

# MARIA HOLLAND

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## EDUCATION

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- Ph.D.**, Mechanical Engineering 2017  
Stanford University (Stanford, CA)  
Dissertation: “Computational Modeling of the Brain: Development, Health, and Disease”  
Advisor: Ellen Kuhl
- M.S.**, Mechanical Engineering 2013  
Stanford University (Stanford, CA)
- B.S.**, Mechanical Engineering 2011  
University of Tulsa (Tulsa, OK)  
Magna cum laude, Minors: Mathematics & Chinese
- Certificate**, Chinese Language & Culture 2010  
Xiamen University (Xiamen, Fujian Province, China)

## PROFESSIONAL APPOINTMENTS

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- University of Notre Dame (Notre Dame, IN)  
Clare Boothe Luce Assistant Professor, Department of Aerospace & Mechanical Engineering 2017–  
Assistant Professor, Bioengineering Graduate Program 2017–  
Member, Institute for Precision Health 2018–  
Member, Neuroscience & Behavior Program 2019–
- Stanford University (Stanford, CA)  
Visiting Assistant Professor, Department of Mechanical Engineering 2017

## PUBLICATIONS

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### *Peer-Reviewed Journal Publications (corresponding\* ; trainees)*

- [13] Darayi M, Hoffman, ME, Sayut J, Wang S, Demirci N, Consolini J, **Holland MA\*** (submitted). “Computational models of cortical folding: a review of common approaches.”
- [12] Lee T, **Holland MA**, Weickenmeier J, Gosain AK, and Tepole AB\* (2021). “The Geometry of Incompatibility in Growing Soft Tissues: Theory and Numerical Characterization”. *Journal of the Mechanics and Physics of Solids* 146:104177. DOI: 10.1016/j.jmps.2020.104177
- [11] Wang S, Demirci N, and **Holland MA\*** (2020). “Numerical Investigation of Biomechanically Coupled Growth in Cortical Folding”. *Biomechanics and Modeling in Mechanobiology*. DOI: 10.1007/s10237-020-01400-w
- [10] Darayi M and **Holland MA\*** (2020). “Surface Pressure Reduces Stability in Bilayered Systems under Compression”. *International Journal of Non-Linear Mechanics* 127:103589. DOI: 10.1016/j.ijnonlinmec.2020.103589

- [9] **Holland MA**, Budday S, Li G, Shen D, Goriely A\*, and Kuhl E (2020). “Folding Drives Cortical Thickness Variations”. *The European Physical Journal Special Topics* 229 (17-18):2757–2778. DOI: 10.1140/epjst/e2020-000001-6
- [8] Colin J, Darayi M, and **Holland MA\*** (2019). “Stiffness Contrast and Separation Influence Wrinkling of Adjacent Layers in a Homogeneous Matrix”. *Journal of Applied Mechanics* 86 (4):041004. DOI: 10.1115/1.4042430
- [7] Colin J and **Holland MA\*** (2019). “Layer Wrinkling in an Inhomogeneous Matrix”. *International Journal of Solids and Structures* 156-157:119–125. DOI: 10.1016/j.ijsolstr.2018.08.004
- [6] **Holland MA**, Budday S, Goriely A, and Kuhl E\* (2018). “Symmetry Breaking in Wrinkling Patterns: Gyri Are Universally Thicker than Sulci”. *Physical Review Letters* 121:228002. DOI: 10.1103/physrevlett.121.228002
- [5] Oomen PJA, **Holland MA**, Bouten CVC, Kuhl E, and Loerakker S\* (2018). “Growth and Remodeling Play Opposing Roles during Postnatal Human Heart Valve Development”. *Scientific Reports* 8 (1). DOI: 10.1038/s41598-018-19777-1
- [4] **Holland MA**, Li B, Feng XQ, and Kuhl E\* (2017). “Instabilities of Soft Films on Compliant Substrates”. *Journal of the Mechanics and Physics of Solids* 98:350–365. DOI: 10.1016/j.jmps.2016.09.012
- [3] **Holland MA**, Miller KE, and Kuhl E\* (2015). “Emerging Brain Morphologies from Axonal Elongation”. *Annals of Biomedical Engineering* 43 (7):1640–1653. DOI: 10.1007/s10439-015-1312-9
- [2] **Holland MA**, Kosmata T, Goriely A, and Kuhl E\* (2013). “On the Mechanics of Thin Films and Growing Surfaces”. *Mathematics and Mechanics of Solids* 18 (6):561–575. DOI: 10.1177/1081286513485776
- [1] Zöllner AM, **Holland MA**, Honda KS, Gosain AK, and Kuhl E\* (2013). “Growth on Demand: Reviewing the Mechanobiology of Stretched Skin”. *Journal of the Mechanical Behavior of Biomedical Materials* 28:495–509. DOI: 10.1016/j.jmbbm.2013.03.018

