Curriculum Vitae

Davi Ortega
Division of Biology, California Institute of Technology
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RESEARCH INTERESTS

Evolution of complexity, macromolecular machinery, chemotaxis, secretion systems, environmental microbiology, scientific data sharing

EDUCATION

UNIVERSITY OF TENNESSEE Knoxville, TN
Ph.D., Physics, May 2013
Major: Physics
Dissertation: *Application of Computational Molecular Biophysics to Problems in Bacterial Chemotaxis*
Advisor: Dr. Igor B. Zhulin

STATE UNIVERSITY OF CAMPINAS (UNICAMP) Campinas, SP, Brazil
B.S., Physics, Dec 2002

PROFESSIONAL EXPERIENCE

CALIFORNIA INSTITUTE OF TECHNOLOGY Pasadena, CA
LABORATORY FOR RESEARCH IN COMPLEX SYSTEMS San Francisco, CA
Oct 2019 -present — International Fellow (*due to VISA mandatory requirements*)

- Coordinator of the Jensen Lab in the Boundaries of Life initiative
- Coordinator of Bioinformatics and Comparative Genomics projects
- Evolutionary reconstruction of macromolecular complexes
- Development of next generation of distributed solution for scientific data sharing.

LEIDEN UNIVERSITY Leiden, Netherlands
Jun 2019 – Oct 2019 — Short-term Postdoctoral Scholar

- Development and deployment of CryoStack: a software application platform to facilitates the use of multiple cryo-electron microscopy software.
- Development and deployment of the next generation of private and public instances of the distributed Electron Tomography Database (ETDB).
- Architecture and evolution of chemotaxis networks in Actinobacteria.

CALIFORNIA INSTITUTE OF TECHNOLOGY Pasadena, CA
Jun 2014 – Jun 2019 — Postdoctoral Scholar

- Coordinator of the Jensen Lab participation in the Boundaries of Life initiative
- Bioinformatics and comparative genomics of chemotaxis systems
- Evolutionary reconstruction of type II and III secretion system
- Software development for high-throughput, automated analysis of large pan-genome dataset
- Management of the team to design and build the Electron Tomography Database (ETDB)
- Mentoring of rotation student in computational biology
- Guest Instructor for the "Introduction to Programming for the Biological Sciences Bootcamp" at Caltech.

UNIVERSITY OF TENNESSEE Knoxville, TN
Jun 2013 – May 2014 — Postdoctoral Research Associate

- Development of methods to perform comparative genomics and data visualization in large datasets for pathway prediction in chemotaxis systems
- Design, execution and analysis of molecular dynamics simulations of trimers of bacterial chemoreceptors dimers
- Publication of research results as a project leader or member
- Guidance of graduate student research in the lab

Aug 2006 – May 2013 Graduate Research Assistant

- Prediction of signaling mechanism with molecular dynamics simulations.
- Combination of NMR and molecular dynamics methods for protein function prediction
- Contributor to a successfully funded NIH R01 grant proposal
- Correlation of computational results to independent experimental data

NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, Boulder, CO

Sep 2005 – Mar 2006 Guest Researcher

- Laser frequency stabilization to ultra-high quality optical cavity
- Operation of the Calcium optical atomic clock
- Design of miniature system of the Calcium optical atomic clock

STATE UNIVERSITY OF CAMPINAS (UNICAMP) Campinas, SP, Brazil

Feb 2003 – May 2006 Graduate Research Assistant

- Design and construction of diode lasers in extended cavity for laser spectroscopy
- Design and construction of control systems for temperature control and current control in lasers
- Design and construction of vacuum systems (up to 10^{-10} mbar with Turbo and Ionic Pumps)

Feb 1999 – Dec 2002 Undergraduate Research Assistant

- Operation of a variety of lasers for spectroscopy - Ti:Sa (homemade), Dye (Coherent), CO_2 (homemade), Argon (Coherent) and Solid State (Verdi, Coherent)
- Design and construction of electromagnetic coils for deceleration and trapping of Ca atoms

