

MAYANK CHADHA, Ph.D.

University of California San Diego
Structural Engineering Department
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ResearchGate: <https://tinyurl.com/chadha-RG>
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EDUCATIONAL BACKGROUND:

- **University of California, San Diego, USA**
Ph.D. in Structural Engineering
Specialization: Applied Mechanics and Mathematics
Committee members:
Professor Michael D. Todd, (Advisor)
Professor Jiun-Shyan Chen,
Professor Joel P. Conte,
Professor Charles R. Farrar,
Professor Elham Izadi.
Title: *Theoretical development of framed space curve and its applications to higher-order geometrically-exact rod theory, shape sensing, path estimation, and computer graphics*
<https://tinyurl.com/Chadha-PhD-Thesis>
2016-2019
- **University of California, San Diego, USA**
M.S. in Structural Engineering (*GPA: 3.98/4.0*)
2014-2016
- **PSG College of Technology, Anna University, India**
(First class with Distinction, Gold Medalist)
B.E. in Civil Engineering (*CGPA: 9.87/10.0*)
2010-2014

SKILLS AND INTERESTS:

- **Primary research interests:** Risk and uncertainty quantification, Bayesian decision and optimization theory, Structural Health Monitoring, Differential Geometry, Variational Mechanics, Continuum Mechanics, Geometrically exact beam and shell theories, Finite Element Analysis (FEM).
- **Secondary research interests:** Data-driven finance, Gambling Theory, General theory of relativity, Thermodynamics, Information theory, Conservation laws, and symmetry
- **Software:** MATLAB, Mathematica, C++, Python, Latex, and AutoCAD

CURRENT POSITION AND RESEARCH:

- **The University of California, San Diego, USA**
Postdoctoral Scholar
Supervisor: Professor Michael D. Todd, mdtodd@ucsd.edu
Co-Supervisor: Professor Joel P. Conte, jpconte@ucsd.edu
2020-Present

- **Specific areas of research:** Bayesian optimization, behavioral economics, expected utility theory, Bayesian decision theory, Machine Learning, and structural health monitoring.
- **Detailed research description:**
 1. Investigating uncertainty, quantifying risk, and evaluating the Value of Information (VoI) in structural health monitoring (SHM) problems.
 2. Development of Bayesian model parameter and model class optimization solutions for inland waterway civil infrastructure systems and a framework for risk-based optimal sensing. This includes developing advanced optimal sensor design strategies for SHM by explicitly and precisely formulating the problem in terms of Bayes risk and implementing a numerical optimization strategy to create an efficient solution for the sensor-design problem.
 3. Investigating and modeling behavioral psychology in the selection of optimal maintenance strategies and state classification of structures.
 4. Building a machine learning-enabled calibration of hydrological model parameters for better prediction of river discharges. Building hybrid physics-based machine learning time series prediction model to predict the discharge in the river.
 5. Building a probabilistic forecast model for Battery capacity prediction.

RESEARCH SUMMARY:

- **Summary of Ph.D. Research**
 1. Development of a comprehensive non-linear geometrically exact beam model and its numerical solution that captures finite strains and displacements (incorporating various deformation effects such as bending curvatures, torsion, shear, coupled Poisson's and warping effect) while maintaining its single manifold character
 2. Use of director-based kinematics to develop shape reconstruction methodology, measurement model for strain gauges, curve estimation, path estimation techniques for UAVs with limited velocity data, and computer graphics
- **Funding sources**
 1. Department of Structural Engineering, UCSD (2016-2017)
 2. US Army Corps of Engineers (2017 onwards)
- **Journal Publications**
 1. **Chadha, M.**, Todd, M. D., 2017 "A generalized approach to reconstructing the three-dimensional shape of slender structures including the effect of curvature, shear, torsion, and elongation." *American Society of Mechanical Engineering (ASME), Journal of Applied Mechanics*
 2. **Chadha, M.**, Todd, M. D., 2017- "An introductory treatise on reduced balance laws of Cosserat beams", *International Journal of Solids and Structures*
 3. **Chadha, M.**, Todd, M. D., 2018- "A comprehensive kinematic model of single-manifold Cosserat beam structures with applications to a finite strain measurement model for strain gauges", *International Journal of Solids and Structures*
 4. **Chadha, M.**, Todd, M. D., 2019- "On the material and material-adapted approach to curve framing and its application to path estimation, shape sensing and computer graphics", *Computers and Structures*
 5. **Chadha, M.**, Todd, M. D., 2019- "On the derivatives of curvature of framed space curve and their time-updating scheme", *Applied Mathematics Letters, Elsevier*

