Metal Structures, 6th Edition, John Wiley & Sons, Inc.

Refereed Publications

ii) Refereed Journal Papers

Stephany, R., **Earls, C.J.** (2023) "PDE-LEARN: Using deep learning to discover partial differential equations from noisy, limited data," *Neural Networks*, IN REVIEW. [arXiv: 2212.04971]

Praveen, H., Boullé, N., Earls, C.J. (2023) "Principled interpolation of Green's functions learned from data," *Computer Methods in Applied Mechanics and Engineering*, Elsevier, Vol. 409, 115971, pp.1-22. [arXiv:2211.06299]

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Boullé, N., Earls, C.J., Townsend, A. (2022) "Data-driven discovery of Green's functions with human-understandable deep learning," *Scientific Reports*, Springer Nature, Vol. 12, No. 4824. [arXiv:2105.00266]

van Ede, M.S., **Earls, C.J.**, Fichtner, A., Angst, U. (2021) "Electrochemical tomography as a nondestructive technique to study localized corrosion of metals," *NPJ Materials Degradation*, Volume 5, No 58, Springer Nature.

Sit, H., **Earls, C.J.** (2021) "Deep learning for classifying and characterizing atmospheric ducting within the maritime setting," *Computers and Geosciences*, Vol. 157, Elsevier, 104919.

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Loeb, A., **Earls, C.J.** (2021) "Bayesian inference approaches for the detection and characterization of hidden pitting corrosion," *Mechanical Systems and Signal Processing,* Vol. 154, Elsevier, 107545.

Lin, Y.C., **Earls, C.J.** (2021) "Validation experiment of a single image sequence algorithm to identify scale and sea state characteristics," *IEEE Journal of Oceanic Engineering*, doi: 10.1109/JOE.2020.3045645.

Wu, W., Kosianka, J., Reed, H., Stull, C., **Earls, C.J.** (2020) "CU-BENs: a dedicated structural modeling finite element library," *SoftwareX,* Vol. 11, Elsevier, pp. 1-5.

Sit, H., **Earls, C.J.** (2020) "Gaussian process regression for estimating EM ducting within the marine atmospheric boundary layer," *Radio Science*, American Geophysical Union, Vol. 55, Issue 6, pp. 1-14.

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[§] **Earls, C.J.**, Shah, B.J. (2002) "High Performance Steel Bridge Girder Compactness," *Journal of Constructional Steel Research,* Elsevier Science Ltd., Great Britain, Vol. 58, pp. 859-880.

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iii) Conference Proceedings

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Earls, C.J., Shah, B.J. (2001) "Proportioning of High Performance Girders and Beams," *Proceedings of the Structural Stability Research Council Annual Technical Session,* Ft. Lauderdale, Florida, pp. 229-260.

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Earls, C.J., (2000) "A Study of Single Angle Major Principal Axis Flexure," *Proceedings of the Structural Stability Research Council Annual Technical Session,* Memphis, Tennessee, pp. 329-360.

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Earls, C.J., Galambos, T.V., (1997) "Effects of Material Properties on Single Angle Compactness Requirements," *Proceedings of the Structural Stability Research Council Annual Technical Session,* Toronto, Canada, pp. 39-54.

Earls, C.J., Galambos, T.V., (1996) "Proposed Design Specifications for Single Angle Flexural Members," *Proceedings of the Structural Stability Research Council Annual Technical Session,* Chicago, Illinois, pp. 145-154.

Earls, C.J., Galambos, T.V., (1995) "The Stability and Strength of Single Angle Beams," *Proceedings of the 5th International Colloquium on the Stability of Steel Structures,* Budapest, Hungary.

Earls, C.J., Galambos, T.V., (1995) "Compactness Requirements for Single Angles in Flexure," *Proceedings of the Structural Stability Research Council Annual Technical Session,* Kansas City, Missouri, pp. 127-135.

Non-Refereed Publications

i) Papers in Non-Refereed Conference Proceedings

Earls, C.J., (1998) "Modification of the DYNA 3-D Nonlinear Finite Element Program to Study the Effects of Sabot Petal Lift Off," *Proceedings of the Sixth Annual ARL / USMA Technical Symposium,* U.S. Army Research Laboratory, Aberdeen Proving Grounds, MD.

Earls, C.J., (1997) "Natural Frequency and Mode Shape Evaluation for the Study of Aeroelastic Phenomena in Extended Range Field Artillery Projectiles," *Proceedings of the Fifth Annual ARL / USMA Technical Symposium,* U.S. Army Research Laboratory, Aberdeen Proving Grounds, MD.

ii) Technical Research Reports

Yulismana, Y., Earls, C.J. (2005), "Evaluation of the Performance in Shallow Fiber Reinforced Polymer Deck Systems Acting Compositely with Steel I-Shaped Stringers," *Report No. CE/ST 30*, Department of Civil Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Earls, C.J., Kozy B. M., Boyle, R. L. (2005), "Buckling Strength of Circular Tubes in Sign Structures," *Report No. CE/ST 29*, Department of Civil Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Chavel B.W., Earls, C.J., (2004), "Deflection of Horizontally Curved I-Girder Bridge Members Under Construction," Report No. CE/ST 28, Department of Civil Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Aktas, M., Earls, C.J., (2004) "Ductility of I-Shaped Beams in Minor Axis Flexure" *Report No. CE/ST 27*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Claybaugh B., **Earls, C.J.,** (2003) "Fatigue and Strength Performance of Concrete Filled Steel Grid Deck Bridge Deck," *Report No. CE/ST 26*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Luo Y., **Earls, C.J.,** (2002) "The Composite Response Assessment of the Steel Stringer-FRP Deck System in the Boyer Bridge," *Report No. CE/ST 25*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

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Thomas, S.J., **Earls, C.J.,** (2002) "Cross Sectional Compactness and Bracing Requirements for HPS70W Girders," *Report No. CE/ST 22*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

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Earls, C.J., Johnston, T.R., (2001) "Behavior of Field Splice Details in Pre-Cast Concrete Filled Steel Grid Bridge Deck," *Report No. CE/ST 20*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Chaklos, J. M., **Earls, C.J.,** (2001) "Evaluation of Concrete Interfacial Bond Strength in Composite Floors," *Report No. CE/ST 19*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Chavel, B.W., **Earls, C.J.,** (2001), "Evaluation of Erection Procedures of the Curved Span of the Ford City Steel I-Girder Bridge," *Report No. CE/ST 18*, Department of Civil Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Earls, C.J., Shah, B.J., (2001) "Compactness and Bracing Requirements for Use in the Analysis and Design of High Performance Steel Highway Bridges," *Report No. CE/ST 17*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Earls, C.J., (2000) "Wire Rope Connection Evaluation and Testing," *Report No. CE/ST 16*, Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania.

Galambos, T.V., Hajjar, J.F., **Earls, C.J.**, Gross, J.L., (1997) "Required Properties of High - Performance Steels," NISTR 6004 *Report of Research Sponsored by the National Institute of Standards and Technology,* Gaithersburg, Maryland.

Earls, C.J., Pugh, A.D., Murray, T.M., (1991) "Strength Evaluation of Multispan C-Purlin Roof Systems Under Uplift Loading," *Report No. CE/VPI-ST-91/16* Structures and Materials Research Laboratory, The Charles E. Via Department of Civil Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Earls, C.J., Murray, T.M., (1991) "Cantilever Diaphragm tests -Whirlwind Steel Buildings," *Report No. CE/VPI-ST-91/07* Structures and Materials Research Laboratory, The Charles E. Via Department of Civil Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Earls, C.J., Pugh, A.D., Murray, T.M., (1991) "Base Test for Z-Purlin Under Gravity Load With SSR System," *Report No. CE/VPI-ST-91/08* Structures and Materials Research Laboratory, The Charles E. Via Department of Civil Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Hankins, S.C., **Earls, C.J.**, Easterling, W.S., (1991) "Sound Barrier Panel Tests," *Report No. CE/VPI-ST-91-14* Structures and Materials Research Laboratory, The Charles E. Via Department of Civil Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

iii) Invited Talks

Earls, C.,J., *"Gaining mechanistic insight through learning Green's functions: Uncovering the solutions to hidden PDEs,"* Scientific Computing and Numerics Seminar (SCAN), Cornell University, Ithaca, New York, September 26, 2022.

Earls, C.,J., *"Gaining mechanistic insight through learning Green's functions: Uncovering the solutions to hidden PDEs,"* Data Driven Physical Simulations (DDPS) Seminar Series, Lawrence Livermore National Laboratory, August 19, 2021.

Earls, C.,J., *"Inverse problems: background, theory, and applications,"* Institute for Building Materials, ETH Zurich, Zurich, Switzerland, November 11, 2019.

Earls, C.,J., *"Combining data with mechanism in constructing "grey box" models: towards a general theory,"* U.S. Army Research Laboratory Colloquia and Science Café series, Adelphi, Maryland, July 18, 2018.

Earls, C.,J., *"Perspectives on FSI coupling approaches: emphasis on Naval applications,"* Gerald R. Ford Presidential Library, University of Michigan, Ann Arbor, Michigan, July 19, 2016.

Earls, C.,J., *"Empirical eigenfunction surrogates as reduced order models in inversions,"* CNR-INSEAN, Rome, Italy, May 19, 2016.

Earls, C.,J., *"Data-driven simulation of RADAR propagation within the MABL,"* Scientific Computing and Numerics Seminar (SCAN), Cornell University, Ithaca, New York, October 6, 2014.