TEACHING EXPERIENCE

CALIFORNIA INSTITUTE OF TECHNOLOGY

2019 – Summer Featured Lecture – Introduction to Programming for the Biological Sciences Bootcamp.
2018 – Summer Guest Instructor – Introduction to Programming for the Biological Sciences Bootcamp.
2017 – Summer Guest Instructor – Introduction to Programming for the Biological Sciences Bootcamp.
2016 – Summer Visitor – Introduction to Programming for the Biological Sciences Bootcamp (TA)

UNIVERSITY OF MINNESSOTA - DULUTH

2016 – Spring Invited lecture – Introduction to Evolution

UNIVERSITY OF TENNESSEE - KNOXVILLE

2012 – Fall Invited lecture – Mapping sequence patters in structures
2011 – Fall Invited lecture – Molecular dynamics simulations

STATE UNIVERSITY OF CAMPINAS (UNICAMP)

2004 – Spring Instructor on record – Experimental Physics III

2004 – Fall Instructor on record – Experimental Physics IV

PUBLICATIONS

Gumerov V. M., **Ortega D. R.**, Adebali O., Ulrich L. E., Zhulin I. B., (2019) MiST 3.0: an updated microbial signal transduction database with an emphasis on chemosensory systems. Nucleic Acids Res https:/doi.org/10.1093/nar/gkz988

Kaplan, M., Sweredoski, M.J., Rodrigues, J.P.G.L.M., Tocheva, E.I., Chang, Y.-W., **Ortega, D.R**., Beeby, M., Jensen, G.J., (2019). Bacterial flagellar motor PL-ring disassembly Sub-complexes are widespread and ancient. bioRxiv 786715. https://doi.org/10.1101/786715

O'Neal, L., Gullett, J.M., Aksenova, A., Hubler, A., Briegel, A., **Ortega, D.**, Kjær, A., Jensen, G., Alexandre, G., (2019). Distinct Chemotaxis Protein Paralogs Assemble into Chemoreceptor Signaling Arrays To Coordinate Signaling Output. mBio 10, e01757-19. https://doi.org/10.1128/mBio.01757-19

Petukh, M. G., **Ortega, D. R.**, Baudry, J. & Zhulin, I. B. (2019) Interdimer "zipping" in the chemoreceptor signaling domain revealed by molecular dynamics simulations. *bioRxiv* 745117 doi:10.1101/745117

Ortega D. R., Jensen G. J., (2019) "Regular Architecture (RegArch): A standard expression language for describing protein architectures". *bioRxiv* 679910. doi:10.1101/679910

Ortega D. R., Subramanian P., Mann P., Kjær A., Chen S., Watts K. J., Pirbadian S., Collins D. A., Kooger R., Kalyuzhnaya M. G., Ringgaard S., Briegel A., Jensen G. J. (2019) Repurposing a macromolecular machine: Architecture and evolution of the F7 chemosensory system. *bioRxiv* 653600 (2019). doi:10.1101/653600

Kaplan M., Subramanian P., Ghosal D., Oikonomou C. M., Pirbadian S., Starwalt-Lee R., Mageswaran S. K., **Ortega D. R.**, Gralnick J. A., El-Naggar M. Y., Jensen G. J. (2019) "In situ imaging of the bacterial flagellar motor disassembly and assembly processes". The EMBO Journal. 0, e100957.

Ortega D.R., Oikonomou C.M., Ding H.J., Rees-Lee P., Alexandria, Jensen G.J. (2019) "ETDB-Caltech: A blockchain-based distributed public database for electron tomography." PLOS ONE 14:e0215531. doi:10.1371/journal.pone.0215531.

Kaplan, M., Ghosal, D., Subramanian, P., Oikonomou, C.M., Kjaer, A., Pirbadian, S., **Ortega, D.R.**, Briegel, A., El-Naggar, M.Y., and Jensen, G.J. (2019). The presence and absence of periplasmic rings in bacterial flagellar motors correlates with stator type. ELife *8*, e43487.

