Exponent®
Engineering & Scientific Consulting


# Lawren Gamble, Ph.D.

Senior Associate | Mechanical Engineering
Menlo Park
+1-650-688-7049 | lgamble@exponent.com


## Professional Profile

Dr. Gamble specializes in the analysis and testing of fluid structure interactions (FSI) which incorporates multi-disciplinary knowledge across the fields of mechanical engineering and fluid mechanics. Her experience extends to both computational methods, such as finite element analysis (FEA) and computational fluid dynamics (CFD), in addition to experimental methods and validation.

Dr. Gamble has extensive experience in data acquisition of multi-physics problems, 3D printing and additive manufacturing, and wind tunnel testing. Her breadth of experience also extends to vibration testing, unmanned aerial vehicle (UAV) wing design and analysis, smart and shape memory material applications, composite materials, and digital imaging. She has applied her expertise in these areas to projects on modal analysis of 3D printed piezoelectric sensors, and morphing aero-control devices in aircraft and automobiles.

Prior to joining Exponent, Dr. Gamble's postdoctoral research at the University of Michigan experimentally and computationally investigated the load-alleviation properties of bird-inspired flexible wings. During this research, she developed a custom FSI framework to model geometrically nonlinear structures interacting with fluids and verified it using commercial software (Ansys). Through cross-disciplinary collaborations, Dr. Gamble also conducted vibration testing and static wind tunnel testing on a 3D printed feather sensor with piezoresistive and piezoelectric sensing capabilities to characterize the sensor's performance. She incorporated her passion for photography and digital imaging into these experiments by designing a stereo photography test setup to visually measure the aero-structural coupling of the sensor under aerodynamic loads. During her postdoctoral fellowship, she also co-taught "Introduction to Solid Mechanics and Aerospace Structures".

Dr. Gamble's graduate research at the University of Michigan further drew inspiration from birds to identify ways in which gliding UAVs could operate with improved efficiency and maneuverability by developing and analyzing bioinspired morphing aircraft. She redesigned traditional aircraft control surfaces using novel bioinspired morphing mechanisms which were actuated using piezoelectric composites and shape memory alloys. She experimentally and numerically analyzed their aero-structural performance and control effectiveness. Dr. Gamble also numerically modeled the response of piezoelectric composites using finite element software (Abaqus). Her graduate degree included experience in structural dynamics, fluid dynamics, composites, and finite element methods. She has also worked on developing similar active morphing control surfaces for automotive applications.

## Academic Credentials & Professional Honors

M.S.E., Aerospace Engineering, University of Michigan, Ann Arbor, 2018

Ph.D., Aerospace Engineering, University of Michigan, Ann Arbor, 2018

 

B.S., General Engineering, Smith College, 2014

## Professional Affiliations

American Institute of Aeronautics and Astronautics (AIAA)

## Patents

US Patent 15/916,048: Active aero device to attenuate wind throb, September 2019 (Howard K, Lietz R, Romig J, Gamble L, Inman D, Gulker WS, and Poliakov A).

## Publications

Shaffer CM, Deo A, Tudor A, Shenoy R, Danesh CD, Nathan D, Gamble LL, Inman DJ, Chen Y. Self-Programming Synaptic Resistor Circuit for Intelligent Systems. Advanced Intelligent Systems. 2021; 3:2100016.

Gamble LL, Harvey C, Inman DJ. Load alleviation of feather-inspired compliant airfoils for instantaneous flow control. Bioinspiration & Biomimetics. 2020; 15:056010.

Gamble LL, Inman DJ. A tale of two tails: Developing an avian inspired morphing actuator for yaw control and stability. Bioinspiration & Biomimetics. 2018; 13:026008.

Gamble LL, Inman DJ. Why morphology matters in birds and UAV's: How scale affects attitude wind sensitivity. Applied Physics Letters. 2017;111(20):203701.

Gamble LL, Pankonien AM, Inman DJ. Stall recovery of a morphing wing via extended nonlinear lifting-line theory. AIAA Journal. 2017; 55:2956-63.

**Presentations**

Gamble LL, Inman DJ. Aeroelastic design and analysis of a bioinspired flexible airfoil. Proceedings, AIAA Scitech Forum, AIAA 2020-1540, Orlando, FL, 2020.

Gamble LL, Harvey C, Inman DJ. Analysis of a morphing bioinspired flexible trailing edge concept. Proceedings, 29th International Conference on Adaptive Structures and Technologies, Seoul, South Korea, 2018.

Gamble LL, Moosavian A, Inman DJ. Effects of speed on coupled sweep and camber in morphing wings. Proceedings, AIAA Scitech 55th AIAA Aerospace Sciences Meeting, AIAA 2017-0267, Grapevine, Texas, 2017.

Gamble LL, Inman DJ. Aerodynamic performance of a bioinsipred morphing tailless aircraft concept. Proceedings, 27th International Conference of Adaptive Structures and Technologies, Bolton Landing, NY, 2016.

Gamble LL, Inman DJ. Yaw control of a smart morphing tailless aircraft concept. Proceedings, 6th International Conference of Smart and Multifunctional Materials, Structures and Systems, Perugia, Italy, 2016.

Gamble LL, Pankonien AM, Inman DJ. Stall recovery of the span-wise morphing trailing edge concept via an optimized nonlinear model. Proceedings, 26th International Conference on Adaptive Structures and Technologies, Kobe, Japan, 2015.

Haughn, K. P., Gamble, L. L., & Inman, D. J. (2022). Deep reinforcement learning achieves multifunctional morphing airfoil control. Journal of Composite Materials, 00219983221137644.

Harvey, C., Gamble, L. L., Bolander, C. R., Hunsaker, D. F., Joo, J. J., & Inman, D. J. (2022). A review of avian-inspired morphing for UAV flight control. Progress in Aerospace Sciences, 132, 100825.

## Peer Reviews

Proceedings of the Royal Society B: Biological Sciences

IEEE Access

The Aeronautical Journal

Journal of Applied Physics

Journal of Intelligent Material Systems and Structures