

Jorge Bustamante, Jr. *Ph.D.*

Postdoctoral researcher. Urban entomologist in training. Biomechanist.

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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 - Present)

Postdoctoral research | August 1, 2022 – Present

Utilizing entrapping surfaces to augment non-chemical IPM approaches to bed bug control.

Advisor: Dong-Hwan Choe

Bed bugs are some of the most challenging pests to track and remove. Bed bugs have also evolved resistance to many chemical pesticides. We develop and test non-chemical entrapping devices as a physical method of bed bug control. We also coordinate with pest management professionals to test the non-chemical trapping material in the field. The California Department of Pesticide Regulation partly funds this work in collaboration with Dr. Catherine Loudon, Dr. Andrew Sutherland, Patrick Liu, and Kathleen Campbell.

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 to simulate a moth's motion tracking a vertically oscillating stimulus. I used Monte Carlo methods to randomize the control inputs. As model parameter inputs, I experimentally measured various material properties (*e.g.*, body length, weight, torsional stiffness, and torsional damping). In collaboration with other lab members (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 lab members (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. Using a tungsten nanomanipulator (a separate mechanism from nanoindentation) under low vacuum scanning electron microscopy provided key insight 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 a dissecting microscope. I then landscaped images, converted them into Cartesian coordinates with digitizing software (Didger 4), and maintained a small colony of 40+ crickets.

Publications (5)

1. 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*. <https://doi.org/10.1371/journal.pcbi.1010512>
2. **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*. <https://doi.org/10.1093/iob/obaco39>
3. **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. <https://doi.org/10.1242/bio.028381>
4. Loudon, C., **Bustamante, J.** and Kellogg, D.W. (2014). Cricket antennae shorten when bending (*Acheta domesticus* L.). *Frontiers in Physiology*. 5 JUN, 1–9. <https://doi.org/10.3389/fphys.2014.00242>
5. 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. <https://doi.org/10.1021/nl2028848>

In prep

Bustamante, J., and Choe, D.-H. (2023). An avoidance behavior to wet surfaces by bed bugs (Hemiptera: Cimicidae) Intended for submission to: *Journal of Insect Behavior*.

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 comparative biomechanics. I graded exams and 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 animal physiology, plant development, and physiology assignments. I graded exams and 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 class with course material and was involved in course administration (*e.g.*, office hours, grading, and the online development 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 and assisted 24 undergraduate students (per course) outside class with course material,

assignments, and scientific writing. Such laboratory courses included dissecting 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 (3)

Journal of Experimental Biology, Insects, Journal of Asia-Pacific Entomology

Departmental and Organizational Involvement (2010 – 2019, 2022)

Diversity, Equity, and Inclusion committee | UC Riverside Department of Entomology | October 2022 - 2023

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+ virtual interviews, and participated in 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

I provided the student chapter leadership with guidance on organizational structure, finances, and day-to-day matters when solicited to foster progress in the student's 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. Council members represented 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. I handled the student chapter's 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, and helped write proposals 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. I handled the student chapter's internal affairs. Planned board meetings and on-campus events, liaised with other on-campus organizations, acquired campus permits and 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

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

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

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

Conference Presentations (26 between 2009 - 2023)

Entomological Society of America	2023, 2014
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
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 This was awarded to a select number of student poster presenters.
Fall 2010	Dr. Francisco J. Lara endowed scholarship recipient UC Irvine UC Irvine funded this award in Vice Chancellor Emeritus Francisco Lara's name to six undergraduate students who participated in academic enrichment and outreach programs.
Fall 2010	Pi Tau Sigma member UC Irvine Granted membership of the honors mechanical engineering society based on "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 Received a GPA of 3.5 or higher during the respective quarter. Received in four undergraduate quarters.

Professional Memberships

2014, 2022, 2023	Entomological Society of America
2013-2020	Society for Integrative and Comparative Biology
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 • Motion tracking of organisms • Excel • Canvas X Draw (graphics) • Light microscopy

Experienced: Python • Euler-Lagrange • Insect husbandry (crickets, silverfish, bed bugs) • \LaTeX • EthoVision • Scanning electron microscopy • R • Instron • Nanoindentation • High speed videography

Familiar: SQL • Arduino • SolidWorks • LabView • Mathematica

References

Dr. Dong-Hwan Choe, University of California, Riverside

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Dr. Thomas L. Daniel, University of Washington
Professor Emeritus
Komen Endowed Chair, Department of Biology & Program in Neuroscience Director
AFOSR Center of Excellence on Nature Inspired Flight Technologies Co-Director
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