

# CURRICULUM VITAE

PAUL EGAN, PH.D.

Laboratory for Orthopaedic Technology  
Postdoctoral Research Fellow

Swiss Federal Institute of Technology (ETH Zurich)  
pegan@ethz.ch <http://paul-egan.com>



## EDUCATION

### Carnegie Mellon University

Department of Mechanical Engineering

Pittsburgh, Pennsylvania  
2009-2014

#### Ph.D., Mechanical Engineering

May 2014

Advisor: Dr. Jonathan Cagan  
Co-Advisor: Dr. Phillip LeDuc

Dissertation: "Cognitive and Agent-based Design Methodologies  
for Engineering Complex Biological Systems."

Concentrations: Design Theory and Methodology,  
Computational Design,  
Biophysical Modeling,  
Complex Systems,  
Cognitive Science

#### M.S., Mechanical Engineering

December 2010

Advisor: Dr. Jonathan Cagan  
Focus: Numerical Methods in Engineering,  
Integrated Product Design,  
Design for Manufacturing

### Oklahoma State University

Department of Mechanical and Aerospace Engineering

Stillwater, Oklahoma  
2004-2009

#### B.S., Aerospace Engineering

May 2009

#### B.S., Mechanical Engineering

May 2009

General Honor's Degree

May 2005

#### Additional Completed Majors:

**Applied Physics**  
**Philosophy**

### International Studies

ETH Zurich, German (A1)  
University of Canterbury  
Trinity University  
Cambridge University

Zurich, Switzerland  
Christchurch, New Zealand  
Dublin, Ireland  
Cambridge, England

Fall 2014 - Winter 2015  
Fall 2008  
Summer 2007  
Summers 2005, 2007

# JOURNAL PUBLICATIONS

## PUBLISHED

- [11] **Egan, P.**, V. Gonella, M. Engelsperger, S. Ferguson, and K. Shea. "Computationally designed lattices with tuned properties for tissue engineering using 3D printing." *PLoS One*, accepted, 2017.
- [10] **Egan, P.**, S. Ferguson, and K. Shea. "Design of hierarchical 3D printed scaffolds by considering mechanical and biological factors for bone tissue engineering." *Journal of Mechanical Design*, 139(6), pp.061401: 1-9, 2017.
- [9] **Egan, P.**, J. Cagan, C. Schunn, F. Chiu, J. Moore, and P. LeDuc. "The D3 Methodology: Bridging science and design for bio-based product development." *Journal of Mechanical Design*, 138(8), pp. 081101: 1-13, 2016.
- [8] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. "Improving human understanding and design of complex multi-level systems with animation and parametric relationship supports." *Design Science*, e3: pp. 1-31, 2015.
- [7] **Egan, P.**, B. Sinko, S. Ketan, and P. LeDuc. "The role of mechanics in biological and bio-inspired systems." *Nature Communications*, 6, pp. 1-11, 2015.
- [6] Stankovic, T., J. Mueller, **P. Egan**, and K. Shea. "Generalized optimality criteria for optimization of additively manufactured multi-material lattice structures." *Journal of Mechanical Design*, 137(11), pp. 111705: 1-12, 2015.
- [5] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. "Emergent systems energy laws for predicting myosin ensemble processivity." *PLOS Computational Biology*, 11(4), pp. e1004177: 1-16, 2015.
- [4] **Egan, P.**, J. Cagan, C. Schunn, and P. LeDuc. "Synergistic human-agent methods for deriving effective search strategies: The case of nanoscale design." *Research in Engineering Design*, 26(2), pp. 145-169, 2015.
- [3] **Egan, P.**, J. Cagan, C. Schunn, and P. LeDuc. "Design of complex biologically based nanoscale systems using multi-agent simulations and structure-behavior-function representations." *Journal of Mechanical Design*, 135(6), pp. 061005: 1-12, 2013.
- [2] Zapf, V., V. Correa, P. Sengupta, C. Batista, M. Tsukamoto, N. Kawashima, **P. Egan**, C. Pantea, A. Migliori, J. Betts, M. Jaime, and A. Paduan-Filho. "Direct measurement of spin correlations using magnetostriction." *Physical Review B*, 77(2), pp. 020404: 1-4, 2008.
- [1] Franco, A., V. Zapf, and **P. Egan**. "Magnetic properties of nanoparticles of  $\text{CoFe(3-x)O}_4$  prepared by combustion reaction." *Journal of Applied Physics*, 101(9), pp. 09M506: 1-3, 2007.

