

# JULIÁN NORATO

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## PRESENT POSITION

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Assistant Professor  
Department of Mechanical Engineering  
University of Connecticut

*Aug. 2014–Present*

## ACADEMIC BACKGROUND

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### EDUCATION

University of Illinois at Urbana-Champaign  
Ph.D. in Mechanical Engineering with Specialization in  
Computational Science and Engineering *2005*

University of Illinois at Urbana-Champaign  
M.S. in Mechanical Engineering with Specialization in  
Computational Science and Engineering *2003*

Universidad Nacional de Colombia, Colombia  
B.S. in Mechanical Engineering *1997*

### RESEARCH INTERESTS

My current research interests lie in incorporating localized failure mode criteria (such as stress and fatigue) as well as manufacturing, cost and geometric constraints in topology and shape optimization for the design exploration of structures and materials, with the aim of exploring efficient structures that are tailored to a specific manufacturing process, and with applications across domains, from machine components to bone scaffolds. In particular, I am interested in the incorporation of geometry models into topology optimization that accommodate the imposition of geometric requirements that render closer-to-manufacturing optimal topologies.

### DISSERTATION

Title: “Geometry Projection Methods for Shape and Topology Optimization”  
Co-advisors: Prof. Daniel Tortorelli and Prof. Robert Haber

The objective of this thesis is to develop fictitious domain methods for shape and topology optimization of continuum structures in which an unambiguous definition of the geometry is available. We accomplish this by projecting the design onto a fixed analysis grid, thereby simplifying the response analysis by eliminating the need for re-meshing when the design changes.

## HONORS AND AWARDS

Caterpillar's Product Development & Global Technology Division *Move the Mountain Award* for the development of a Computational Method for Welding Sequence Optimization.

Danish Center for Applied Mathematics and Mechanics Grant to attend Ph.D. course on "Optimal Designs: Size, Shape and Topology, Jun. 2002

General Scholarship for Graduate Studies Overseas, The Foundation for the Future of Colombia (COLFUTURO), 1999

Meritorious Thesis, Universidad Nacional de Colombia, 1997

## PROFESSIONAL EXPERIENCE

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- **Engineering Supervisor, Product Optimization, Caterpillar Inc., Jan. 2014–Jul. 2014.** Led a highly talented group with an internal budget of over \$2M to conduct research on structural and multidisciplinary optimization methodologies for virtual product development, develop and deploy in-house software, and apply these methodologies to reduce the weight, decrease the cost, and improve the performance of structural components and machine systems for various machines across Caterpillar's product line.
- **Visiting Lecturer, Dept. of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Jan. 2014–May 2014.** Taught the *ME 570 – Nonlinear Solid Mechanical Design* course, which combines continuum mechanics, finite element analysis and design sensitivity analysis to prepare students for research on design, inverse analysis, and reliability analysis of continuous solids.
- **Engineering Supervisor, Structural Optimization, Caterpillar Inc., Jan. 2012–Dec. 2013** Led the Structural Optimization group to perform research and development for structural design exploration, in particular in the areas of structural topology and shape optimization, welding sequence optimization, fixture optimization and pin joint design. Served as Technology Owner of the Large Structures and Linkage Structures Technology Group, part of the Virtual Product Development program, whereby product groups pool funds to execute initiatives to advance the application of simulation-based design and validation in product development.
- **Engineering Specialist Research/Development, Caterpillar Inc., Apr. 2010–Dec. 2011.** Conducted research on, developed numerical methods for, and wrote computer codes to perform fatigue-based topology optimization and welding sequence optimization.
- **Sr. Research Engineer, Caterpillar Inc., Apr. 2006–Mar. 2010.** Performed research of methodologies for stress-based topology optimization and the use of Analytical Target Cascading for multi-mode inverse optimization for tuning of a 1-D combustion engine simulation (both in collaboration with the University of Illinois).
- **Sr. Project Engineer, Belcan Corporation, Dec. 2004–Mar. 2006.**
- **Graduate Research Assistant, Center for Process Simulation and Design, University of Illinois at Urbana-Champaign, Aug. 2001–Dec. 2004.**

## PROFESSIONAL AFFILIATIONS AND SERVICE

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### AMERICAN SOCIETY OF MECHANICAL ENGINEERS

- Member and Industry Liaison of the Design Automation Committee, *Mar. 2012–Aug. 2014*
- Co-organizer, Paper Review Coordinator and Co-Chair of Technical Session on "Design of Engineering Materials and Structures" at the *40th Design Automation Conference*, Buffalo, New York, Aug. 2014.

