

Jorge Bustamante, Jr. *Ph.D.*

Biomechanist, aspiring entomologist

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Education (2008 - 2021)

Sept. 2015 – Aug. 2021	University of Washington , Department of Biology <i>Ph.D. in Biology</i> Candidacy received: June 2, 2017 • Degree awarded: August 12, 2021 Advisor: Tom Daniel • Committee members: Jeffrey Riffell, Adam Summers
Sept. 2013 – Sept. 2015	University of California, Irvine , Department of Ecology and Evolutionary Biology <i>Master of Science in Biology</i> Degree awarded: September 1, 2015 Advisor: Catherine Loudon • Committee members: Matt McHenry, Timothy Bradley
Sept. 2008 – June 2013	University of California, Irvine <i>Bachelor of Science in Mechanical Engineering</i> Degree awarded: June 15, 2013

Research Experience (2010 - 2021)

Ph.D. research | September 12, 2015 – August 12, 2021

Computational and experimental studies reveal a role for airframe configuration in insect flight control

Advisor: Tom Daniel

My thesis was centered around determining the role of abdominal flexion in insect flight maneuverability and flight control. I developed an inertial dynamics model was developed to simulate the motion of a moth tracking a vertically oscillating stimulus. I used Monte Carlo methods to randomize the control inputs. I experimentally measured various material properties (body length, weight, torsional stiffness and torsional damping) as model parameter inputs. In collaboration with other labmates (Tanvi Deora and Mahad Ahmed), we found that restriction of abdominal movement yielded poorer flight performance in freely flying moths.

In collaboration with two other labmates (Olivia Zahn and Callin Switzer), we utilized a Deep Neural Network to identify the network architecture and how brittle the system gets as nodes are pruned.

Master's research | September 12, 2013 – September 1, 2015

Piercing mechanics of bed bug cuticle (*Cimex lectularius*)

Advisor: Catherine Loudon

I investigated the piercing mechanics of bed bug cuticle by plant trichomes to develop physical (non-chemical) pesticides. I used nanoindentation to indent in specific locations of bed bug tarsi. All indents generated by nanoindentation were imaged in low vacuum scanning electron microscopy for verification. The use of a tungsten nanomanipulator (a separate mechanism from nanoindentation) under low vacuum scanning electron microscopy provided key insight in order to visualize the events that occur during piercing. We identified a specific region of the pretarsus (*i.e.* the membrane with microtrichia) which was more frequently pierced by trichomes during bed bug locomotion required approximately 20-30% less force, exhibited more mechanical creep, and had a lower reduced elastic modulus for the first micron of indentation compared to the other regions.

Undergraduate research | June 5, 2010 – June 15, 2013

Cricket antennae shorten when bending (*Acheta domesticus* L.)

Advisor: Catherine Loudon

Dr. Loudon and I investigated the mechanical behavior of cricket antennae when bent. I took images of highly magnified cricket antennae with dissecting microscope. I then landscaped images and converted into Cartesian coordinates with digitizing software (Didger 4). and maintained 40+ crickets.

Publications

1. **Bustamante, J.**, Panzarino, J.F., Rupert, T.J. and Loudon, C. (2017). Forces to pierce cuticle of tarsi and material properties determined by nanoindentation: The Achilles' heel of bed bugs. *Biology Open* 6, 1541–1551.
2. Loudon, C., **Bustamante, J.** and Kellogg, D.W. (2014). Cricket antennae shorten when bending (*Acheta domesticus* L.). *Frontiers in Physiology*. 5 JUN, 1–9.
3. Liu, Y., Gibbs, M., Perkins, C.L., Tolentino, J., Zarghami, M.H., **Bustamante, J.** and Law, M. (2011). Robust, functional nanocrystal solids by infilling with atomic layer deposition. *Nano Letters*. 11, 5349–5355.