Earls, C.,J., *"Structural condition assessment and performance prognosis: Naval applications and beyond,"* Department of Mechanical Engineering, George Washington University, Washington, D.C, October 28, 2013.

Earls, C.,J., *"Inverse problems: background, theory, Naval applications,"* Naval Surface Warfare Center, Carderock Division, Code 65, Carderock, Maryland, October 24, 2013.

Earls, C.,J., *"Structural condition assessment: Bayes' Theorem, reduced-order models, and Riemannian geometry,"* Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, Massachusetts, September 23, 2011.

Earls, C.,J., *"Opportunities for model-based health monitoring in naval vessels,"* Committee on Naval Engineering in the 21st Century, U.S. National Academy of Science, June 10, 2010.

Earls, C.,J., *"Computational approaches for simulating transient response in solids and structures: blast, progressive collapse, and inverse problem solutions,"* Cornell University, Department of Theoretical and Applied Mechanics, February 20, 2008.

Earls, C.,J., *"A new direction in structural condition assessment and non-destructive evaluation…,"* The Johns Hopkins University, Department of Civil Engineering, November 29, 2005.

Earls, C.,J., *"A new direction in structural condition assessment and non-destructive evaluation…,"* Cornell University, Department of Civil and Environmental Engineering, October 28, 2005.

Earls, C.,J., *"Detailing and Constructional Issues Affecting the Erection of Curved Steel I-Girder Bridge Systems",* Carnegie Mellon University, Institute for Complex Engineered Systems, Pittsburgh, Pennsylvania, May 27, 2004.

Earls, C.J., "*Fatigue and Ultimate Resistance Testing of Filled Steel Grid Decks,"* American Society of Civil Engineers – Pittsburgh Section, Structures Group, Pittsburgh, Pennsylvania, April 2004.

Earls, C.J., "*Fatigue and Ultimate Resistance Testing of Filled Steel Grid Decks,"* AASHTO T-14 Meeting, American Iron and Steel Institute – Bridge Task Force Meeting, Austin, Texas, August 7, 2003.

Earls, C.J., "*Web-tapered Member Flexural Response,"* Meeting of the Technical Committee, Metal Building Manufacturers Association, Cleveland, Ohio, July 16, 2003.

Earls, C.J., "*Compactness and Bracing Requirements for High Performance Steel Beams,"* American Society of Civil Engineers – Pittsburgh Section, Structures Group, Pittsburgh, Pennsylvania, April 2003.

Earls, C.J., "*Construction and Detailing in a Horizontally Curved Steel I-Girder Bridge: Case Study,"* Federal Highway Administration 36th Annual Quality Assurance Workshop, Charleston, West Virginia, February 2003.

Earls, C.J., "*Web Tapered Member Design,"* Metal Building Manufacturers Association Research Symposium, Cleveland, Ohio, February 2001.

Earls, C.J., "*Single Angle Major Axis Bending,"* Meeting of the Committee on Compression and Flexural Members, 1999 ASCE Structures Congress, New Orleans, Louisiana, April 1999.

Earls, C.J., "*Finite Element Modeling of 120mm Tank Gun Projectiles,"* Benet Labs, Watervliet Arsenal, Troy, New York, April 1999.

Earls C.J., "*Stress Softening in Kinetic Energy Type Armor Defeating Tank Projectiles,"* Benet Labs, Watervliet Arsenal, Troy, New York, December, 1998.

d) Externally Funded Research Proposals

Earls, C.J. *The Scientific Artificial Intelligence (SciAI) Center*

Funding Agency:	Office of Naval Research, ONR
Period of Support:	September 1, 2023 to August 31, 2028
Level of Support:	$11,336,724
PI:	**Earls, C.J.**
Co-I:	Bouklas, N.

Co-I: Damle, A.
Co-I: Townsend, A.

Brief Summary: The SciAI Center's research focus is on developing pioneering AI methods and approaches that facilitate human-machine partnerships: to push the frontiers of scientific discovery and enable the development of unprecedented technological advancements. Mathematics has been identified as the common language underpinning the envisioned partnership, but this choice has deeper motivations.

Mathematics is the language of the natural laws that, with great precision, describe our universe. The associated governing equations are then the syntax for our predictive theories. By creating novel AI architectures, that reason in terms of sophisticated mathematics, we facilitate both the machine's ability to learn about the world, and also its ability to communicate back to us what it has discovered; while at the same time opening the door to theoretical understanding of how and why the machine is able to learn what it does from data that are too complex for human interpretation.

The SciAI Center is also a community of researchers who share a common interest in carefully studying the scientific questions that emanate from a consideration of the foregoing. The community members that we have assembled are select mathematicians, computer scientists, and engineers; all having a deep interest in how applied mathematics can facilitate our theoretical and practical understanding of novel SciAI systems and architectures. Our community is also deeply curious about the interplay between scientific data and learning: a topic at the heart of SciAI. As a community, we are committed to helping underrepresented student groups gain access to our leading-edge discoveries and emerging tools. We see this access as pivotal to increasing interest in STEM fields, and enhancing retention. Additionally, we believe that by exposing our student cohorts to new methods and techniques, we will instill skills that create avenues to future, professional opportunities.

Earls, C.J. *Mathematical understanding of emergent behaviors within complex AI systems*
Funding Agency: Office of Naval Research, ONR
Period of Support: September 1, 2023 to August 31, 2028
Level of Support: $844,960
PI: **Earls, C.J.**
Brief Summary: This research uses mathematical formalism to precisely describe emergent phenomenology displayed by Transformer large language models, at the small-, medium-, and large-scales of the underlying architecture.

Earls, C.J. *Uncovering mathematical insights into the human gut microbiome*
Funding Agency: Army Research Office, ARO
Period of Support: June 1, 2023 to April 30, 2027
Level of Support: $889,178

PI: **Earls, C.J.**
Co-I: Brito, I.
Brief Summary: This research develops and applies novel machine learning architectures, that are well suited to *operator learning*, in order to offer unprecedented insights into the population dynamical system responses at work within communities of fermenters, present within the human gut microbiome.

Earls, C.J. *Exploring the promise of AI to revolutionize science and engineering: planning grant*
Funding Agency: Office of Naval Research, ONR
Period of Support: September 21, 2022 to August 31, 2023
Level of Support: $174,716
PI: **Earls, C.J.**
Brief Summary: Artificial Intelligence (AI) holds great promise for revolutionizing scientific discovery and enabling the engineering of unprecedented technologies. While existing AI tools have profoundly impacted our day-to-day lives (within the spheres of finance, consumer experience, entertainment, travel, *etc.*), to realize an AI enabled revolution in science and engineering will require ground breaking advances that pioneer fundamentally new AI approaches, that are interpretable to humans, and useful within "high regret" contexts.

Earls, C.J. *Scientific machine learning enabled next generation design: application to bond lines in soft materials*
Funding Agency: Office of Naval Research, ONR
Period of Support: January 1, 2022 to December 31, 2025
Level of Support: $592,752
PI: **Earls, C.J.**

Brief Summary: We propose to employ machine learning within a revolutionary framework of model discovery that combines clear box and black box modeling aspects in a way that uncovers new engineering theories from mechanistic insight into complex systems. The new mathematical models, that the proposed method finds, will appeal to an engineer's intuition and be amenable to the application of engineering judgment. We do this by learning partial differential equations (PDE), as well as associated solution operators (*e.g.* Green's functions.) The structure of the PDE and Green's functions discovered with the proposed method will offer deep and important clues regarding the mechanics of adhesive bond lines. Such mechanistic insight will be of great value and utility to domain experts when they design experiments and make performance predictions.

Earls, C.J. *Deep learning strategies for identifying and characterizing EM ducts within the marine atmospheric boundary layer*
Funding Agency: Office of Naval Research, ONR
Period of Support: January 10, 2019 to January 11, 2022
Level of Support: $406,723

PI: **Earls, C.J.**

Brief Summary: The goal of the research project is to apply state of the art deep learning methods (*e.g.* convolutional neural networks (CVNs), transfer learning CVNs, and deep neural networks) to the data-driven MABL duct height inversion problem. Preliminary work done in the PI's group indicates that these approaches are immensely promising for inferring MABL duct heights: offering speed, accuracy, precision, and robustness to noise.

Earls, C.J. *Towards an accurate and useful engineering theory on slamming emanating from partitioned CU-BEN / OpenFOAM Simulations*

Funding Agency: Office of Naval Research, ONR
Period of Support: January 19, 2019 to January 22, 2022
Level of Support: $423,299
PI: **Earls, C.J.**

Brief Summary: This three year research effort aims to arrive at an accurate and useful general engineering theory pertaining to slamming in high speed hull forms of all sizes and configurations. The time is right for such an undertaking, as modern computational approaches and hardware capabilities have advanced to a stage where computational simulation can afford needed insight into the slamming phenomenon. Such insight is required in order that tentative theoretical descriptions might be arrived at to guide a program of strategic experimentation, so that the tentative theories may be refined, extended, and subsequently validated. The latter theoretical validation hinges on the availability of a high fidelity "computational microscope" in order that the slamming phenomenon might be initially studied in unprecedented detail; in order that a subsequent theoretical description might be arrived at to guide experimental design, and to serve as the point of departure for subsequent theoretical refinements. Once the tentative theory is in place, strategic experimentation (as informed by the "computational microscope") can be carried out in order that refinements can be made, and the resulting theory validated.