## IN PROCESS

- [4] **Egan, P.**, X. Wang, H. Greutert, K. Shea, K. Würtz-Kozak, and S. Ferguson. "Mechanical and biological characterization of 3D printed polymer lattices for bone tissue engineering." *in Preparation for 3D Printing and Additive Manufacturing*.
- [3] **Egan, P.**, K. Shea, and S. Ferguson. "Simulated biological tissue growth for 3D printed beam-based scaffolds." *in Preparation*; full manuscript available upon request.
- [2] **Egan, P.**, J. Moore, A. Ehlicher, D. Weitz, C. Schunn, J. Cagan, and P. LeDuc. "Robust mechanochemical systems functioning emerges from myosin isoform heterogeneity." *Submitted to PNAS*; full manuscript available upon request.
- [1] **Egan, P.**, C. Schunn, J. Cagan, T. Ho, and P. LeDuc. "The effects of training background and design tools on multi-level biosystems design." *in Preparation*.

## BOOK CHAPTER

- [1] **Egan, P.**, and J. Cagan. "Human and computational approaches for design problem-solving." *Experimental Design Research*. Springer House Publishing, 2016. pp. 187-205.

# CONFERENCE PROCEEDINGS

## PEER-REVIEWED PAPERS

- [13] **Egan, P.**, V. Gonella, M. Engelsperger, S. Ferguson, and K. Shea. "Design and fabrication of 3D printed tissue scaffolds informed by mechanics and fluids simulations." *ASME International Design Engineering Technical Conference*. Cleveland, OH, 2017 (10 pages).
- [12] **Egan, P.**, S. Ferguson, and K. Shea. "Design and 3D printing of hierarchical tissue engineering scaffolds based on mechanics and biology perspectives." *ASME International Conference on Design Theory and Methodology*. Charlotte, NC, 2016 (10 pages).
- [11] **Egan, P.**, J. Cagan, P. LeDuc, and C. Schunn. "The d<sub>3</sub> science-to-design methodology: Automated and cognitive-based processes for discovering, describing, and designing complex nanomechanical biosystems." *ASME International Conference on Design Theory and Methodology*. Boston, MA, 2015 (10 pages).
- [10] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. "Development of graphical user interfaces to improve human design proficiency for complex multi-level biosystems." **\*Best Paper Award\*** at *ASME Computers and Information in Engineering Conference*. Boston, MA, 2015 (10 pages).
- [9] Stankovic, T., J. Mueller, **P. Egan**, and K. Shea. "Optimization of additively manufactured multi-material lattice structures using generalized optimality criteria." **\*Best Paper Award\*** at *ASME Computers and Information in Engineering Conference*. Boston, MA, 2015 (10 pages).
- [8] Chen, T., **P. Egan**, F. Stoeckli, and K. Shea. "Studying the impact of incorporating an additive manufacturing based design exercise in a large, first year technical drawing and CAD course." *ASME International Conference on Design Theory and Methodology*. Boston, MA, 2015 (10 pages).
- [7] **Egan, P.**, T. Ho, C. Schunn, J. Cagan, and P. LeDuc. "The effects of training background and design tools on multi-level biosystems design." *International Conference on Engineering Design*. Milano, Italy, 2015 (9 pages).
- [6] **Egan, P.**, J. Cagan, C. Schunn and P. LeDuc. "Cognitive-based search strategies for complex bio-nanotechnology design derived through symbiotic human and agent-based approaches." *International Conference on Design Theory and Methodology*. Buffalo, NY, 2014. DETC2014-34714. (10 pages).
- [5] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. "Surprisingly stochastic: Learning and design application of emergent behavior using interactive simulations of nano-mechanical biological systems." *Annual Conference of the Cognitive Science Society*. Quebec City, CA, 2014. (6 pages).
- [4] **Egan, P.**, J. Cagan, C. Schunn, and P. LeDuc. "A modular design tool for visualizing complex multiscale systems." *International Conference on Engineering Design*. Seoul, South Korea, 2013. (9 pages).
- [3] **Egan, P.**, J. Cagan, C. Schunn, and P. LeDuc. "Utilizing emergent levels to facilitate complex systems design: demonstrated in a synthetic biology domain." *International ASME Design Automation Conference*. Portland OR, 2013. DETC2013-12072. (10 pages).
- [2] **Egan, P.**, J. Cagan, C. Schunn, and P. LeDuc. "Design of complex nano-scale systems using multi-agent simulations and structure-behavior-function representations." *ASME International Conference on Design Theory and Methodology*. Chicago, IL, 2012. pp. 793-804. (10 pages)
- [1] **Egan, P.**, P. LeDuc, J. Cagan, and C. Schunn. "A design exploration of genetically engineered myosin motors." *International ASME Design Automation Conference*. Washington DC, 2011. pp. 1017-1025 (10 pages).

