

Phanisri Pradeep Pratapa

Assistant Professor
Department of Civil Engineering
Indian Institute of Technology Madras

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RESEARCH INTERESTS Lattice based materials and structures, metamaterials, origami engineering, high performance computing, computational mechanics

EDUCATION **Georgia Institute of Technology**, Atlanta, GA

Ph.D. (Doctor of Philosophy), Civil Engineering, Aug 2016

- Thesis Topic: *Towards electronic structure calculations at the exascale.*
- Advisor: Prof. Phanish Suryanarayana
- GPA: 3.88/4.0, Minor: Computational Science and Engineering

The University of Texas at Austin, Austin, TX

M.S. (Master of Science), Civil (Structural) Engineering, Dec 2011

- Thesis Topic: *Computational simulation of thunderstorm downbursts and associated wind turbine loads.*
- Advisor: Prof. Lance Manuel
- GPA: 3.83/4.0

Indian Institute of Technology Madras, Chennai, India

B.Tech. (Bachelor of Technology), Civil Engineering, Jul 2010

- Thesis Topic: *Optimal design of cylindrical reinforced concrete water tanks resting on ground.*
- Advisor: Prof. Devdas Menon
- GPA: 8.93/10.0 (rank 2 in the class)

SUMMER SCHOOL **Technical University of Denmark**, Copenhagen, Denmark

Topology Optimization - Theory, Methods and Applications. Jun 21-27, 2017.
Organized by Prof. Ole Sigmund.

RESEARCH EXPERIENCE **Assistant Professor** Jan 2019 to present

Department of Civil Engineering,
Indian Institute of Technology Madras

- Currently working on various topics involving lattice mechanics, metamaterials, origami engineering and computational methods.

Postdoctoral Fellow Aug 2016 to Dec 2018

School of Civil and Environmental Engineering,
Georgia Institute of Technology
Supervisor: Prof. Glaucio H. Paulino

- Developed a theoretical framework to study wave propagation in periodic origami structures using Bloch wave analysis.

- Created new origami-based metamaterial ideas with extremely tunable Poisson's ratio from negative infinity to positive infinity demonstrated theoretically through a geometric mechanics approach.
- Developed the idea of hybrid origami patterns that can combine metamaterials with contrasting properties in a re-programmable way.

Graduate Research Assistant Aug 2013 to Aug 2016

School of Civil and Environmental Engineering,
Georgia Institute of Technology

Supervisor: Prof. Phanish Suryanarayana

- Developed a linear scaling method using Spectral Quadrature (SQ) to perform Density Functional Theory (DFT) calculations on large systems of atoms.
- Implemented the SQ method in parallel using C and MPI that scaled to more than 100,000 cores (at Lawrence Livermore National Lab) to perform Molecular Dynamics simulation of thousands of atoms from first principles.
- Developed a novel iterative method (AAJ) using Anderson extrapolation with Jacobi method to solve large sparse linear systems of equations.
- Implemented AAJ in parallel and demonstrated competing performance with state-of-the-art methods like GMRES even with preconditioning.

Graduate Research Assistant Jan 2011 to Dec 2011

Department of Civil, Architectural and Environmental Engineering,
The University of Texas at Austin

Supervisor: Prof. Lance Manuel

- Developed a computational model to simulate thunderstorm downburst using Computational Fluid Dynamics (CFD) to characterize structural performance of wind turbines.

JOURNAL
PUBLICATIONS

- J9. **P. P. Pratapa**, K. Liu, and G. H. Paulino, "Geometric mechanics of origami patterns exhibiting Poisson's ratio switch by breaking mountain/valley assignment" *Physical Review Letters*, (accepted Jan 2019).
- J8. P. Suryanarayana, **P. P. Pratapa**, and J. E. Pask, "Alternating Anderson-Richardson method: An efficient alternative to preconditioned Krylov methods for large, sparse linear systems." *Computer Physics Communications*, 234 (2019), pp. 278-285.
- J7. **P. P. Pratapa**, P. Suryanarayana, and G. H. Paulino, "Bloch wave framework for structures with nonlocal interactions: Application to the design of origami acoustic metamaterials." *Journal of the Mechanics and Physics of Solids*, 118 (2018), pp. 115-132.
- J6. P. Suryanarayana, **P. P. Pratapa**, A. Sharma, and J. E. Pask, "SQDFT: Spectral Quadrature method for large scale parallel O(N) Kohn-Sham calculations at high temperature." *Computer Physics Communications*, 224 (2018), pp. 288-298.
- J5. **P. P. Pratapa**, and P. Suryanarayana, "On numerically predicting the onset and mode of instability in atomistic systems." *Mechanics Research*

Communications, 78 (2016), pp. 27-33.