Earls, C.J. *Hybrid mechanistic, data-augmented modeling as a common language in Biomathematics*

Funding Agency: Army Research Office, ARO
Period of Support: June 15, 2018 to June 14, 2022
Level of Support: $694,044
PI: **Earls, C.J.**

Brief Summary: In classical domain science, there have been two very different approaches taken to modeling physical systems: 1) through mechanistic (clear box/white box) models …leveraging a strong theoretical foundation (expressed as PDE strong and weak forms, systems of ODEs, *etc.*); or 2) through data-driven (black box) models …using direct observations of the system response (expressed within software, as data models that employ statistics, machine learning, *etc.*) This work pursues a novel approach to "grey box" modeling that offers a principled mathematical foundation, that at once admits the

encoding of *salient physics*, while also possessing a *data-inspired mathematical form*; thus leading to a hybrid modeling approach conducive to spanning disciplinary domains within the basic and applied sciences.

Earls, C.J. *Development of Characterization of Failure Modes for Mechanical Components: STTR Phase II*
Funding Agency: Weidlinger Technology Ventures
Period of Support: April 1, 2018 to February 15, 2021
Level of Support: $448,500
PI: **Earls, C.J.**
Brief Summary: Identify salient design features leading to satisfactory component performance within engineered systems of interest. Perform sensitivity study on these features to determine relative importance of each in achieving a satisfactory certification outcome. Explore methods for compressing and/or abstracting the salient elements of the feature space into reduced set of components in order that compressed presentations might be expressed as abstract mathematical entities on general nonlinear spaces. Formulate principled approaches for forming clusters within certification data, along with the means to "interpolate" between certification data instances, expressed as points on these nonlinear spaces. Given the proposed abstract representation of existing data on certified engineered artifacts, measures of "nearness" and characterization of "best approximation" become possible in terms of the semantically rich, reduced representation; thus enabling the clustering and "interpolation."

Earls, C.J. *Characterizing and filtering naturally occurring magnetohydrodynamic signatures in coastal oceanic flows*

Funding Agency: Office of Naval Research, ONR
Period of Support: June 1, 2016 to May 31, 2018
Level of Support: $150,000
PI: **Earls, C.J.**

Brief Summary: An analytical research program is pursued. It aims to develop novel, physics-inspired approaches to EM signature extraction that are informed by field and experimental magnetohydrodynamic data. The proposed approach seeks to characterize and accurately describe naturally occurring EM signatures that accompany coastal oceanic flows, so that these may be differentiated from other signals of interest.

Earls, C.J. *Rigorous and robust partitioned fluid-structure interaction with CU-BEN and OpenFOAM*
Funding Agency: Office of Naval Research, ONR
Period of Support: November 1, 2015 to December 31, 2018
Level of Support: $576,917
PI: **Earls, C.J.**

Brief Summary: This research brings together a state-of-the-art partitioned fluid structure interface (FSI) infrastructure, built using CU-BEN and

OpenFOAM. The required coupling of the codes will be achieved by through two complementary efforts: 1) an effort leveraging CU-BEN against existing software infrastructure available at NSWCCD, for coupling various modest capability computational structural dynamics solvers (CSD) with OpenFOAM, via a communications interface written in Python, and 2) a parallel effort aimed at incorporating CU-BEN directly into the OpenFOAM API framework, through the incorporation of a new set of OpenFOAM classes. Within this proposed project scope, all new FSI modeling capabilities will be verified against closed form solutions, and then validated though comparisons to experimental efforts being carried out by others.

Earls, C.J. *Data-driven inversion in identifying and characterizing EM ducts within the marine atmospheric boundary layer*
Funding Agency: Office of Naval Research, ONR
Period of Support: January 16, 2016 to December 31, 2018
Level of Support: $374,089
PI: **Earls, C.J.**

Brief Summary: As part of an earlier grant, the PI has developed a data-driven, faster-than-real-time inversion framework to detect and characterize the presence of such ducting within novel marine atmospheric boundary layer (MABL) environments. This data-driven framework has been demonstrated on realistic surrogate data that is consistent with real-world contexts: yielding quick and accurate inversions for detection and characterization of MABL ducting. The goal of this research project is to build on the PI's new data driven framework to: 1) demonstrate its efficacy using real-world data; 2) optimize sampling strategies and MABL library organization; 3) test an extension of the method for use with clutter return data (i.e. as a novel refractivity from clutter (RFC) method); 4) extend the method even further, to work with fixed transmitter (Tx) / Receiver (Rx) scenarios; and to 5) enhance robustness of the method, by leveraging other EM sources, and frequencies, as a means for enhancing accuracy in the method's predictions.

Earls, C.J. *Stochastic inversion framework for monitoring evolving surface ship mass properties during Arctic operations*
Funding Agency: Office of Naval Research, ONR
Period of Support: July 14, 2014 to September 30, 2017
Level of Support: $395,000
PI: **Earls, C.J.**
Brief Summary: This basic research effort will focus on the development of a flexible and robust inverse solution methodology aimed at combining onboard motion package telemetry with the best available ship motion prediction codes so that inversion for real time ship mass properties may be realized. Such ship motion prediction capabilities are important within operational and recoverability contexts. As part of the proposed research effort, an icing model will be developed through consideration of existing tools for ice accretion prediction, along with enhancements resulting from careful study of the unique

climatological challenges facing surface combatants operating within Arctic waters, such that these conditions may be encoded within the proposed computational simulation framework that models the effects of ice accretion on seakeeping and vessel stability. This ice accretion prediction capability will be coupled with the relevant ship motion prediction code, as part of the Bayesian likelihood function mentioned earlier. When the resulting likelihood is combined with the prior probability density function, the resulting joint posterior distribution may be explored through dependent sampling strategies such as Markov chain Monte Carlo (MCMC) methods: the approach to be pursued in this proposed work.

Earls, C.J. *Partitioned fluid structure interaction simulation capability with CU-BEN and NFA*
Funding Agency: Office of Naval Research, ONR
Period of Support: January 13, 2014 to December 12, 2017
Level of Support: $345,000
PI: **Earls, C.J.**
Brief Summary: This research project represents an important step toward the complete realization of an unprecedented modeling and simulation capability for coupled FSI problems. The coupling of CU-BEN with NFA will enable a whole host of "what ifs" to be considered during the design evolution of the next generation of surface combatants. The vision of transitioning from simple panel testing to hull bending, whipping and slamming simulation, and on through to full-scale simulation in blue water battlespace contexts begin with the enhanced coupling proposed in this document.

Earls, C.J. *Data-driven simulation of RADAR propagation within the marine atmospheric boundary layer*
Funding Agency: Office of Naval Research, ONR
Period of Support: January 1, 2013 to December 31, 2015
Level of Support: $323,712
PI: **Earls, C.J.**
Brief Summary: The goal of the proposed research is to develop novel, data-driven, faster than real time approaches for simulating the complex effects of the marine atmospheric boundary layer on RADAR propagation.

Earls, C.J. *Enabling next generation hull design with a CU-BEN to NFA coupling*
Funding Agency: Office of Naval Research, ONR
Period of Support: May 15, 2012 to May 14, 2013
Level of Support: $75,000
PI: **Earls, C.J.**
Brief Summary: The proposed research work represents a critical first step in establishing an unprecedented level of modeling sophistication and fidelity, as an integral part of the design cycle. The project is a 12 month applied research effort aimed at coupling two highly capable simulation tools in order to create an initial capability for fluid structure interaction (FSI) simulation.

Earls, C.J. *Advanced simulation capabilities in support of sonar-based SHM and next generation design*
Funding Agency: Office of Naval Research, ONR
Period of Support: October 1, 2011 to September 30, 2014
Level of Support: $476,318
PI: **Earls, C.J.**
Brief Summary: The proposed research will bring the multi-year CU-BEN / CU-PSST development effort to a point where it will be possible to demonstrate the power of the hull structure health monitoring approaches vigorously developed by the PI's team to date. Additionally, the present project will leave the codes positioned for the next stage of development: implementation of enhanced, data-driven reduced order modeling strategies.

Earls, C.J., Philpot, W. D, Zehnder, A. T., *Thermal imaging of nascent stage cracks in metal components*
Funding Agency: Office of Naval Research, ONR
Period of Support: May 1, 2009 to April 31, 2010
Level of Support: $76,705
PI: **Earls, C.J.**
Brief Summary: The proposed research seeks to employ thermal imaging techniques as a means for searching for early stage cracking over a relatively large metal component area (*i.e.* length scale differences of six orders of magnitude, between the crack and the component). The techniques underpinning this work come from the areas of: remote sensing, pattern recognition, machine learning, inverse problems, computational mechanics, and high performance scientific computing.

Earls, C.J., Koutsourelakis, P-S, *Parallel stochastic search and reduced order modeling strategies in support of hull structure health monitoring*
Funding Agency: Office of Naval Research, ONR
Period of Support: April 4, 2009 to September 30, 2011
Level of Support: $296,871
PI: **Earls, C.J.**
Brief Summary: This research project supports the vision of a real-time decision support framework through the development of a parallel stochastic search capability. Such a capability is intended to enhance the practicality of model-based hull structure health monitoring approaches in order that the vast and complicated parametric space of model instances may be searched in a principled and rational manner. The methods emanating from the proposed work will leverage techniques from Bayesian statistics, machine learning, reduced order modeling, and scientific computing in pursuit of an efficient examination of the parameterized model space. As software design is a critical element of the proposed work, the development of a multi-purpose parallel stochastic search toolbox (CU-PSST) is an important deliverable of the project.