6. **Chadha, M.**, Todd, M. D., 2019- “On the derivatives of curvature of framed space curve and their time-updating scheme: Extended version with MATLAB code”, arXiv: 1907.11271, *Archives of Mathematics (Differential Geometry)*
7. **Chadha, M.**, Todd, M. D., 2020- “Mathematical theory of higher-order geometrically-exact single-manifold Cosserat beam with deforming cross-section”, *International Journal of Solids and Structures*
8. **Chadha, M.**, Todd, M. D., 2020- “Poisson bracket formulation of a higher-order geometrically-exact beam”, *Applied Mathematics Letters, Elsevier*
9. Yang, Y., **Chadha, M.**, Hu, Z., Parno, M., Todd, M. D., 2021- “A probabilistic sensor design approach for structural health monitoring using risk-weighted f-divergence”, *Mechanical Systems and Signal Processing*
10. **Chadha, M.**, Hu, Z., Todd, M. D., 2021- “An Alternative Quantification of the Value of Information in Structural Health Monitoring”, *Structural Health Monitoring: Value of Information perspective*, SAGE
11. Yang, Y., **Chadha, M.**, Hu, Z., Todd, M. D., 2021- “An optimal sensor design framework for structural health monitoring via Bayes risk”, *Mechanical Systems and Signal Processing*
12. **Chadha, M.**, Ramancha, M.K., Vega, M.A., Conte, J.P. and Todd, M.D., 2023- “The modeling of risk perception in the use of structural health monitoring information for optimal maintenance decisions”, *Reliability Engineering & System Safety*

- **Pending and upcoming Journal Publications**

1. Yang, Y., **Chadha, M.**, Hu, Z., Parno, M., Todd, M. D., 2021- “An optimal sensor design framework accounting for sensor reliability over the structural life cycle”, (Submitted to *Reliability Engineering & System Safety Journal*.)
2. Zhao, Y., **Chadha, M.**, Olsen, N., Yeates, E., Turner, J., Gugaratshan, G., Qian, G., Todd, M. D., Hu, Z., “Machine learning-enabled rapid calibration of hydrological model parameters” (Under internal USACE’s review and soon to be submitted)
3. **Chadha, M.**, Y., Hu, Farrar, C., Z., Todd, M. D., 2023 (expected)- “A Value of Information based optimal sensor network design framework for structural health” (Writing under progress)
4. **Chadha, M.**, Yang, Y., Hu, Z., Todd, M. D., 2023 (expected)- “A time-dependent optimal sensor network design framework for structural health monitoring using dynamic decision theory” (Writing under progress)

- **Conference Publications and presentations**

1. **Chadha, M.**, Todd, M. D., 2017, “Shape reconstruction methodology,” *Engineering Mechanics Institute (EMI 2017 conference)*, San Diego
2. **Chadha, M.**, Todd, M. D., 2017, “A displacement reconstruction strategy for long, slender structures from limited strain measurements and its application to underground pipeline monitoring,” 7th International Conference on *Experimental Vibration Analysis for Civil Engineering Structures (EVACES)*. Lecture Notes in Civil Engineering, Springer, Cham, 5 pp. 317-327
3. **Chadha, M.**, Todd, M. D., 2018, “An improved shape reconstruction methodology for long rod-like structures using Cosserat kinematics- including the Poisson’s effect,” *Society of Experimental Mechanics (SEM-IMAC conference)*, Orlando
4. **Chadha, M.**, Todd, M. D., 2018, “Comprehensive kinematics and mathematical model of discrete and finite-length strain gauges” at *Engineering Mechanics Institute Conference (EMI) 2018*, MIT, Cambridge

5. **Chadha, M.**, Todd, M. D., 2018, “Comprehensive kinematics and kinetics of Cosserat beams and their application for developing measurement models for strain gauges”, 6th *European Conference on Computational Mechanics and Fluid Dynamics (ECCM-ECFD)*, Glasgow, UK.
6. **Chadha, M.**, Todd, M. D., 2020, “A higher-order geometrically-exact Cosserat beam with a deforming cross-section”, 14th *World Congress on Computational Mechanics and European Conference on Computational Methods in Applied Science and Engineering (WCCM-ECCOMAS)*.
7. **Chadha, M.**, Hu, Z., Todd, M. D., 2021, “Quantifying the benefits of structural health monitoring using the value of information and decision risk modeling”, *Society of Experimental Mechanics (SEM-IMAC conference)* (organizes virtually).
8. **Chadha, M.**, Ramancha M. K., Vega, M. A., Conte, J. P., Todd, M. D., 2021, “The role of risk profile in state determination of structures”, In proceedings 10th *International Conference on Structural Health Monitoring (SHMII-10 conference)*, Porto, Portugal, June 30-July 2, 2021.
9. **Chadha, M.**, Yang, Y., Hu, Z., Vega, M. A., Parno, M. D., Todd, M. D., 2021 “Risk-weighted f-divergence based sensor network design optimization for structural health monitoring of structures”, *Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology (MMLDT-CSET 2021 conference)*, San Diego, Sept. 26-29, 2021.
10. **Chadha, M.**, Todd, M. D., 2021, “AN application of framed space curve to higher-order geometrically-exact beam with a deforming cross-section”, *Australian Conference on Applied Mechanics (ACAM10 conference)*
11. **Chadha, M.**, Hu, Z., Todd, M. D., 2022, “An optimal sensor network design framework for structural health monitoring using value of information”, *Society of Experimental Mechanics (SEM-IMAC conference)*

- **Book chapter:**

1. Vega, M., Yang, Y., **Chadha, M.**, Hu, Z., Todd, M. D, 2021 (to be published) “Diagnosis, prognosis, and maintenance decision making for civil infrastructure: Bayesian data analytics and machine learning”, *Data Science in SHM*, Springer.