### Other Publications

- [1] **Holland MA** (2018). *Hitchhiker’s Guide to Abaqus*. DOI: 10.5281/zenodo.1243270

### SOFTWARE & CODE

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- [1] **Growth** (author and maintainer): Subroutines and input files for modeling growth in Abaqus. DOI: 10.5281/zenodo.3862950

### HONORS & AWARDS

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- Clare Boothe Luce Professorship, Henry Luce Foundation 2017–
- Diversifying Academia, Recruiting Excellence (DARE) Fellowship, Stanford University 2015–2017
- Brit and Alex d’Arbeloff Graduate Fellowship, Stanford University 2011–2016
- Phi Beta Kappa 2011
- China Scholarship Council Scholarship, Chinese Ministry of Education 2009–2010
- Morris K. Udall Scholarship 2009–2010
- Barry M. Goldwater Scholarship 2008–2010

## GRANTS & FELLOWSHIPS

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### **Active**

- Pontificia Universidad Católica de Chile Open Seed Fund 1/1/2021–6/30/2022  
Mechanical correction of brain cortical thickness with deep learning  
(Sahli Costabal, PI)
- I-CTSI Core Pilot 7/1/2019–6/30/2020  
Mechanobiology of dura mater growth: an *in vivo* and *ex vivo* longitudinal study  
(Holland, PI; Collaborators Ravosa & Goergen)
- NSF IIS-1850102 CISE Research Initiative 6/1/2019–5/31/2022  
CRII: SCH: A computational toolbox for analysis of big brain data  
+ Research Experiences for Undergraduates Supplement  
(Holland, PI)

### **Completed**

- ND Advanced Diagnostics & Therapeutics Discovery Award 8/16/2018–8/15/2019  
Cortical thickness variation as a biomarker for Autism Spectrum Disorders  
(Holland, PI)
- NSF OISE-1515340 East Asia & Pacific Summer Institute 6/1/2015–5/31/2016  
EAPSI: Investigation of the wrinkling and buckling behavior of layered  
soft materials with applications in the developing brain  
(Holland, PI)
- NSF DGE-1147470 Graduate Research Fellowship 9/1/2013–8/31/2017  
Establishing, calibrating, and validating a mechanistic, patient-specific,  
multiscale model for heart failure through sarcomerogenesis  
(Holland, Fellow)

## PRESENTATIONS

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### **Conference and Workshop Keynotes and Invited Talks**

- [2] “Mechanics-informed analysis of cortical thickness,” International Brain Mechanics and Trauma Lab International Workshop. Virtual, April 2021.
- [1] “The role of physical forces in the evolution of cortical morphogenesis,” American Physical Society, March Meeting. Denver, CO, Mar 2020 (meeting canceled; talk delivered at the Virtual March Meeting).

### **Invited Seminars**

- [14] “Emergent heterogeneity & other surprises in cortical folding” Purdue University, Weldon School of Biomedical Engineering. West Lafayette, IN, March 2021.
- [13] “Brain folding as a soft layered instability: Unique features and puzzles,” University of Florida, Department of Biomedical Engineering. Gainesville, FL, March 2021.
- [12] “Instabilities in soft materials: Emergent heterogeneity & other surprises,” University of Connecticut Dept. of Mechanical Engineering. Storrs, CT, Oct 2019.
- [11] “Mechanics of brain morphology: Cortical thickness variations,” Stanford University School of Engineering. Stanford, CA, Nov 2018.
- [10] “Mechanics of instabilities in the brain and other soft materials,” Indiana U. - Purdue U. Indianapolis Dept. of Mechanical & Energy Engineering. Indianapolis, IN, Sep 2018.