## ADDITIONAL CONFERENCE PROCEEDINGS

- [6] **Egan, P.**, X. Wang, H. Greutert, K. Shea, K. Würtz-Kozak, and S. Ferguson. “Mechanical and biological characterization of 3D printed polymer lattices for bone tissue engineering.” *Swiss Society for Biomedical Engineering*. Winterthur, Switzerland, 2017. (Oral presentation and poster, accepted by abstract review)
- [5] **Egan, P.**, K. Shea, and S. Ferguson. “Tissue growth simulations for 3D printed scaffolds.” *European Society of Biomechanics*. Seville, Spain, 2017. (Oral presentation, accepted by abstract review)
- [4] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. “Multiscale modeling and optimization of natural and biomimetic myosin-based systems.” *World Congress of Biomechanics*. Boston, MA, 2014. (Oral presentation, invited).
- [3] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. “Robust active material components designed with agent-based myosin-actin simulations.” *Materials Research Society Meeting and Exhibit*. Boston, MA, 2013. (Poster session, accepted by abstract review).
- [2] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. “Probing why nature may favor heterogeneous myosin systems through single molecule and systems level approaches.” *Biophysical Society Annual Meeting, Systems Biology*. Philadelphia, PA, 2013. (Poster session, accepted by abstract review).
- [1] **Egan, P.**, C. Schunn, J. Cagan, and P. LeDuc. “Investigating heterogeneous system performance of synthetic myosins computationally.” *AIChE Synthetic and Systems Biology Conference*. Pittsburgh, PA, 2012. (Oral presentation, accepted by abstract review).

## INVITED TALKS

- [12] **Open Seminar**. “Computational design methods for biomechanics and 3D printing.” *Virginia Polytechnic Institute and State University*, Mechanical Engineering Department, Blacksburg, VA, 2017.
- [11] **Open Seminar**. “Computational design methods for biomechanics and 3D printing.” *Ecole polytechnique federale de Lausanne (EPFL)*, Mechanical Engineering Department, Lausanne, Switzerland, 2017.
- [10] **Internal Talk**. “Design and 3D printing of tissue scaffolds tuned for mechanics and biology.” *Swiss Federal Institute of Technology (ETH Zurich)*, for European Grants Commission and Postdoctoral Fellows, Zurich, Switzerland, 2017.
- [9] **Flash Talk**. “Design and 3D printing of tissue scaffolds with mechanics and biology perspectives.” *Life Sciences Post-doc Day*, Zurich, Switzerland, 2016.
- [8] **Open Seminar**. “Computational, human-centered, and manufacturing approaches for complex biological systems design.” *University of California Berkeley*, Mechanical Engineering Department, Berkeley, CA, 2016.
- [7] **Open Seminar**. “Cognitive and agent-based design methodologies for engineering complex biological systems.” *Northwestern University*, Mechanical Engineering Department, Evanston, IL, 2016.
- [6] **Flash Talk**. “Characterization, design, and fabrication of tissue engineering scaffolds for optimal mechanical and biological functioning.” *Life Sciences Post-doc Day*, Zurich, Switzerland, 2015.
- [5] **Outreach Talk**. “Overcoming the challenges of effective interdisciplinary communication.” *ASME IDETC conference FutureME speakers*, Boston, MA, 2015.
- [4] **Open Seminar**. “Computational, human-centered, and manufacturing approaches for complex biological systems design.” *University of Michigan*, Mechanical Engineering Department, Ann Arbor, MI, 2015.
- [3] **Open Seminar**. “Biological systems inspire non-obvious engineering design principles.” *Mechanics and Engineering of Cellular Systems Center*, Carnegie Mellon University, Pittsburgh, PA, 2013.

- [2] **Dynamic Talk.** "Designing complex systems in the human body." *ICED conference Young Member's Event*, Seoul, South Korea, 2013.
- [1] **Awards Seminar.** "State of the art in unmanned aerial vehical design at Oklahoma State University." *AIAA Conference*, Albuquerque, NM, 2009.

## SELECTED RESEARCH EXPERIENCES

<b>Postdoctoral Research</b> Stephen Ferguson Kristina Shea	<b>ETH Zurich</b> Laboratory of Orthopaedic Techonlogy Engineering Design and Computing Lab	Zurich, Switzerland Fall 2014-present
<b>Visiting Researcher</b> Mauro Ferrari	<b>Houston Methodist Research Institute</b> Nanomedicine, Biomechanics, and Cancer	Houston, TX Fall 2015
<b>Doctoral Research</b> Jonathan Cagan Philip LeDuc	<b>Carnegie Mellon University</b> Integrated Design Innovation Group Biomechanics and Cellular Systems	Pittsburgh, PA Fall 2009-2014
<b>Visiting Researcher</b> David Weitz Allen Ehrlicher Jeffrey Moore	<b>Harvard University and Boston University</b> Applied Physics and Soft Matter Biophysics and Protein Mechanics Physiology and Biophysics	Boston, MA Summer 2012
<b>Undergraduate Researcher</b> Larry Hoberock Doren Recker	<b>Oklahoma State University</b> Machine Vision and Robotics Philosophy of Science and Cognition	Stillwater, OK Fall 2008 Fall 2006-Fall 2009
<b>Research Internship</b> Richard Welle	<b>Aerospace Corporation</b> Microfluidics Research and Development	El Segundo, CA Summer 2007
<b>Research Internship</b> Viven Zapf	<b>Los Alamos National Laboratory</b> National High Magnetic Field Lab	Los Alamos, NM Summer 2006