In review

1. **Bustamante, J.**, Ahmed, M., Deora, T., Fabien, B. and Daniel, T.L. (2022). Abdominal movements in insect flight reshape the role of non-aerodynamic structures for flight maneuverability I: Model predictive control for flower tracking. *Integrative Organismal Biology*. (submitted: June 25, 2021)
2. Zahn, O., **Bustamante, J.**, Switzer, C., Daniel, T.L., Kutz, J.N. (2022). Pruning deep neural networks generates a sparse, bio-inspired nonlinear controller for insect flight. *PLOS Computational Biology*. (submitted: January 5, 2022)

In prep

Bustamante, J., Deora, T., and Daniel, T.L. (2022). Abdominal movements in insect flight reshape the role of non-aerodynamic structures for flight maneuverability II: performance trade-offs of inertial, elastic, and morphological determinants of flight. Intended for submission to: *Integrative Organismal Biology*.

Teaching Experience (7 academic quarters between 2014-2019)

Teaching Assistant | *Biomechanics* | UW | September – December 2016 & 2019

I prepared, instructed, and supervised two weekly laboratory experiments (per lab section) and assignments in the subject of comparative biomechanics. I graded exams, assisted 17-20 undergraduate students (per course) outside of class with course material, and assignments. Techniques instructed included (but were not limited to): high speed videography, digitization, and computational fluid dynamics software.

Teaching Assistant | *Introductory Biology* | UW | January – March 2017

I prepared, instructed, and supervised two weekly laboratory experiments (per lab section) and assignments in the subject of animal physiology, plant development and physiology. I graded exams, assisted 21-24 undergraduate students (per course) outside of class with course material, and assignments. Techniques instructed included (but were not limited to): light microscopy, introductory dissection, and introductory coding in R.

Teaching Assistant | *From Organisms to Ecosystems* | UC Irvine | June – July 2014 & 2015

An online course in the introductory biology series. I assisted students outside of class with course material and involved in course administration (e.g. office hours, grading, developing the online course).

Teaching Assistant | *Physiology Laboratory* | UC Irvine | April – June, October – December 2014

I prepared, instructed, and supervised weekly physiology laboratory experiments and assignments. Graded lab reports and exams, assisted 24 undergraduate students (per course) outside of class with course material, assignments, and scientific writing. Such laboratory courses included: dissections of deceased frogs, respiratory physiology on hissing cockroaches and student volunteers, and muscle form and function.

Grants awarded

National Science Foundation Graduate Research Fellowship (NSF-GRFP) | March 2015

Referee for Peer-reviewed Journals (1)

Journal of Experimental Biology

Departmental and Organizational Involvement (2010 – 2019)

Diversity and Equity committee | UW Department of Biology | September 2017 - June 2019

Attended weekly meetings, and served on two sub-committees to discuss and improve diversity, equity, and inclusion at the UW Department of Biology. Such discussions were driven by attempts to enact the actionable items the graduate students wished to see in the "Letter to UW Biology Community" (See GLADE below).

Diversity and Equity sub-committee: Faculty search | UW Department of Biology | September 2017 - January 2019

Evaluated and scored 200+ diversity statements, participated in 50+ Zoom interviews, and participated the in-person interviews of 21 faculty candidates.

Graduate-Led Action on Diversity and Equity (GLADE) | UW Biology graduate students | February 2017 - 2018

One of the 15 original authors of the Letter to the Department of Biology. The letter defines 19 actionable items the members of the Department of Biology can take to improve diversity, equity, and inclusion within the department. This letter was circulated and signed by 69 members of the Department (graduate students and staff). The letter is available upon request – or can be viewed [here](#).

Professional development advisor of MAES student chapter | UC Irvine | April 2014 - 2015

Provided the student chapter leadership with guidance on organizational structure, finances and day-to-day matters when solicited to foster progress in the students' professional careers and the development of the student chapter.

Association of Graduate Students council member - Internal committee | UC Irvine | May 2014 - June 2015

An elected position by my graduate student peers in the Department of Ecology and Evolutionary Biology. Members of the council were responsible for representing on-campus graduate student concerns (e.g. on-campus housing, parking, academic units, student life, healthcare and insurance).