Earls, C.J. *Hull structure health monitoring theoretic for decision support*

Funding Agency: Office of Naval Research, ONR
Period of Support: April 4, 2007 to April 4, 2009
Level of Support: $214,453
PI: **Earls, C.J.**
Brief Summary: This project focuses on the formulation and development of a decision support framework that employs techniques from structural health monitoring and computational mechanics to provide a quantifiable, semantically rich data stream related to current hull conditions for the purposes of condition assessment and prognostication.

Harries, K.A., **Earls, C.J.** *Full-scale testing program on decommissioned girder from the Lake View Drive Bridge over I-70.*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: February 1, 2006 to September 1, 2006
Level of Support: $213,477
PI: Harries, K.H.
Brief Summary: The primary activity of the proposed project is to conduct two full-scale "proof" tests on girders removed from the decommissioned Lake View Drive Bridge over I-70; outside of Pittsburgh. The tests will represent one interior and one exterior girder, respectively. The objective of this test program is to assess the behavior of such box girders, accounting for their deteriorated condition, in order to arrive at adequate rating factors for similar bridges that remain in service and to develop observations useful in assisting bridge inspection of similar structures. By testing one interior and one exterior girder, the effect of the eccentric barrier wall loading on girder capacity may be determined.

Earls, C.J., Akinci, B. *Safety Assessment of Steel Bridges Damaged by Truck Strikes.*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: February 1, 2005 to February 1, 2007
Level of Support: $302,178
PI: **Earls, C.J.**
Brief Summary: The occurrence of impacts involving over-height trucks with the underside of steel bridge overpass superstructures is not an altogether uncommon occurrence. The circumstances following such an accident are problematic for decision makers needing to protect the public safety and preserve interstate commerce. Should the damaged structure be closed, posted with a vehicular load limit, or simply left open to normal traffic? Such questions are not currently answerable on reasonable time scales. The present research will remedy this unsatisfactory situation. Through the deployment of state-of-the-art laser scanning technology and robust image processing techniques, the actual post incident geometry of the damaged structure can be precisely determined in order that a sophisticated nonlinear finite element models of the structure may be constructed very quickly. The finite element models then permits a virtual "load test" to be conducted in order than the reserve capacity of the damaged bridge may be ascertained, with a very high degree of accuracy, in a matter of hours instead of weeks.

Kontz, A.M., Cooper, R.A., **Earls, C.J.,** *Finite Element Model of the Shoulder for Detecting Mechanisms of Injury Among Wheelchair Users*
Funding Agency: U.S. Department of Veterans Affairs
Period of Support: April 1, 2004 – August 31, 2005
Level of Support: $100,000
PI: Koontz, A.M.
Brief Summary: We propose to develop a musculoskeletal model consisting of finite elements and realistic mechanical parameters to study stress and strain on the intrinsic structures of the shoulder during daily activities such as wheelchair propulsion and transfers. The model will incorporate a variety of bone geometries to match the individual's morphology.

Earls, C.J., *Extension of Monitoring on an Existing IBRC Bridge Project.*
Funding Agency: Federal Highway Administration
Period of Support: July 1, 2003 to September 30, 2004
Level of Support: $100,110
PI: **Earls, C.J.**
Brief Summary: The proposed project is aimed at extending the field monitoring efforts already underway on the FRP deck of the Boyer Bridge in Butler County within PennDOT Engineering District 10-0 (as partially funded by an FY02 IBRC award). In addition, a synthesis of results from the field testing of other similar FRP deck installations (also funded by the IBRC program) will be undertaken as part of the proposed work. The end-state of the proposed FY03 project is a formal, well documented, proposal for recommended FRP deck design provisions applicable within the context of the AASHTO LRFD Specification.

Earls, C.J., *Buckling Strength of Circular Tubes in Sign Structures.*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: September 1, 2003 to January 31, 2004
Level of Support: $161,999
PI: **Earls, C.J.**
Brief Summary: The proposed research will study the relevant tri-chord sign structure connection details extensively. A carefully crafted finite element based investigation supplemented by a program of experimental testing of full-scale tri-chord sign structure components and sub-assemblies are the heart of the work proposed herein. The outcome of the proposed research effort is a practical capacity equation for presentation to AASHTO for inclusion in the *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Earls, C.J., *Deflection of Horizontally Curved I-Girder Bridge Members Under Construction.*
Funding Agency: Federal Highway Administration
Period of Support: November 1, 2002 to December 25, 2003
Level of Support: $88,448

PI: **Earls, C.J.**
Brief Summary: Very little research is currently available in relation to issues of curved steel I-Girder constructabililty. The proposed research, outlined herein, hopes to address this shortcoming in the research literature related to horizontally curved steel I-girder bridge construction by undertaking a carefully crafted program of study focusing on an actual field installation. Field monitoring of the erection sequence employed during the construction of a subject bridge superstructure will be performed. Furthermore, detailed finite element modeling of individual components, as well as subassemblies, will also be carried out for the purposes of drawing a comparison between modeled bridge response and actual field response measurements.

Such research will lead to verified modeling techniques that may be promulgated as a minimum standard for proper erection sequence simulation when arriving at a tractable erection scheme. Furthermore, verified models of curved girder bridge installations will provide a framework upon which parametric studies may be carried out for the purposes of identifying parametric combinations (such as span length, girder spacing, radius of curvature, super- elevation, skew angle, etc.) that may lead to problems in superstructure constructability.

Earls, C.J., *Evaluation of Strength and Fatigue Performance in Shallow Fiber Reinforced Polymer Deck Systems Acting Compositely with Steel I-Shaped Stringers*
Funding Agency: Martin Marietta Composites
Period of Support: September 1, 2003 to August 31, 2004
Level of Support: $41,565
PI: **Earls, C.J.**
Brief Summary: It has been shown in earlier research that fiber reinforced polymer bridge deck systems attached to the underlying steel superstructure enjoy full composite behavior at service conditions (Keelor et al. 2002). This conclusion is based on the results from a series of load tests carried out on existing field installations employing FRP decks attached to steel stringers with headed shear studs (Keelor et al. 2002) as well as the results from a series of laboratory push-off tests (Moon et al. 2002, Turner and Harries 2002). The accumulated data related to FRP composite action with the underlying steel superstructure has been based on field and laboratory testing of 8” deep bridge decks. The current project is aimed at providing complimentary data for a new 5” deep FRP bridge deck design. In addition to effective width behavior associated with the new 5” deck design, fatigue performance is also important to quantify. Current 8” FRP deck designs have demonstrated satisfactory fatigue resistance under laboratory conditions (Moon et al. 2002), and what is sought is similar characterization of fatigue performance with the new, shallower deck. However, a more realistic context for fatigue testing is sought as compared with that used in the experiments of Moon et al. (2002). In these experiments, unintended deflections within the load frame may have contributed to the development of unrealistic secondary forces that may have contaminated the test results to some unknown degree.

Earls, C.J., *Design Recommendations for the Proportioning and Detailing of Long-Span Tri-Chord Sign Structures, Phase I*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: October 8, 2001 – June 8, 2002
Level of Support: $36,619
PI: **Earls, C.J.**
Brief Summary: The Bridge Quality Assurance Division of the Bureau of Design has expressed concern that the current tri-chord sign structure design standards in place are not safe and economical when applied to long-span sign structures. This sentiment comes on the heals of a recent failure in PennDOT District 6 in which a tri-chord sign structure with a 180' span experienced a crushing failure at the column connections during final erection: a similar sign structure (with a 140' span) was scheduled to be erected in District 12 shortly thereafter. As result of the failure in District 6, the District 12 job was delayed while modifications were made to the connection region details. The resulting design retrofit consisted of a "brute-force" approach to the problem in that large, solid steel saddles where fabricated and placed on the column tops. In addition, the chord members in contact with the column tops were filled with non-shrink grout. While a design approach such as this may prove successful in the short term, it does not represent an adequate long-term solution.

Earls, C.J., *Boyer Bridge Fiber Reinforced Polymer Deck Field Monitoring*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: July 30, 2001 – November 29, 2002
Level of Support: $162,590
PI: **Earls, C.J.**
Brief Summary: The Boyer Bridge over Slippery Rock Creek in PennDOT Engineering District 10 has been selected to serve as the demonstration bridge for a new FRP deck design that provides for some level of composite action with the steel stringers used in the superstructure. The compositeness is achieved by providing square cut-outs in the FRP deck, spaced two feet on center, to accommodate shear studs that are welded to the top flange of the steel stringers. Non-shrink grout is injected in the cut-outs, and around the shear studs, so as to create a positive mechanical connection between the FRP deck and the steel stringers. While the FRP deck manufacturer recognizes that some composite behavior exists in such an FRP installation, a definite percentage of full compositeness is not given due to lack of test data. The present research project will provide further data from which to ascertain composite participation of the FRP deck in load resistance as well as how this compositeness might change over time due to traffic loading as well as environmental loading (i.e. seasonal temperature changes, etc.)

Earls, C.J., *Evaluative Testing of a Novel Weldless Steel Open Grid Floor System*
Funding Agency: Stargrate Systems Incorporated
Period of Funding: November 1, 2000 - October 31, 2001

Level of Support: $14,561
PI: **Earls, C.J.**
Brief Summary: Experimental testing and validation of an innovative open grid deck system is the goal of this research. The fatigue resistance and ultimate strength of the new grid deck will be studied in this research.