- **Invited talks and Conference Presentations (without Publications)**

1. Invited for a talk on “A generalized approach for reconstructing the three-dimensional shape of slender structures using Cosserat rod theory” at the Department of Structural Engineering seminar sponsored by Professor Kenneth Loh in 2017, UCSD, San Diego
2. Invited for a talk on “Decision making under uncertainty” at the Department of Structural Engineering seminar sponsored by Professor Georgios Tsampras in 2021, UCSD, San Diego
3. Invited for a talk on “Decision making under uncertainty in Structural Health Monitoring-*it’s still gambling but with confidence*” at TU Munich School of Engineering and Design seminar sponsored by Prof. Dr. Daniel Straub
4. Invited for a talk on “Decision making under uncertainty in Structural Health Monitoring-*it’s still gambling but with confidence*” (same topic as the previous one) at ETH Zurich seminar sponsored by Prof. Dr. Eleni Chetzi
5. Presented a talk on “Importance of variational calculus in the theory of deformation” at Dr. B. R. Ambedkar Institute of Technology in 2016, Port Blair, India

- **Undergraduate Final Project, PSG College of Technology, Anna University**

Design and analysis of 10-story framed structure for lateral (Earthquake/Wind loads) and gravity loads, using both manual and computational methods of analysis. The substitute frame method was used for manual analysis and StaadPro & SAP2000 for computational analysis (<https://tinyurl.com/chadha-bestproject-UG>)

PROFESSIONAL EXPERIENCES:

- Reviewed papers in numerous journals from 2017 onwards, including Smart Material and Structures, Measurement Science and Technology, Experimental Techniques, Mathematical Problems in Engineering, Mechanical Systems and Signal Processing, and Sounds and Vibrations (*the list is not comprehensive*)
- Participated in organizing *Engineering Mechanics Institute* (EMI) and *Experimental Vibration Analysis for Civil Engineering Structures* (EVACES) conferences at UCSD in 2017. Served as an official photographer for the latter conference.
- Helped organize various outreach events for high school and undergraduate students including *Shake Table* tours, *Earthquake Engineering Research Institute* (EERI) outreach events, and *Science hunt*.

TEACHING EXPERIENCES:

Instructor/Associate In.

University of California, San Diego
Department of Structural Engineering
(<https://tinyurl.com/chadha-TA>)

Designed and instructed an undergraduate course on Structural Analysis (SE 130A) for a class of 20 students.

(Jan 2022-March 2022)

Instructor/Associate In.

University of California, San Diego
Department of Structural Engineering
(<https://tinyurl.com/chadha-TA>)

Designed and instructed an undergraduate course on Dynamics (SE 101B) for a class of 20 students.

(March 2021-June 2021)

Instructor/Associate In.

University of California, San Diego
Department of Structural Engineering
(<https://tinyurl.com/chadha-TA>)

Design and instructed an undergraduate course on Statics (SE 101A) for a class of 50 students.

(Sept 2019-Dec 2019)

TA positions at the University of California, San Diego

Department of Structural Engineering
(<https://tinyurl.com/chadha-TA>)

Served as Teaching Assistant for Dynamics of Continuum Structures, Solid mechanics, Advanced dynamics of Structures (thrice), Cable Structures, Non-Destructive Evaluation, Statics, Introduction to Structures and Design, Structural Materials.

(Jan 2015-Dec 2019)

UCSD Extension Summer Program (Academic connection)

Designed and instructed a course on “Introduction to Structural Engineering from Pyramids to Modern Marvels”

(July 2015-Aug 2015)

NOTABLE AWARDS AND HONORS:

- Received “**Ruth Newmark Fellowship**” awarded by *Friends of International Center (FIC)*, UCSD in the year 2017
- Awarded “**Proficiency Award**” and “**Gold Medal**” for standing first in all the semester exams of *Bachelor of Engineering (B.E.)* in Civil
- Awarded “**K.N Chintamani Memorial Award**” in recognition of best final year thesis in undergraduate *Bachelor of Engineering (B.E.)* in Civil
- Awarded “**Gold Medal**” twice by *Directorate of Education*, Government of India for academic performance in 10th and 12th grade
- Awarded the title “**Amul Vidya Bhushan**” for outstanding academic performance in *Central Board of Secondary Education (CBSE)* examinations, India in 2010
- Recognized by the *Central Board of Secondary Education (CBSE)*, India for being among 0.1% of successful candidates in the field of Physics in 2010 and Science in 2008 national-level secondary examinations