## SELECTED HONORS

Favorable Submission for Branco Weiss Postdoctoral Fellowship (top 7% of 592)	2017
<b>Best Paper:</b> IDETC/CIE Conference for Additive Manufacturing and 3D-Printing	<b>2015</b>
<b>Best Paper:</b> IDETC/CIE Conference for Virtual Environments and Systems	<b>2015</b>
<b>ETH Zurich Postdoctoral Fellowship</b>	<b>2015</b>
Travel Scholarship for Bio-Inspired Design Workshop in Palo Alto California	2011
<b>National Defense Science and Engineering Graduate Fellowship (NDSEG)</b>	<b>2010</b>
Carnegie Institute of Technology Dean's Fellow	2009
<b>1<sup>st</sup> Place AIAA International Design Build Fly Competition</b>	<b>2009</b>
<b>Barry M. Goldwater Scholarship</b>	<b>2008</b>
Lew Wentz Foundation Research Scholarship	2006, 2007, 2008
Honor's Freshman Research Scholarship	2004
Oklahoma State Regent's Scholarship	2004
Valedictorian, Union High School	2004
Eagle Scout, Boy Scouts of America	2002



# SERVICE

**Organizer:** ASME Early Career Design and Advanced Manufacturing Market Segment Leadership Team, 2015-2016.

Design Society, Organizer for Young Member's Speakers Event for ICED Conference in Milan, Italy, 2015.

**Reviewer:** *Journal of Mechanical Design,*  
*Design Studies,*  
*3D Printing and Additive Manufacturing,*  
*PLoS One,*  
ASME IDETC/CIE Conference,  
Design Society ICED Conference.

# FUNDING

**NSF CMMI-1160840 Grant** 2012  
Significantly aided in writing with funded investigators (Jonathan Cagan and Philip LeDuc).  
Grant title: "Computational Design of Complex Multi-scale Systems: Design of Synthetic Muscle with Shape Grammars and Agent-based Search"

# TEACHING

**École Polytechnique Fédérale de Lausanne (EPFL)**  
Lecture for Short PhD Course: "Design for 3D printed Scaffolds" Fall 2017

**Swiss Federal Institute of Technology (ETH Zurich)**  
Developed and Taught Course (50%): Engineering Design Methods Fall 2015 - Spring 2016  
Research Skills for Engineering Design and Computing Lab Group Fall 2014 - Spring 2015

**Carnegie Mellon University**  
Teaching Assistant for Engineering Design: Grand Challenges Fall 2012  
Teaching Assistant for Engineering Design I Spring 2011

# ADVISING

**ETH Zurich**

Xiuyu Wang	Master's Thesis	2017 (6 months)
Veronica Gonella	Research Assistant	2016 (9 months)
Max Engensperger	Master's Thesis	2016 (6 months)
Fernando Rodriguez	Bachelor's Thesis	2011 (3 months)

**Carnegie Mellon University**

Felix Chiu	Undergraduate/Honor's Research	2011-2014 (36 months)
Tiffany Ho	Undergraduate/Honor's Research	2012-2013 (6 months)
Patra Virasathienpornkul	Undergraduate Project	2012 (6 months)
Xiaozhou Fu	Master's Project	2010-2011 (12 months)
Chao Li	Master's Project	2010-2011 (12 months)

## REFERENCES

**Carnegie Mellon University**

Prof. Dr. Jonathan Cagan	Design/Product Engineering	cagan@cmu.edu
Prof. Dr. Philip LeDuc	Mechanical/Bio-Engineering	pri@andrew.cmu.edu

**University of Pittsburgh**

Prof. Dr. Christian Schunn	Cognitive Science	schunn@pitt.edu
----------------------------	-------------------	-----------------

**University of Massachusetts, Lowell**

Prof. Dr. Jeffrey Moore	Wet-lab Experiments	Jeffrey_Moore@uml.edu
-------------------------	---------------------	-----------------------

**ETH Zurich**

Prof. Dr. Stephen Ferguson	3D Printing/Biomechanics	sferguson@ethz.ch
----------------------------	--------------------------	-------------------