Earls, C.J., *Pilot Study in the Pursuit of Revisions to the Web-Tapered Member Flexural Design Provision Contained in Appendix F of the AISC-LRFD Specification*
Funding Agency: Metal Building Manufacturers Association
Period of Support: December 1, 2000 - November 3, 2002
Level of Support: $27,138
PI: **Earls, C.J.**
Brief Summary: The proposed research project will serve as a pilot study aimed at carefully studying the unique behavioral features associated with web-tapered member flexural response. Validated nonlinear finite element modeling techniques will be employed in the study of web-tapered beam limit states. The evolution of the governing limit states, as well as any coupling and interaction between limit states, will be rigorously examined as part of this study. Results from this work will provide insight into the type of full-scale experimental program deemed necessary to bolster the finite element results required for credibility in the proposal of any changes to the AISC Appendix F web-tapered member flexural provisions.

Earls, C.J., *Optimization of Concrete Filled Grid Deck Design Standards*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: December 21, 2000 – March 18, 2003
Level of Support: $157,042
PI: **Earls, C.J.**
Brief Summary: This project is unique in its impact on Pennsylvania in that there are only three grid fabricators in the U.S. and they are all in Southwestern Pennsylvania. Unfortunately, the last significant application of filled grid in PA was the re-decking of the Smithfield Street Bridge in Pittsburgh in 1995. The proposed research would allow for the more rational, safe, and economical extension of PennDOT design provisions so as to allow for a more optimized usage of grid deck in PennDOT's bridge facilities. Such an outcome would be beneficial to the local economy while at the same time providing PennDOT with a very high quality decking option for the future. The research partnership between the University of Pittsburgh and PennDOT District 12 also represents an important milestone in the research process.

Earls, C.J., *Use of High Performance Steel In Rehabilitation of the National Infrastructure.*
Funding Agency: Oak Ridge Associated Universities
Period of Support: July 2000 – July 2001
Level of Support: $10,000
PI: **Earls, C.J.**

Brief Summary: This peer reviewed grant is awarded in support of my ongoing research in the area of computational modeling of high performance steel buildings and bridges. An engineering workstation will be purchased with the funds.

Earls, C.J., Stapf, P., *Bracing and Diaphragm Requirements for HPS70W Steel Highway Bridges*
Funding Agency: Federal Highway Administration
Period of Support: September 2000 – August 2002
Level of Support: $95,000
PI: **Earls, C.J.**
Co-PI: Stapf, P.
Brief Summary: Field testing and finite element study of an existing two-span continuous high performance steel highway bridge is carried out so as to develop rational bracing requirements for inclusion in bridge specifications. Currently, bridge specification provisions are extremely conservative with regards to bracing requirements for high performance steel bridges. This work will help alleviate economic penalties deriving from this conservatism.

Earls, C.J., *Evaluation of Alternative Erection Schemes in the Ford City Bridge Type*
Funding Agency: Pennsylvania Department of Transportation
Period of Support: July 1, 2000 – January 9, 2002
Level of Support: $81,653
PI: **Earls, C.J.**
Co-Investigator: Sause, Richard (Lehigh University)
Brief Summary: The goal of this project is to identify, study, and provide strategies for the mitigation of constructional limit states in large, multi-span high performance steel bridges so as to preserve the economic viability of this bridge type for the future. Cost savings on material must not be supplanted by increased construction costs due to excessive deflections during erection.

Earls, C.J., *Epic Metals Corporation Equipment Grant*
Funding Agency: Epic Metals Corporation
Period of Funding: April 2000 – March 2001
Level of Support: $13,000
PI: **Earls, C.J.**
Brief Summary: The grant provides for the purchase of a testing machine and loading device in support of the project "*Evaluation of Concrete Interfacial Bond Strength in Composite Floors"* sponsored by the Steel Deck Institute. In addition the grant supports several undergraduate research assistants.

Earls, C.J., *Evaluation of Concrete Interfacial Bond Strength in Composite Floors*
Funding Agency: Steel Deck Institute
Period of Funding: June 2000 – May 2001
Level of Support: $30,594

PI: **Earls, C.J.**
Brief Summary: The purpose of this research program is to perform full scale structural tests of composite floor systems so as to quantify the concrete/steel interfacial bond strength evolution as a function of time and concrete mix design.

Earls, C.J., *Wire Rope Connection Evaluation and Testing*
Funding Agency: SMG Incorporated
Period of Funding: February 2000 – March 2000
Level of Support: $11,627
PI: **Earls, C.J.**
Brief Summary: The purpose of this research program is to perform full scale structural tests of wire rope connection details for the purpose of evaluating the need for periodic maintenance and retightening of U-bolt connectors in the connection details.

Earls, C.J., Manglesdorf, C.P., *Testing and Evaluation of a new Pre-cast Concrete Filled Grid Deck Field Splice*
Funding Agency: Bridge Grid Floor Manufacturers Association
Period of Funding: January 2000 – September 2000
Level of Support: $25,437
PI: **Earls, C.J.**
Co-PI: Manglesdorf, C.P.
Brief Summary: Experimental testing and validation of an innovative concrete filled grid deck system for use in bridge construction is the goal of this research. The composite behavior, fatigue resistance, and ultimate strength after damage of the new grid deck will be studied in this research.

Earls, C.J., Nadratowski, T., *Compactness and Bracing Requirements for Use in the Analysis and Design of High Performance Steel Highway Bridges*
Funding Agency: Federal Highway Administration
Period of Support: September 1999 – August 2001
Level of Support: $93,000
PI: **Earls, C.J.**
Co-PI: Nadratowski, T.
Brief Summary: The project involves the field testing and finite element modeling of several new high performance steel highway bridges so as to obtain necessary insights needed to modify existing bridge specifications in order that new modern steel types may be used more efficiently.

Earls, C.J., *Finite Element Modeling of 120mm Tank Gun Projectiles*
Funding Agency: U.S. Army, Benet Labs, Watervliet Arsenal
Period of Support: November 1998 - September 1999
Level of Support: $14,000
PI: **Earls, C.J.**

Brief Summary: An effort to model entire battlefield systems, such as the M1-A2 US main battle tank, has led to intensive efforts by the Army to support research aimed at integrating advanced modeling tools for the solution of complicated problems. This research provides valuable information needed to quantify how the tank-gun projectile, moving down the gun bore during firing, influences the structural response of the gun-tube itself. Such information will lead to more robust fire control algorithms to be developed thus improving tank gun accuracy and hence this battle systems lethality.

Earls, C.J., *Finite Element Modeling of Sabot Separation in 120mm Tank Gun Projectiles*
Funding Agency: Army Research Labs, Weapons Technology Directorate
Period of Support: January 1998 - December 1998
Level of Support: $15,000
PI: **Earls, C.J.**
Brief Summary: This research is used to help extend the capabilities of the commercial finite element program DYNA3D to address the salient features of the structural response, during sabot petal lift off, which impact on the flight dynamics of the armor defeating penetrator.
In this work, an algorithm is developed to identify the active aerodynamic faces of continuum elements which are used to model the sabot petal. The normals to these faces are also computed so that aerodynamic drag forces may be imposed on the element face. This aerodynamic force will change as the normal changes its angle of attack with the air-stream surrounding the projectile. A change in angle of attack occurs from one time increment to another during the analysis.

Earls, C.J. *On the Effects of Aeroelastic Phenomena in Extended Range Field Artillery Projectiles*
Funding Agency: Army Research Labs, Weapons Technology Directorate
Period of Support: January 1997 - August 1997
Level of Support: $15,000
PI: **Earls, C.J.**
Brief Summary: A comprehensive investigation of the free vibratory response of the developmental projectile known as the *ERP* is presented. Both closed form differential equation and finite element type solutions are considered and compared.

Earls, C.J. *Finite Element Modeling of 120mm Tank Gun Projectiles*
Funding Agency: U.S. Army, Benet Labs, Watervliet Arsenal
Period of Support: March 1997 - September 1998
Level of Support: $5,000
PI: **Earls, C.J.**
Brief Summary: Kinetic Energy type anti-tank munitions fired from the 120mm main gun of the M1-A2 US main battle tank experience peak accelerations of 1000 g's. Such accelerations as these result in enormous inertial forces that act on the long, slender penetrators. These inertial forces are sufficiently close to the buckling load as to produce significant stress-softening of

the penetrator. This softening leads to degradation in gun accuracy. The present study formulates and solves this problem in closed form. Results are discussed in terms of mitigating these unwanted effects.

e) Listing of Courses Taught

Inverse Problems: Theory and Applications (CEE5745/6745, Cornell University)
Spring 2023 - One section of 10 graduate students, plus 5 undergraduates

Mathematical Modeling of Natural and Engineered Systems (CEE5735/6736, Cornell University)
Fall 2022 - One section of 10 graduate students, plus 3 undergraduates

Inverse Problems: Theory and Applications (CEE5745/6745, Cornell University)
Spring 2022 - One section of 28 graduate students

Mathematical Modeling of Natural and Engineered Systems (CEE5735/6736, Cornell University)
Fall 2021 - One section of 12 graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2021 - Two sections, 26 undergraduate students

Mathematical Modeling of Natural and Engineered Systems (CEE5735, Cornell University)
Fall 2020 - One section of 11 graduate students, plus 2 undergraduates

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2019 - One section of 43 undergraduate students

Introductory Finite Element Analysis with Applications (CEE5720, Cornell University)
Fall 2018 - One section of 16 undergraduate and graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2018 - One section of 21 undergraduate students

Introductory Finite Element Analysis with Applications (CEE5720, Cornell University)
Fall 2017 - One section of 25 undergraduate and graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2017 - One section of 41 undergraduate students

Modern Structures (CEE1160, Cornell University)
Fall 2016 - One section of 53 undergraduate students

Introductory Finite Element Analysis with Applications (CEE5720, Cornell University)
Fall 2016 - One section of 17 undergraduate and graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2016 - One section of 32 undergraduate students