Ortega D.R., Zhulin I.B. (2018) "Phylogenetic and Protein Sequence Analysis of Bacterial Chemoreceptors." In: Manson M. (eds) Bacterial Chemosensing. Methods in Molecular Biology, vol 1729. Humana Press, New York, NY

Swulius M.T., Nguyen L.T., Ladinsky M.S., **Ortega DR**, Aich S., Mishra M. and Jensen G.J. (2018) "Structure of the fission yeast actomyosin ring during constriction." Proc Natl Acad Sci USA. 201711218. doi:10.1073/pnas.1711218115

Ortega D.R., Fleetwood A.D., Krell T., Harwood C.S., Jensen G.J., Zhulin I.B. (2017) "Assigning chemoreceptors to chemosensory pathways in *Pseudomonas aeruginosa*", Proc Natl Acad Sci USA. 201708842. doi:10.1073/pnas.1708842114

Chang Y.-W., Rettberg L. A., **Ortega D. R.** and Jensen G.J. (2017) "In vivo structures of an intact type VI secretion system revealed by electron cryotomography", EMBO Rep., e201744072. doi:10.15252/embr.201744072

Schulz, F., Yutin, N., Ivanova, N. N., **Ortega, D. R.**, Lee, T. K., Vierheilig, J., Daims, H., Horn, M., Wagner, M., Jensen, G. J., Kyrpides, N. C., Koonin, E. V. and Woyke, T. (2017) 'Giant viruses with an expanded complement of translation system components', Science, 356(6333), pp. 82–85. doi: 10.1126/science.aal4657.

Chang Y.-W., Kjær A., **Ortega D. R.**, Kovacikova G., Sutherland J. A., Rettberg L. A., Taylor R. K. and Jensen G. J. (2017). "Architecture of the Vibrio cholerae toxin-coregulated pilus machine revealed by electron cryotomography." Nature Microbiology 2: 16269.

Briegel A., **Ortega D. R.**, Mann P., Kjaer A., Ringgaard S. and Jensen G. J. (2016). "Chemotaxis cluster 1 proteins form cytoplasmic arrays in *Vibrio cholerae* and are stabilized by a double signaling domain receptor DosM." Proc Natl Acad Sci USA. 113(37): 10412-10417.

Tocheva, E. I., **Ortega, D. R.** & Jensen, G. J. (2016). "Sporulation, bacterial cell envelopes and the origin of life". *Nat Rev Micro* 14, 535–542.

Ortega D.R. & Zhulin I.B. (2016). "Evolutionary Genomics Suggests That CheV Is an Additional Adaptor for Accommodating Specific Chemoreceptors within the Chemotaxis Signaling Complex." *PLoS Comput Biol* 12(2): e1004723.

Briegel, A., **Ortega D. R.**, Huang A., Oikonomou C. M., Gunsalus R. P. and Jensen G. J. (2015). "Structural conservation of chemotaxis machinery across Archaea and Bacteria." *Environ Microbiol Rep*. 7, 3: 414–19. doi: 10.1111/1758-2229.12265

Adebali O., **Ortega D. R.,** and Zhulin, I. B. (2015). "CDvist: A Webserver for Identification and Visualization of Conserved Domains in Protein Sequences." *Bioinformatics* 31, 9: 1475–77. doi:10.1093/bioinformatics/btu836.

Ortega D.R., Yang C, Ames P, Baudry J, Parkinson J.S., et al. (2013). "A phenylalanine rotameric switch for signal-state control in bacterial chemoreceptors." *Nature Communications* 4. doi: 10.1038/ncomms3881.

Ortega D.R., Mo G, Lee K, Zhou H, Baudry J, et al. (2013). "Conformational Coupling between Receptor and Kinase Binding Sites through a Conserved Salt Bridge in a Signaling Complex Scaffold Protein". *PLoS Computational Biology* 9: e1003337.

Cashman, D.J., **Ortega, D.R.**, Zhulin, I.B., Baudry, J. (2013). "Homology modeling of the CheW coupling protein of the chemotaxis signaling complex." *PLoS One* 8: e70705.

Li, X., Fleetwood, A.D., Bayas, C., Bilwes, A.M., **Ortega, D.R.**, Falke, J.J., Zhulin, I.B., Crane, B.R. (2013). "The 3.2 A resolution structure of a Receptor:CheA:CheW signaling complex defines overlapping binding sites and key residue interactions within bacterial chemosensory arrays". *Biochemistry* 52: 3852-3865.

Briegel, A., **Ortega D. R.**, Tocheva E. I., Wuichet K., Li Z., Chen S., Muller A., Iancu C. V., Murphy G. E., Dobro M. J., Zhulin I. B. and Jensen G. J. (2009). "Universal architecture

of bacterial chemoreceptor arrays." *Proceedings of the National Academy of Sciences* 106(40): 17181-17186.