- J4. **P. P. Pratapa**, P. Suryanarayana, and J. E. Pask, "Spectral Quadrature method for accurate $O(N)$ electronic structure calculations of metals and insulators." *Computer Physics Communications*, 200 (2016), pp. 96-107.
- J3. **P. P. Pratapa**, P. Suryanarayana, and J. E. Pask, "Anderson acceleration of the Jacobi iterative method: An efficient alternative to Krylov methods for large, sparse linear systems." *Journal of Computational Physics*, 306 (2016), pp. 43-54.
- J2. **P. P. Pratapa**, and P. Suryanarayana, "Restarted Pulay mixing for efficient and robust acceleration of fixed-point iterations." *Chemical Physics Letters*, 635 (2015), pp. 69-74.
- J1. **P. P. Pratapa**, and D. Menon, "Optimal design of cylindrical reinforced concrete water tanks resting on ground." *Indian Concrete Journal*, 85(2) (2011), pp. 19.

CONFERENCE
PUBLICATIONS

- R2. **P. P. Pratapa**, P. Suryanarayana, and G. H. Paulino, "Design of Miura-Ori Patterns With Acoustic Bandgaps." In *ASME 2017 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, 2017, pp. V05BT08A038-V05BT08A038.
- R1. **P. P. Pratapa**, H. H. Nguyen, and L. Manuel, "Alternative Procedures for the Simulation of Thunderstorm Downbursts and Associated Wind Turbine Loads." In *50th AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition*, 2012, pp. 657.

CONFERENCE
PRESENTATIONS/
TALKS

- C5. "Origami-based mechanical metamaterials." Mechanical Engineering Seminar, Virginia Tech, Blacksburg, VA, USA, Nov 2018.
- C4. "Bloch wave framework for structures with nonlocal interactions: Application to the design of origami acoustic metamaterials." American Society of Civil Engineers (ASCE), Engineering Mechanics Institute Conference (EMI) held at MIT, Cambridge, MA, USA, May-Jun 2018.
- C3. "Design of Miura-ori patterns with acoustic bandgaps." American Society of Mechanical Engineers (ASME), International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC/CIE) held at Cleveland, OH, USA, Aug 2017.
- C2. "Restarted Pulay mixing for efficient and robust acceleration of fixed-point iterations." 13th US National Congress on Computational Mechanics (USNCCM13) held at San Diego, CA, USA, Jul 2015.
- C1. "Alternative procedures for the simulation of thunderstorm downbursts and associated wind turbine loads." American Institute of Aeronautics and Astronautics (AIAA), 50th Aerospace Meeting, Nashville, TN, USA, Jan 2012.

POSTER

PRESENTATIONS

- P2. “Programming acoustic bandgaps in origami patterns.” Summer school on Topology Optimization at Technical University of Denmark, Copenhagen, Denmark, Jun 2017.
- P1. “Restarted Pulay mixing for efficient and robust acceleration of fixed-point iterations.” USNCCM13 held at San Diego, CA, USA, Jul 2015.

TEACHING
EXPERIENCE

- Graduate Teaching Assistant** Aug 2010 to Dec 2010
Course: Probability and Statistics for Civil Engineers,
The University of Texas at Austin
- Conducted lab sessions and tutored undergraduate students.

INDUSTRY
EXPERIENCE

- Associate Structural Engineer** Mar 2012 to Jul 2013
McDermott International Inc., Houston, TX
- Involved with structural analysis and design of offshore oil & gas platforms.
- Intern** Jun 2009 to Jul 2009
M N Dastur & Co (P) Ltd., Chennai, India
- Performed structural analysis and design of reinforced concrete buildings and steel trusses.

AWARDS

- Travel award grant to attend the USNCCM13 conference held at San Diego, CA, USA in July 2015.
- Institute merit prize (2009) at IIT Madras for the best academic performance in the civil engineering department for the academic year 2007-08.
- Practicum exchange scholarship (2009) to pursue summer internship at the University of New South Wales, Sydney, Australia.

SERVICE

- Reviewed papers for the journals *Proceedings of the National Academy of Sciences (PNAS)*, *Science Advances*, *Proceedings of the Royal Society-A*, *Mechanics Research Communications*, *ASCE Journal of Engineering Mechanics* and *ASME proceedings*.