Modern Structures (CEE1160, Cornell University)
Fall 2015 - One section of 63 undergraduate students

Nonlinear Finite Element Analysis: Structures (CEE7790, Cornell University)
Fall 2015 - One section of 4 graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2015 - One section of 37 undergraduate students

Modern Structures (CEE1160, Cornell University)
Fall 2014 - One section of 58 undergraduate students

Nonlinear Finite Element Analysis: Structures (CEE7790, Cornell University)
Fall 2014 - One section of 11 graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2014 - One section of 41 undergraduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2013 - One section of 56 undergraduate students

Nonlinear Finite Element Analysis II (CEE7790, Cornell University)
Fall 2012 - One section of 12 graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2012 - One section of 39 undergraduate students

Modern Structures (CEE1160, Cornell University)
Fall 2011 - One section of 58 undergraduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2011 - One section of 52 undergraduate students

Nonlinear Finite Element Analysis II (CEE7790, Cornell University)
Fall 2010 - One section of 9 graduate students

Introduction to the Behavior of Metal Structures (CEE4740, Cornell University)
Spring 2010 - One section of 50 undergraduate students

Nonlinear Finite Element Analysis II (CEE7790, Cornell University)
Fall 2009 - One section of 10 graduate students

Introduction to the behavior of Steel Structures (CEE4740, Cornell University)

Spring 2009 - One section of 46 undergraduate students

Advanced Behavior of Metal Structures (CEE7790, Cornell University)
Fall 2008 - One section of 13 graduate students

Introduction to the Behavior of Steel Structures (CEE474, Cornell University)
Spring 2008 - One section of 29 undergraduate students

MEng Structures Project Course (CEE502, Cornell University)
Spring 2008 - One section of 11 graduate students

MEng Structures Project Course (CEE501, Cornell University)
Fall 2007 - One section of 11 graduate students

Advanced Behavior of Metal Structures (CEE779, Cornell University)
Fall 2007 - One section of 13 graduate students

Introduction to the behavior of Steel Structures (CEE474, Cornell University)
Spring 2007 - One section of 57 undergraduate students

MEng Structures Project Course (CEE502, Cornell University)
Spring 2007 - One section of 12 graduate students

MEng Structures Project Course (CEE501, Cornell University)
Fall 2006 - One section of 12 graduate students

Advanced Behavior of Metal Structures (CEE779, Cornell University)
Fall 2006 - One section of 11 graduate students

Advanced Structural Steel Design (CEE2341, University of Pittsburgh)
06-2 One section of 14 students
Evaluation: **4.00 / 5.0**

Theory of Plates and Shells (CEE3331, University of Pittsburgh)
05-2 One section of 7 graduate students
Evaluation: ***Qualitative Evaluation***

Structural Stability (CEE3330, University of Pittsburgh)
05-01 One section of 7 graduate students
Evaluation: **4.29 / 5.0**

Dynamics of Structures (CEE2360, University of Pittsburgh)
04-2 One section of 12 graduate students
Evaluation: **4.64 / 5.0**

Structural Analysis (CEE1330, University of Pittsburgh)
04-1 One section of 71 undergraduate students

Evaluation: **3.28 / 5.0**

Nonlinear Structural Behavior (CEE3334, University of Pittsburgh)
04-1 One section of 4 graduate students
Evaluation: **Qualitative evaluation report**

Theory of Plates and Shells (CEE3331, University of Pittsburgh)
03-2 One section of 5 graduate students
Evaluation: **Qualitative evaluation report**

Structural Steel Design (CEE1341, University of Pittsburgh)
03-2 One section of 29 undergraduate students
Evaluation: **4.36 / 5.0**

Structural Stability (CEE3330, University of Pittsburgh)
03-1One section of 8 graduate students
Evaluation: **4.88 / 5.0**

Structural Analysis (CEE1330, University of Pittsburgh)
03-1One section of 46 undergraduate students
Evaluation: **4.70 / 5.0**

Dynamics of Structures (CEE2360, University of Pittsburgh)
02-2 One section of 12 graduate students
Evaluation: **4.69 / 5.0**

Structural Steel Design (CEE1341, University of Pittsburgh)
02-2 One section of 41 undergraduate students
Evaluation: **4.58 / 5.0**

Structural Analysis (CEE1330, University of Pittsburgh)
02-1 One section of 71 undergraduate students
Evaluation: **4.63 / 5.0**

Theory of Plates and Shells (CEE3331, University of Pittsburgh)
01-2 One section of 11 graduate students
Evaluation: **4.82 / 5.0**

Advanced Structural Steel Design (CEE2341, University of Pittsburgh)
01-1 One section of 17 graduate students
Evaluation: **4.56 / 5.0**

Structural Analysis (CEE1330, University of Pittsburgh)
01-1 One section of 57 undergraduate students
Evaluation: **4.57 / 5.0**

Structural Steel Design (CEE1341, University of Pittsburgh)

02-2 One section of 38 undergraduate students
Evaluation: **4.93 / 5.0**

Advanced Structural Steel Design (CEE2341, University of Pittsburgh)
00-1 One section of 13 graduate students
Evaluation: **4.78 / 5.0**

Structural Analysis (CEE1330, University of Pittsburgh)
00-1 One section of 63 undergraduate students
Evaluation: **4.80 / 5.0**

Structural Steel Design (CE404, West Point)
98-1 Two sections of 18 cadets
98-2 Two sections of 18 cadets, Course Director
99-1 Four sections of 18 cadets, Course Director
99-1 Two sections of 18 cadets, Course Director

Strengths of Materials (EM364, West Point)
97-2 Three sections of 18 cadets

Statics and Dynamics of Rigid Bodies (EM302, West Point)
97-1 Four sections of 18 cadets

Advanced Independent Study in Civil Engr. (CE489, West Point)
97-2 One section of 1 cadet
98-2 One section of 1 cadet
99-2 One section of 2 cadets

Mechanical Engineering Capstone (ME496, West Point)
97-2 One section of 4 cadets

Introduction to Construction Materials (CE5603, University of Minnesota)
92-1 to 94-2 Lab Instructor teaching five lab sections, each with 17 undergraduate students (each section had a one hour lecture and two additional hours of lab work)
95-1 Teacher of Record. One section of 80 undergraduate students (two hour lectures twice weekly)
Lab Instructor teaching four lab sections, each with 20 undergraduate students

UNDERGRADUATE RESEARCH AT CORNELL:
A demonstration of model-based structural health monitoring techniques.
Student: Justin Fisher (Mississippi State University)
Term: Summer 2010
Sponsor: NSF Louis Stokes Alliance for Minority Participation

Investigation of acoustic fluid-structure interaction formulations for the finite element method.
Student: Rick Zamora
Term: Summer 2009
Sponsor: none

Formulation and implementation of time integration strategies for use with the nonlinear finite element method.
Student: Heather Reed
Term: Summer 2009
Sponsor: none

Verification of CU-BEN and application to hull structural modeling
Student: Naomi Drucker
Term: Spring 2009
Sponsor: Rawlings Undergraduate Research Fellowship

UNDERGRADUATE LEVEL INDEPENDENT STUDIES:

CEE1996 Evaluation of a New Pre-Cast Concrete Filled Grid Deck Splice (University of Pittsburgh)
Sponsor: Bridge Grid Flooring Manufacturers Association
Student: Thomas Johnston

CEE1996 Experimental Testing of Composite Floor Slabs (University of Pittsburgh)
Sponsor: Steel Deck Institute
Student: Bryan Dietrich

CEE1996 Experimental Testing of a Concrete Filled Grid Deck Splice (University of Pittsburgh)
Sponsor: Bridge Grid Flooring Manufacturers Association
Student: Mathew Pierce

CEE1996 Heat Straightening of Deformed Eye-bars (University of Pittsburgh)
Sponsor: American Bridge Corporation
Student: Timothy Gattie

CE489 Advanced Individual Study and Research in Civil Engineering (West Point)
Project: "Finite Element Modeling of a Wind Loaded Gable Frame" (1999)
Sponsor: National Institute of Standards and Technology (NIST), Dr. Emil Simiu
Cadets: Thomas Howell and Christopher Klein

CE489 Advanced Individual Study and Research in Civil Engineering (West Point)
Project: "Strength Evaluation of Web-tapered Moment Resisting Frames Subject to Severe Wind Loadings" (1998)
Sponsor: National Institute of Standards and Technology (NIST), Dr. Emil Simiu
Cadet: Scott Galloway

CE489 Advanced Individual Study and Research in Civil Engineering (West Point)
Project: "Influence Lines for Metal Building Gable Frames Under Wind Loading" (1997)
Sponsor: National Institute of Standards and Technology (NIST), Dr. Emil Simiu
Cadet: Dean Mitchell

ME496 *Mechanical Engineering Capstone Course* (West Point)
Project: "Structural Redesign and Optimization of Life Support for Trauma and Transport (LSTAT) System" (1997)
Sponsor: Walter Reed Army Institute of Research, Division of Surgery
Cadets: Adib Khoury, Linda Donahue, Joseph Kling

f) Complete Listing of MS and PhD Students Advised (sole advisor)

MS Students (Thesis Option):

<u>*University of Pittsburgh*</u>

Primary Advisor, Civil and Environmental Engineering:

Bhavik Shah, *Grad: 3/01*	(Support: Fed. Highway. Admin.)
Brandon Chavel, *Grad:12/01*	(Support: PennDOT)
Joseph Chaklos, *Grad:12/01*	(Support: Steel Deck Institute)
Nicola Greco, *Grad:4/02*	(Support: Department)
Brodie Claybaugh, *Grad:4/02*	(Support: PennDOT)
Chris Keelor, *Grad:4/02*	(Support: PennDOT)
Steven Thomas, *Grad:4/02*	(Support: Fed. Highway Admin.)
Yupeng Luo, *Grad:12/02*	(Support: PennDOT)
Ying Li, *Grad: 3/03*	(Support: PennDOT)
Laura Volle*, Grad: 4/03*	(Support: Department)
Bryan Miller, *Grad: 12/03*	(Support: Department)
Monica Falgoust, *Grad: 12/04*	(Support: Department)
Rebecca Boyle, *Grad: 8/04*	(Support: PennDOT)
Noah Accord, *Grad: 12/05*	(Support: CEE Department, UPitt)
Matthew Pierce, *Grad: 12/05*	(Support: Stargrate, Inc.)
Thomas Howell, *Grad: 5/06*	(Support: CEE Department, UPitt)
Christopher J. Stull, *Grad:* 8/06	(Support: PennDOT)

<u>*Cornell University*</u>

Primary Advisor, Civil and Environmental Engineering:

Mija H. Hubler, *Grad*: 4/09	(Support: CEE School, Cornell)
Woo Yong Jeong, *Grad*: 11/10	(Support: Office of Naval Research)

Primary Advisor, Applied Mathematics:

Nicholas LaVigne, *Grad:* 6/19	(Support: Office of Naval Research)
Max Jenquin, *Grad:* 12/21	(Support: Army Research Office)

PhD Students:

<u>*University of Pittsburgh*</u>

Primary Advisor, Civil and Environmental Engineering:

Brian Kozy, *Grad: 12/04*	(Support: PennDOT)
Muharrem Aktas, *Grad: 11/04*	(Support: Turkish Government)
Joe Yulismana, *Grad: 4/05*	(Support: Fed. Highway Admin.)

<u>*Cornell University*</u>

Primary Advisor, Civil and Environmental Engineering:

Christopher Stull, *Grad: 3/10*	(Support: Office of Naval Research)
Emily Leigh, *Grad: 6/10*	(Support: NSF)
Raphael Sternfels: *Grad: 12/12*	(Support: CEE School, Cornell)
Heather Reed, *Grad: 4/14*	(Support: Office of Naval Research)
Vasileios Fountoulakis, *Grad: 5/16*	(Support: Office of Naval Research)
Yolanda Lin, *Grad: 5/18*	(Support: Office of Naval Research)
Justyna Kosianka, *Grad:* 6/18	(Support: Office of Naval Research)
Wensi Wu, *Grad:* 5/21	(Support: Office of Naval Research)
Hilarie Sit, *Grad:* 5/21	(Support: Office of Naval Research)
Christophe Bonneville, *Grad:* 5/23	(Support: Office of Naval Research)
Harshwardhan Praveen, Exp: 5/24	(Support: Army Research Office)

Primary Advisor, Applied Mathematics:

Andrew Loeb, *Grad*: 5/17	(Support: NSF)
John Chavis, *Grad*: 5/21	(Support: National Geospatial Intelligence Agency)
Dominic Diaz, Exp: 5/24	(Support: Sloan Foundation)
Robert Stephanie, Exp: 5/24	(Support: Office of Naval Research)
Jacob Brown, Exp: 5/24	
Maria Oprea, Exp: 5/24	(Support: Army Research Office)
Dory Castillo-Peters, Exp: 5/25	(Ford Foundation)

Ph.D. *Minor Committee Member:*

Jake Hochhalter, Grad 6/10 – Civil and Environmental Engineering
Mike Veilleux, Grad 8/10 – Civil and Environmental Engineering
Bin Wen, Grad 8/12 – Mechanical and Aerospace Engineering
Jiang Wan, Grad 5/13 – Mechanical and Aerospace Engineering
Veronica Prush, Grad 7/13 – Earth and Atmospheric Science
Chi Zhang, Grad 12/13 – Mechanical and Aerospace Engineering
Erin Oneida, Grad 1/14 - Civil and Environmental Engineering
Ashley Spear, Grad 4/14 – Civil and Environmental Engineering
Brett Davis, Grad 5/14 – Civil and Environmental Engineering
Siming Zhao, Grad 5/16 – Theoretical and Applied Mechanics
Alin Radu, Grad 8/14 – Civil and Environmental Engineering
Wayne Isaac Uy, Grad 6/19 – Applied Mathematics
Xinzeng Feng, Grad 5/16 – Theoretical and Applied Mechanics
Chris Budrow, Grad 6/19 – Mechanical and Aerospace Engineering
Wenjia Gu, Grad 4/21 – Civil and Environmental Engineering
Zezhou Liu, Grad 4/21 – Theoretical and Applied Mechanics
Chun-Yu Ke, Grad 7/21 – Civil and Environmental Engineering

Sangwu Kim, Grad 7/21 – Civil and Environmental Engineering
Luria Greene – Biological and Environmental Engineering
Xun Gao – Civil and Environmental Engineering
Jan Niklas Fuhg – Mechanical and Aerospace Engineering
Arnold Chen – Biomedical Engineering
Liming Zhao – Mechanical and Aerospace Engineering
Robin Armstrong – Applied Mathematics
Jonah Botvinick Greenhouse – Applied Mathematics
Kapil Khanal – Systems Engineering

M.S. *Committee Member:*
Hannah Goldberg – Electrical and Computer Engineering

g) Honors and Awards

Daniel M. Lazar ’29 Excellence in Teaching Award, College of Engineering, Cornell University, 2021

James and Mary Tien Excellence in Teaching Award, College of Engineering, Cornell University, 2016

James and Mary Tien Excellence in Teaching Award, College of Engineering, Cornell University, 2011

“Outstanding Young Alumni Award” The Charles E. Via Department of Civil and Environmental Engineering, Virginia Tech, 2004

“Outstanding Professor of the Year Award”, American Society of Civil Engineers, Pittsburgh Section, 2001

William Kepler Whiteford Faculty Fellow 2000-2006

Ralph E. Powe Junior Faculty Enhancement Award, Oak Ridge Associated Universities, 2000

Phi Kappa Phi Scholastic Achievement Award, 1998-1999 (for outstanding research performance)

Peter S. Michie Outstanding Teacher Award, 1998 (West Point)

Member, Chi Epsilon

Erdős number = 5

h) Detailed Listing of Professional Services and Activities

1) Department, School, and University Committees

University

Director of Graduate Studies, Graduate Field of Civil and Environmental Engineering.
(Cornell, January 24, 2018 to June 30, 2020)

College of Engineering representative on the University Appeals Panel.
(Cornell, July 1, 2013 to June 30, 2018)

College of Engineering representative on the Library Board.
(Cornell, September 15, 2010 to June 30, 2014)

CEE representative to the Faculty Senate
(Cornell, July 1, 2009 to July 1, 2012)

Member, Conflict of Interest Committee
(University of Pittsburgh, 06-1 to 07-1)

Member, Entrepreneurial Oversight Committee
(University of Pittsburgh, 06-1 to 07-1)

Member, Council on Academic Computing
(University of Pittsburgh, 04-1 to 07-1)

College

Member, Independent Major Committee
(Cornell, July 21, 2010 to June 30, 2012)

Chair, Endowed Chair Search Committee – 3 chairs searched for simultaneously
(University of Pittsburgh, 05-1 to 07-1)

Member, Promotion and Tenure Review Committee
(University of Pittsburgh, 03-1 to 04-2)

Department

Member, Search Committee for Professor of Civil Infrastructure Engineering
(Cornell University, September 2022 to June 2023)

Chair, Search Committee for Professor of Practice in Structural Engineering
(Cornell University, September 2020 to June 2021)

Mission Area Coordinator, Civil Infrastructure Group
(Cornell University, July, 2020 – April, 2023)

Member, CEE Curriculum Committee
(Cornell University, January, 2018 – present)

Co-Chair, Search Committee for Sustainable Subsurface Energy Systems
(Cornell University, September 2018 to April 2019)

Director of Graduate Studies
(Cornell University, January 24, 2018 – June 30, 2020)

Mission Area Coordinator, Civil Infrastructure Group
(Cornell University, March, 2014 – March, 2017)

Member, Search Committee for Structures Hire
(Cornell University, January 2014 to May 2014)

Faculty Advisor for the School's Steel Bridge Team
(Cornell University, 2010 - 2011)

Mission Area Coordinator, Civil Infrastructure Group
(Cornell University, July, 2009 - July, 2012)

Member, Ad-Hoc Strategic Planning Committee
(Cornell University, 2007 - 2008)

Faculty Advisor for the School's Steel Bridge Team
(Cornell University, 2007 - 2008)

Co-Chair, Search Committee for Structures Dual Hire
(Cornell University, September 2006 to April 2007)

Faculty Advisor for the School's Steel Bridge Team
(Cornell University, 2006 - 2007)

Director, Structures Group
(University of Pittsburgh, 03-1 to 05-1)

Chairman, Transportation Faculty Search Committee
(University of Pittsburgh, 02-1 to 02-2)

Chairman, Construction Management Faculty Search Committee
(University of Pittsburgh, 00-2 to 01-2)

Faculty Advisor for the Department's Steel Bridge Team
(University of Pittsburgh, 04-1 to 05-2)

Faculty Advisor for the Chi Epsilon Civil Engineering Honor Society

(University of Pittsburgh, 00-2 to 05-1)

Departmental Research Liaison to the Pennsylvania Department of Transportation *(University of Pittsburgh, 00-1 to present)*