- [9] “Computational mechanics of morphology in the brain,” University of Xiamen School of Architectural & Civil Engineering. Xiamen, China, July 2018.
- [8] “Computational mechanics of morphology in the brain,” Tsinghua University Institute of Biomechanics and Medical Engineering. Beijing, China, July 2018.
- [7] “Computational modeling of the brain: Development, health, and disease,” University of Texas at El Paso Dept. of Mechanical Engineering. El Paso, TX, March 2017.
- [6] “Computational modeling of the brain: Development, health, and disease,” Catholic University of America Dept. of Mechanical Engineering. Washington, D.C., March 2017.
- [5] “Computational modeling of the brain: Development, health, and disease” University of Notre Dame Dept. of Aerospace & Mechanical Engineering. Notre Dame, IN, March 2017.
- [4] “Computational modeling of the brain: Development, health, and disease,” University of Tulsa Dept. of Mechanical Engineering. Tulsa, OK, March 2017.
- [3] “Computational modeling of the brain: Development, health, and disease,” Villanova University Dept. of Mechanical Engineering. Villanova, PA, February 2017.
- [2] “Computational modeling of the brain: Development, health, and disease,” University of Texas at Dallas Dept. of Mechanical Engineering. Richardson, TX, February 2017.
- [1] “Computational modeling of the brain: Development, health, and disease” University of North Texas Dept. of Mechanical & Energy Engineering. Denton, TX, January 2017.

#### ***Conference Presentations (trainees)***

- [20] Demirci N and **Holland MA**. “Cortical thickness distribution of the human cerebral cortex identified by curvature at local scales,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2021.
- [19] Wang S, Demirci N, Castro Solar V, **Holland MA**, and Sahli Costabal F. “In vivo quantification of brain morphologies via mechanics-informed deep learning approach,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2021.
- [18] Hoffman ME, Demirci N, and **Holland MA**. “The relation between cortical thickness and morphology: a study of nonhuman primate brains,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2021.
- [17] Wang S and **Holland MA**. “Coupled bio-mechanical growth in cerebral gyrification,” *World Congress of Computational Mechanics*. Paris, France, July 2020 (meeting canceled).
- [16] Darayi M and **Holland MA**. “Buckling under pressure: Does the cerebrospinal fluid affect the wrinkling instabilities in the brain?” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2020.
- [15] Demirci N and **Holland MA**. “Quantitative investigation of the folding patterns of the human cerebral cortex,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2020.
- [14] Wang S and **Holland MA**. “Numerical investigation of biomechanically-coupled growth in brain gyrification,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2020.
- [13] Hoffman ME, Sayut JP, and **Holland MA**. “Analyzing the cortical thickness of mammalian species through the segmentation of magnetic resonance imaging scans,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Virtual, June 2020.

- [12] Demirci N, Wang S, and **Holland MA**. “Mechanics-informed big data analysis of cortical thickness,” *Sixth Annual Brain Initiative Investigators Meeting*. Washington, D.C., Jan 2020.
- [11] **Holland MA**, Kuhl E, and Goriely A. “Passive physical forces in gyrification lead to characteristic cortical thickness variations,” *Society for Neuroscience Annual Meeting*. Chicago, IL, Oct 2019.
- [10] **Holland MA**. “Kinematic measures influence cortical thickness,” *Biomedical Engineering Society Annual Meeting*. Philadelphia, PA, Oct 2019.
- [9] **Holland MA**, Darayi M, Hoffman ME, Twohy K, Hardan AY, Goriely A, and Kuhl E. “Image-based analysis of cortical thickness patterns,” *U.S. National Congress of Computational Mechanics*. Austin, TX, July 2019.
- [8] Darayi M, Colin, J, and **Holland MA**. “Linear stability analysis of bilayer wrinkling in an infinite-sized homogeneous matrix,” *U.S. National Congress of Computational Mechanics*. Austin, TX, July 2019.
- [7] **Holland MA**, Kuhl E, and Goriely A. “Cortical thickness differences emerge from passive physical forces generated by growth,” *Summer Biomechanics, Bioengineering, and Biotransport Conference*. Seven Springs, PA, June 2019.
- [6] **Holland MA**, Goriely A, and Kuhl E. “Physiological and pathological cortical thickness variations,” *World Congress of Computational Mechanics*. New York, NY, July 2018.
- [5] **Holland MA**, Hardan AY, Goriely A, and Kuhl E. “Thickness variations resulting from symmetry breaking in soft matter instabilities,” *U.S. National Congress for Theoretical and Applied Mechanics*. Chicago, IL, June 2018.
- [4] **Holland MA**, Li B, Feng XQ, and Kuhl E. “Instabilities in growing or compressed bilayered systems with low stiffness contrast,” *World Congress of Computational Mechanics*. Seoul, South Korea, July 2016.
- [3] Vijayakumar N, **Holland MA**, and Kuhl E. “A mechanical model for cortical folding during brain development,” *Summer Biomechanics, Bioengineering and Biotransport Conference*. Snowbird, UT, June 2015.
- [2] **Holland MA** and Kuhl E. “The effect of white matter anisotropy on cortical folding during development,” *World Congress of Computational Mechanics*. Barcelona, Spain, July 2014.
- [1] **Holland MA**, Steinmann P, and Kuhl E. “Theory and numerics of volume and surface growth in the developing brain,” *U.S. National Congress of Computational Mechanics*. Raleigh, NC, July 2013.