- Co-organizer and Paper Review Coordinator of Technical Session on “Design of Engineering Materials and Structures” at the *39th Design Automation Conference*, Portland, Oregon, Aug. 2013.
- Organizer of Panel on “Industrial Design Automation in the Cloud: Opportunities and Challenges” at the *38th Design Automation Conference*, Chicago, Illinois, Aug. 2012
- Co-organizer and Paper Review Coordinator of Technical Session on “Novel Applications of Structural Optimization” at the *38th Design Automation Conference*, Chicago, Illinois, Aug. 2012.

#### AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

- Member
- Former member of the Multidisciplinary Optimization Technical Committee, *Apr. 2008–Jan. 2011*
- Session Chair and Paper Reviewer of Technical Sessions on “MA&O - Product Design” and “Topology Optimization” at the *13th AIAA/ISSMO Multidisciplinary Analysis Optimization (MAO) Conference*, Fort Worth, Texas, Sep. 2010.

#### INTERNATIONAL SOCIETY OF STRUCTURAL AND MULTIDISCIPLINARY OPTIMIZATION

- Member
- Member of Scientific Advisory Committee and Co-organizer of Technical Session on “Topology Optimization” for the 2013 World Congress in Structural and Multidisciplinary Optimization in Orlando, Florida, May 2013.

#### OTHER PROFESSIONAL SERVICE

- **Review Editor, Journal of Structural and Multidisciplinary Optimization**, *Dec. 2013–Present*.
- Reviewer for the following publications: Mechanism and Machine Theory, ASME Journal of Mechanical Design, Computer-Aided Design, Computer Methods in Applied Mechanics and Engineering, and Finite Elements in Analysis and Design
- Panelist for NSF Proposal Review Panels for the Division of Civil, Mechanical and Manufacturing Innovation
- Co-organizer of Technical Session on “Shape and topology optimization” at the *10th U.S. National Congress on Computational Mechanics*, Columbus, Ohio, Jul. 2009.

#### TEACHING EXPERIENCE

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- **Visiting Lecturer, University of Illinois at Urbana-Champaign**, *Dec. 2013–May 2014*.
- **Instructor on Structural Optimization Classes, Caterpillar Inc.**, *2007–2013*. Over the course of five years, designed and delivered classes on structural optimization to more than a hundred engineers across the corporation. Also taught and mentored on an individual basis engineers from other facilities who requested to be stationed in my group.

#### PUBLICATIONS

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1. Bryan Bell, Julian Norato and Daniel Tortorelli, “A Geometry Projection Method for Continuum-Based Topology Optimization of Structures”, *Proceedings of the 14th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference*, Sep. 2012.
2. Julian Norato and Amy Wagoner Johnson, “A computational and cellular solids approach to the stiffness-based design of bone scaffolds”, *ASME Journal of Biomechanical Engineering*, 133(9), 2011.

3. Chau Le, Julian Norato, Tyler Bruns, Christopher Ha and Daniel Tortorelli, “Stress-based topology optimization for continua”. *Structural and Multidisciplinary Optimization*, 41(4), p. 605-620, 2010.
4. Mariana Silva, Daniel A. Tortorelli, Julian A. Norato, Christopher Ha and Ha-Rok Bae, “Component and system reliability-based topology optimization using a single-loop method”. *Structural and Multidisciplinary Optimization*, 41(1), p. 87-106, 2010.
5. Shen Lu, Harrison M. Kim, Julian Norato, and Christopher Ha. “Analytical Target Cascading for Multi-Mode Design Optimization: An Engine Case Study”, *Proceedings of the 4th AIAA Multidisciplinary Design Optimization Specialist Conference*, 2008.
6. Julian A. Norato, Martin P. Bendsøe, Robert B. Haber and Daniel A. Tortorelli, “A topological derivative method for topology optimization”. *Structural and Multidisciplinary Optimization*, 33(4-5), p. 375-386, 2007.
7. Julian A. Norato, Robert B. Haber, Daniel A. Tortorelli, and Martin P. Bendsøe. “A Geometry Projection and Optimality Criterion Method for Topology Optimization using the Topological Derivative”, *Proceedings of the 6th World Congress on Structural and Multidisciplinary Optimization, Rio de Janeiro*, 2005.
8. Julian A. Norato, Robert B. Haber, Daniel A. Tortorelli and Martin P. Bendsøe, “A geometry projection method for shape optimization”. *International Journal for Numerical Methods in Engineering*, 60(14), p. 2289-2312, 2004.