Member, Departmental Graduate Curriculum Committee
(University of Pittsburgh, 00-2 to 05-1)

Member, Green Construction Steering Committee
(University of Pittsburgh, 00-1 to 04-2)

Chairman, Departmental Recruitment Committee
(University of Pittsburgh, 02-1 to 04-1)

Chairman, Landis Lecture Committee
(University of Pittsburgh, 00-1,01-1,02-1)

Department junior faculty representative, Faculty Council
(West Point, 98-1 to 99-2)

Secretary, Middle States Accreditation Faculty Working Group Sub-Committee *(West Point, 98-1 to 99-1)*

Member, Mechanical Engineering Division Faulty Search Committee
(West Point, 98-2)

Department Library Officer *(West Point, 97-1 to 99-2)*

2) Professional Society Committees, Membership, and Service

Member, **Society for Industrial and Applied Mathematics**
(2010 – present)

Member, **International Association for Computational Mechanics**
(2007 – 2016)

Member, **United States Association for Computational Mechanics**
(2007 – 2016)

Member at Large, **Structural Stability Research Council**:
Member, Executive Committee
(2006 – 2008)
Member Task Group 26 "Stability of Angle Members"
(Chairman 2001 – 2006, Member since 1995)
Member, Task Group 13 "Thin-Walled Metal Construction"
(1999 – 2008)

Member, Task Group 14 "Horizontally Curved Girders"
(2003 – 2008)
Member, Task Group 15 "Beams"
(1999 – 2008)
Member, Task Group 30 "Bracing Members"
(2001 – 2008)
Member, Nominating Committee
(2001 – 2003)

Member, **International Association for Bridge and Structural Engineering**
(2003 – 2005)

Member, **American Society of Civil Engineers** (1988 – 2007)
Structural Engineering Institute:
SEI Technical Administrative Committee on Metals
Member (2000-2003)

ASCE Committee on Compression and Flexural Members
Chairman (2000 – 2003)
Control Member (1999 – 2004)

ASCE Steel Bridge Committee
Control Member (1998 – 2004)

Engineering Mechanics Division:
ASCE Stability Committee
Member (2001 – 2004)

Local Chapter Involvement:
Member, Board of Trustees, Student Awards Foundation (2001 – 2004)

Engineering Society of Western Pennsylvania (2000 – 2004)
Member of the Executive Committee of the IBC
Member of Technical Program Committee of the IBC
Member of Student Awards Committee of the IBC

American Institute of Steel Construction
Member of Regional Professional Members Committee (2000-2006)
Chairman, Regional Sub-Committee on Research and Education (2000-2006)

National Research Council:
Transportation Research Board Representative for the University of Pittsburgh February 2002 – 2004.

National Academy of Sciences: *Panel Member for Committee on Naval Engineering in the 21st Century*

DOE Panelist: *Advanced Scientific Computing Research (Applied Mathematics): Scientific Machine Learning for Modeling and Simulations*

NSF Panelist: *Mechanics of Materials*; *Structural Hazard Mitigation; International Research Experience for Students*

Reviewer, SIAM Journal on Applied Dynamical Systems
Reviewer, AMS – Journal of Applied Meteorology and Climatology
Reviewer, Structural Health Monitoring
Reviewer, AGU – Radio Science
Reviewer, IEEE Transactions on Industrial Informatics
Reviewer, SIAM Journal on Uncertainty Quantification
Reviewer, Probabilistic Engineering Mechanics
Reviewer, Finite Elements in Analysis and Design
Reviewer, Inverse Problems
Reviewer, Strain: An International Journal for Experimental Mechanics
Reviewer, Mechanical Systems and Signal Processing
Reviewer, *Journal of Environmental Informatics*
Reviewer, *Journal of Composites for Construction*
Reviewer, *Engineering Computations*
Reviewer, C*anadian Journal of Civil Engineering*
Reviewer, *Engineering Structures*
Reviewer, *Journal of Structural Engineering*
Reviewer, *Steel and Composite Structures: An International Journal*
Reviewer, *Structural Engineering and Mechanics: An International Journal*
Reviewer, *Journal of Bridge Engineering*
Reviewer, *A.I.S.C. Engineering Journal*
Reviewer, *Journal of Constructional Steel Research*
Reviewer, *Journal of Mechanical Design*
Reviewer, *Journal of Engineering Education*
Reviewer, *Journal of Vibration and Acoustics*

3. Conferences and Sessions Organized

Association for the Advancement of Artificial Intelligence, 2023 Spring Symposium Series: Computational Approaches to Scientific Discovery
San Francisco, California, March 27 – 29, 2023
Session Chair, Introducing New Variables

International Conference of the ASCE Engineering Mechanics Institute
Durham, United Kingdom, April 5 – 8, 2020

Member, International Scientific Committee

Society of Industrial and Applied Mathematics, 2012 Annual Meeting
Minneapolis, Minnesota, July 9 – 13, 2012
Session Chair, Imaging and Detecting with Inverse Problems (MS25)

World Congress on Advances in Structural Engineering and Mechanics
Jeju Island, Korea, August 35 – 29, 2013
Member, International Advisory Committee

World Congress on Advances in Structural Engineering and Mechanics
Seoul, Korea, July 13 – 15, 2012
Member, International Advisory Committee

7th International Conference on Steel and Aluminum Structures
Sarawak, Malaysia, July 13 – 15, 2011
Member, Scientific Committee

Society of Industrial and Applied Mathematics, 2010 Annual Meeting
Pittsburgh, Pennsylvania, July 12 – 16, 2010
Session Chair, Imaging (CP21)

4th International Conference on Steel and Composite Structures
Sydney, Australia , July 21 – 23, 2010
Conference Co-Chair

1st International Conference on Structures and Architecture
University of Minho, Guimarães, Portugal , July 15 – 16, 2010
Member, Scientific Committee

10th U.S. Congress of Computational Mechanics
Columbus Ohio, US, July 16 – 19, 2009
Session Organizer, "Inverse Problems: theory and applications"

6th International Conference on Computation of Shell and Spatial Structures
Cornell University, US, May 28 – 31, 2008
Member, Organizing / Scientific Committee
Session Organizer and Chair, "Advances in Shell Elements I & II"
Session Chair, "Spanning Between Theory and Practice I & II"

3rdInternational Conference on Steel & Composite Structures
University of Manchester, UK, August 22 – 24, 2007
Member, International Scientific Committee

North American Steel Construction Conference
New Orleans, Louisiana , April 18 – 21, 2007

Chaired a session entitled "Bracing members and distortional buckling"

20th International Colloquium on Stability and Ductility of Steel Structures
Lisbon, Portugal, September 6 – 8, 2006
Member, International Scientific Committee
Chaired a session entitled "Columns"

1st International Conference on Advances in Engineering and Technology (AET2006)
Entebbe, Uganda, July 16 – 19, 2006
Member, International Scientific Advisory Board

1st International Conference on Advances in Bridge Engineering
Brunel University, Uxbridge, Middlesex, UK, June 28 – 28, 2006
Member, International Advisory Committee

7th International Congress on Civil Engineering
Tehran, Iran, May 8 – 10, 2006
Member, International Scientific Board

2nd International Conference on Steel & Composite Structures
Seoul, Korea, September 12 – 14, 2004
Member, International Advisory Committee

1st National Workshop – "Innovative Applications of Finite Element Modeling in Highway Structures"
Sponsored by the Federal Highway Administration
New York City, August 20 – 21, 2003
Member, Steering Committee

International Bridge Conference 2004
Pittsburgh, Pennsylvania – June 14 – 16, 2004
Member of the Executive Committee
Member of Student Awards Committee

International Bridge Conference 2003
Pittsburgh, Pennsylvania – June 9 – 11, 2003
Member of the Executive Committee
Member of Student Awards Committee

International Bridge Conference 2002
Pittsburgh, Pennsylvania – June 2002
Member of the Executive Committee
Member of Technical Program Committee
Member of Student Awards Committee

Structures 2002

American Society of Civil Engineers, Structures Congress
Denver, CO: April 4-6, 2001
Chaired a session entitled *"Curved Steel Girder Bridge Erection"*

International Bridge Conference 2001
Pittsburgh, Pennsylvania – June 2000
Member of the Executive Committee
Member of Technical Program Committee
Member of Student Awards Committee

Structures 2001
American Society of Civil Engineers, Structures Congress
Washington, DC: May 21-23, 2001
Chaired a session entitled *"Cross Bracing in Bridges"*

Structures 2001
American Society of Civil Engineers, Structures Congress
Washington, DC: May 21-23, 2001
Chaired a session entitled *"Research in Applications of High Performance Steel"*

International Bridge Conference 2000
Pittsburgh, Pennsylvania – June 11-14, 2000
Member of the Executive Committee
Member of Technical Program Committee
Member of Student Awards Committee

International Bridge Conference 2000
Pittsburgh, Pennsylvania – June 11-14, 2000
Chaired a session entitled *"Design-Build Methods / Moveable Bridges"*

Metal Building Manufacturers Primary Framing Members Committee
Pittsburgh, Pennsylvania – October 4, 2000
Organized and hosted this annual meeting that sets research priorities for the metal building industry.

4. Journal Editorships or Journal Editorial Board Service

Editor-in-Chief for the Americas*, Steel & Composite Structures: An International Journal*, February 2005 – January 1, 2011.

Editorial Board Member*, Steel & Composite Structures: An International Journal*, January 2004 – 2005.

Associate Editor, *Journal of Structural Engineering*, American Society of Civil Engineers. August 2001 – August 2004.