### ***Internal Presentations***

- “Biomechanics: A new tool for understanding brain development,” St. Mary’s College Master of Autism Studies Program. Notre Dame, IN, Mar 2019.
- “Neuromechanics across the scales,” University of Notre Dame Department of Biological Sciences. Notre Dame, IN, Jan 2019.

## **TEACHING**

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### ***Instructor of Record***

Notre Dame AME 60624: Continuum Mechanics

- Spring 2020: 10 students

Notre Dame AME 50572: Introduction to Biomechanics (new course developed)

- Spring 2021: 44 students
- Fall 2019: 37 students
- Spring 2019: 40 students
- Spring 2018: 34 students

### ***Guest Lectures***

- Master of Autism Studies Program, St. Mary's University 2019

### ***Course Assistant***

- Stanford Graduate Summer Institute: Jumpstart Your Academic Job Search 2016-2017
- Stanford ME 337: Mechanics of Growth 2013

### ***Pedagogical Training***

- A Practical Guide to Teaching and Learning in STEM conference (Notre Dame) 2018
- Stanford EDUC 297: Teaching and Learning in Higher Education 2016
- Stanford ENGR 312: Science and Engineering Course Design 2015

## **RESEARCH ADVISING**

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### ***Postdoctoral Scholars***

- Shuolun Wang (NJIT Ph.D. '18) 2019–
  - Publications: 11, 13
  - Presentations: 9, 11, 14, 16

### ***Graduate Students***

- Fatemeh Jafarabadi (Notre Dame AME Ph.D. program) 2021–
- Katie Lindsley (Notre Dame AME M.S. program) 2020–
- Jack Consolini (Notre Dame AME Ph.D. program) 2020–
  - Publications: 13
- Nagehan Demirci (Notre Dame BIOE Ph.D. program) 2019–
  - Publications: 11, 13
  - Presentations: 9, 12, 15, 16, 17
- Mohsen Darayi (Notre Dame AME Ph.D. program) 2018–
  - Publications: 8, 10, 13
  - Presentations: 5, 6, 13

### ***Undergraduate Students***

- John Sayut (Notre Dame B.S.M.E. '22) Spring 2019–
  - Awards: Sorin Scholar (2019), Naughton Fellow (2020, canceled)
  - Publications: 13
  - Presentations: 10
- Mia Hoffman (Notre Dame B.S.M.E. '21) Fall 2018–

- Awards: NSF Graduate Research Fellowship (2021)
- Publications: 13
- Presentations: 6, 10, 15
- Kyra Twohy (Notre Dame B.S.M.E. ‘18) Spring 2018
  - Current Position: Ph.D. student at U. Delaware
  - Presentations: 6
- Nithya Vijayakumar (Stanford B.S.M.E. ‘15) Summer 2014
  - Current Position: M.D. student at U. Michigan
  - Presentations: 0
- Nick Forsch (Wash U. B.S.M.E. ‘14) Summer 2013
  - Current Position: Ph.D candidate at UC San Diego