## PATENT APPLICATIONS

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1. Julian Norato, Chau Le, Dan Tortorelli, and Christopher Ha, “Fatigue-based topology optimization method and tool”. Filed Nov. 2012.
2. Julian Norato, Sungmoon Jung, Badrinarayan Athreya, and Christopher Ha, “An efficient virtual approach for welding sequence optimization”. Filed Nov. 2011. U.S. Patent Application 13/166,181.

## TALKS

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### CONFERENCE PRESENTATIONS

1. “A Method for Fatigue-Based Topology Optimization”, *10th World Congress in Structural and Multidisciplinary Optimization*, Orlando, Florida, May 2013
2. “A Geometry Projection Method for Continuum-Based Topology Optimization of Structures”, *14th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference*, Indianapolis, Indiana, Sep. 2012
3. “A cellular solids model for the design of bone scaffolds for stiffness”, *48th Annual Technical Conference of Society of Engineering Sciences*, Evanston, Illinois, Oct. 2011.
4. “Large-scale stress-based topology optimization with regional constraints”, *10th U.S. National Congress on Computational Mechanics*, Columbus, Ohio, Jul. 2009.
5. “A Fully-Stressed Design, Geometry Projection Method for Topology Optimization with Fatigue”, *9th U.S. National Congress on Computational Mechanics*, San Francisco, California, Jul. 2007.
6. “A topological derivative-based method for topology optimization”, *8th U.S. National Congress on Computational Mechanics*, Austin, Texas, Jul. 2005.
7. “A geometry projection method for shape optimization with design-dependent loads”, *7th U.S. National Congress on Computational Mechanics*, Albuquerque, New Mexico, Jul. 2003.
8. “Anisotropic filtering in topology optimization”, *6th U.S. National Congress on Computational Mechanics*, Dearborn, Michigan, Jul. 2001.
9. “Computational tools for architecture”, *International Congress of Theoretical and Applied Mechanics*, Chicago, Illinois, Jul. 2000.

**INVITED TALKS**

1. “Structural Optimization at Caterpillar”, Panel Discussion on Industrial Applications of Structural and Multidisciplinary Optimization at the *10th World Congress in Structural and Multidisciplinary Optimization*, Orlando, Florida, May 2013.
2. “Structural Design Exploration at Caterpillar”, Lindbergh Lecture, *Department of Mechanical Engineering Seminar*, University of Wisconsin, Madison, Wisconsin, Apr. 2013.
3. “Structural Optimization: Are We There Yet? (An Industry Perspective)”, Keynote Industry Talk at the *Symposium on Structural Multidisciplinary Design and Simulation-Based Optimization: Recent Applications & Future.*, Northwestern University, Evanston, Illinois, Dec. 2012.
4. “Multidisciplinary Optimization at Caterpillar”, Industry Panel at the *National Science Foundation Workshop on the Future of Multidisciplinary Design Optimization: Advancing the Design of Complex Systems*, Fort Worth, Texas, Sep. 2010.
5. “Challenges and Trends in Industrial Topology Optimization”, *Department of Civil and Environmental Engineering Seminar*, Cornell University, Ithaca, New York, Mar. 2007.

**COMMUNITY SERVICE**

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- Board Member - *Illini Robotics*, Apr. 2012–Aug. 2014. Illini Robotics is a non-profit organization with the goals of supporting FIRST robotics teams, engendering interest in science and engineering –especially in robotics– in grade school students, participating in events to raise profile of robotics, and hosting regional robotics tournaments.

**LANGUAGES**

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Fluent in Spanish and English.