External Vice President of MAES at UC Irvine student chapter | UC Irvine | April 2011 - April 2012

An elected position by my undergraduate peers. Handled the student chapter external affairs. Met with representatives in industry to bring their companies to campus (e.g. Raytheon, Parker Aerospace, Boeing), maintained contact with MAES at UCI alumni, helped write proposals sent out to engineering firms to fundraise for on-campus events.

Internal Vice President of MAES at UC Irvine student chapter | UC Irvine | April 2010 - April 2011

An elected position by my undergraduate peers. Handled the student chapter internal affairs. Planned board meetings and on-campus events, liaison to other on-campus organizations, acquired campus permits, met with other organizations (e.g. National Society of Black Engineers, Society of Women Engineers, etc.)

Undergraduate Mentorship and Outreach Activities

CAMP Summer Science Academy Coordinator/Mentor | UC Irvine | Summer 2015, 2011

Managed and directed five other mentors, and 83 incoming freshman students during a three-week intensive pre-college course. My tasks included: tutoring physics to the 83 incoming freshman students, encouraging their careers in STEM, and overseeing the administration of the entire program.

MAES Science Extravaganza | UC Irvine | May 2015, 2014, 2013, 2012

Volunteered to lead an educational workshop (either egg drop or electromagnetism) to 150+ middle school students from low income areas to stimulate their interests in STEM education and career opportunities.

Conference Presentations (25 between 2009 - 2020)

Society for Integrative and Comparative Biology (SICB) Annual Meeting	2020, 2019, 2018, 2017, 2016, 2015, 2013
Society for the Advancement of Chicanos and Native Americans in Science	2019, 2018, 2010, 2009
UW Biology Graduate Student Symposium	2018, 2017, 2016
Southwest Regional Meeting of the SICB	2014, 2013
Entomological Society of America	2014
California Alliance for Minority Participation Summer Scholars Symposium	2012, 2010, 2009
Ana G. Méndez University System Research Symposium	2012
California Alliance for Minority Participation Statewide Research Symposium	2011, 2010
Undergraduate Research Opportunities Program Symposium - UC Irvine	2011
American Association for the Advancement of Science	2010

Honors and Awards

July 2014	Graduate student travel award UC Irvine An internal award by the UC Irvine Department of Ecology and Evolutionary Biology for travel to the annual Entomological Society of America meeting in Portland, OR.
February 2011	CAMP undergraduate research symposium poster presentation award UC Irvine Awarded to a select number of student poster presenters.
Fall 2010	Dr. Francisco J. Lara endowed scholarship recipient UC Irvine Funded by UC Irvine in the name of Vice Chancellor Emeritus Francisco Lara, to six undergraduate students who have participated in academic enrichment and/or academic outreach programs.
Fall 2010	Pi Tau Sigma member UC Irvine Granted membership of the honors mechanical engineering society on the basis of “sound engineering ability, scholarship (upper 35%), personality and probable future success in mechanical engineering.”
Fall 2008-Spring 2009, Spring 2012	Dean’s Honor List of University of California UC Irvine Receiving a GPA of 3.5 or higher during the respective quarter. Received in four undergraduate quarters.

Professional Memberships

2013-2020	Society for Integrative and Comparative Biology
2014, 2022	Entomological Society of America
2008-2015	Latinos in Science and Engineering –formerly “Mexican-American Engineers and Scientists” (MAES)
2008-2015	California Alliance for Minority Participation

Skills

Proficient: MATLAB • Monte Carlo methods • Excel • Canvas X (graphics) • Light microscopy

Experienced: Python • Euler-Lagrange • Insect husbandry • \LaTeX • Scanning electron microscopy • R • Instron • Nanoindentation • High speed videography

Familiar: Arduino • SolidWorks • LabView • Mathematica

References

Dr. Thomas L. Daniel, University of Washington
Komen Endowed Chair, Department of Biology & Program in Neuroscience Director
AFOSR Center of Excellence on Nature Inspired Flight Technologies Co-Director
UW Institute of Neuroengineering Director
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Dr. Catherine Loudon, University of California, Irvine
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