### ***Supervisory Committees***

- Zoë Penko (AME Ph.D. qualifying exam) May 2020
- Erin Archibeck (AME B.S. DaVinci program) April 2020
- Adam Hellinghausen (AME B.S. DaVinci program) April 2020
- Marzieh Mirhoseini (AME Ph.D. qualifying exam) Aug 2019
- Megan Levis (BioE Ph.D. candidacy exam) July 2019
- Roopak Karulkar (AME Ph.D. qualifying exam) May 2019

## **SERVICE**

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### ***Professional Service***

- Fellow, NSF CMMI Game Changer Academy for Advancing Research Innovation 2021
- Organizer, “Machine Learning for Biological Modelling and Simulation” Minisymposium Nov 2021  
*Pan American Congress on Computational Mechanics*, Rio de Janeiro, Brazil
- Organizer, “Imaging-based methods in computational medicine” Minisymposium Sep 2021  
*International Symposium on Computer Methods in Biomechanics and Biomedical Engineering*, Bonn, Germany
- Organizer, “Growth and remodeling of living tissues” Minisymposium July 2021  
*U.S. National Congress on Computational Mechanics*, Chicago, IL
- Organizer, “Imaging-based methods in computational medicine ” Minisymposium July 2021  
*U.S. National Congress on Computational Mechanics*, Chicago, IL
- Organizer, “Mechanics of brain development” Minisymposium July 2020  
*World Congress on Computational Mechanics*, Paris, France (meeting canceled)
- Organizer, “Imaging-based modeling in biomechanics” Minisymposium July 2019  
*U.S. National Congress on Computational Mechanics*, Austin, TX
- Panelist, National Science Foundation, Division of Civil, Mechanical & Manufacturing Innovation
- Reviewer, *Nature Communications*, *Journal of the Mechanics and Physics of Solids*, *Journal of Biomechanics*, *Journal of the Mechanical Behavior of Biomedical Materials*, *Mathematics and*

*Mechanics of Solids, Cerebral Cortex, International Journal of Non-Linear Mechanics, Advanced Biosystems* (for complete list, see Publons)

### **University & Department Service**

- AME Diversity & Inclusion Coordinator 2019–
- AME faculty search committee, member 2019-2020
- Notre Dame Introduction to Engineering Summer Program, speaker 2018  
Lectured on “Introduction to [Brain] Biomechanics”.
- Notre Dame College of Engineering Future Faculty Workshop, moderator 2018  
Participated in panel on “Preparing a Research and Teaching Statement”.
- Stanford University Career Education, instructor 2016–2017  
Presented workshop on “Writing an Effective Diversity Statement”.
- Stanford University Committee for Graduate Studies, student member 2014–2017  
Reviewed, formulated, and approved policies governing graduate education.
- Stanford University Office of Community Standards, judicial panelist 2015–2016  
Adjudicated cases involving violations of academic integrity.

### **Mentoring**

- Building Bridges, mentor 2019–  
Mentored first-year underrepresented student to adjust to college and explore majors.
- Advancing Women Leaders, mentor 2018–  
Met regularly with mentee to discuss personal & professional development.
- Society of Women Engineers and El Centro Chicano y Latino, mentor 2012–2015  
Met regularly one-on-one with three undergraduates to facilitate the transition to college and advise on majors, courses, activities, time management, etc.

### **Outreach**

- ScienceWorld, interviewee 2020  
Described the science of yo-yo-ing for a student-oriented science magazine.
- Biomechanics in the Wild student blog, podcast, and Youtube channel; creator 2019–  
Started student-written blog to introduce interesting biomechanics topics to the general public.
- American Society of Mechanical Engineers, “Pizza and Professors” speaker 2019  
Spoke to undergraduate students about my research.
- High School outreach, speaker 2018  
Spoke to classes at Coon Rapids and Blaine High Schools in Minnesota.

### **MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS**

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- American Physical Society, member 2020–
- Sigma Xi, The Scientific Research Honor Society, member 2019–
- Biomedical Engineering Society (BMES), member 2019–2020
- Society for Neuroscience (SfN), member 2019–
- Society of Women Engineers (SWE), member 2019–



- American Society of Mechanical Engineers (ASME), member 2018–
- International Association for Computational Mechanics (IACM), member 2018–
- US Association for Computational Mechanics (USACM), member 2018–
- American Society for Engineering Education (ASEE), member 2018–