Bible, A. N., Stephens B. B., **D. R. Ortega**, Xie Z. and Alexandre G. (2008). "Function of a chemotaxis-like signal transduction pathway in modulating motility, cell clumping, and cell length in the alphaproteobacterium Azospirillum brasilense." *Journal of Bacteriology* 190(19): 6365-6375.

Fortier, T. M., Le Coq Y., Stalnaker J. E., **Ortega D.**, Diddams S. A., Oates C. W. and Hollberg L. (2006). "Kilohertz-Resolution Spectroscopy of Cold Atoms with an Optical Frequency Comb." *Physical Review Letters* 97: 163905.

Cavasso, R. L., Manoel D. A., **Ortega D. R.**, Scalabrin A., Pereira D. and Cruz F. C. (2004). "On-axis calcium magneto-optical trap loaded with a focused decelerating laser." *Applied Physics B-Lasers and Optics* 78(1): 49-52.

Cavasso, R. L., Manoel D. A., **Ortega D. R.**, Scalabrin A., Pereira D. and Cruz F. C. (2003). "Calcium magneto-optical trap loaded from a decelerated atomic beam." *Brazilian Journal of Physics* 33(2): 355-362.

HONORS AND AWARDS

2019 Top 2018 Blockchain paper and research team award – Blockchain Connect Conference
2003 Graduate Researcher Scholarship, Sao Paulo Research Foundation (FAPESP). (Renewed until 2006)
2000 Undergraduate Researcher Scholarship, Sao Paulo Research Foundation (FAPESP). (Renewed until 2002)
1999 Undergraduate Researcher Scholarship, National Council for Scientific and Technological Development (CNPq)

WORKSHOPS

2016 Microbial Genomics & Metagenomics Workshop, Walnut Creek, CA
2015 Workshop on Molecular Evolution, Woods Hole, MA
2011 Anton Training Workshop, Pittsburg, PA
2009 Computational Biophysics Workshop, Champaign, IL
2003 *Attendee,* Second Workshop on Cold Alkaline-Earth Atoms, Copenhagen, Denmark
2003 Advanced School on Time and Frequency Metrology, Dourado, SP, Brazil

MEETINGS, SYMPOSIA

2019 *Poster presenter,* BLAST XIV (Bacterial Locomotion and Signal Transduction), New Orleans, LA
2019 *Invited speaker*, Blockchain Connect Conference, San Francisco, CA
2018 *Invited speaker*, Decentralized Web Summit, San Francisco, CA.
2018 *Invited speaker*, Receptor Fest, Ithaca, NY.
2018 *Poster presenter*, Gordon Research Conference on Sensory Transduction in Microorganisms, Ventura, CA.
2017 *Invited speaker,* BLAST XIII (Bacterial Locomotion and Signal Transduction), New Orleans, LA – finalist as best postdoctoral talk.
2016 *Invited speaker*, Receptor Fest, Santa Barbara, CA.
2016 *Invited speaker*, Gordon Research Conference on Sensory Transduction in Microorganisms, Ventura, CA.
2015 *Invited speaker,* BLAST XIII (Bacterial Locomotion and Signal Transduction), Tucson, AZ.
2014 *Invited speaker*, Receptor Fest, Salt Lake City, UT.

2014 *Poster presenter*, Gordon Research Conference on Sensory Transduction in Microorganisms, Ventura, CA.
2012 *Poster presenter*, Gordon Research Conference on Sensory Transduction in Microorganisms, Ventura, CA.
Poster presenter, BLAST XI (Bacterial Locomotion and Signal Transduction),
2011 New Orleans, LA.
Invited speaker, Receptor Fest, Santa Barbara, CA.
2010 *Poster presenter*, Gordon Research Conference on Sensory Transduction in
2010 Microorganisms, Ventura, CA.
Attendee, BLAST X (Bacterial Locomotion and Signal Transduction), Cuernavaca,
2009 Mexico.
Poster presenter, Gordon Research Conference on Sensory Transduction in
2008 Microorganisms, Ventura, CA.
Invited speaker, Receptor Fest, Boulder, CO.
2007 *Attendee,* Meeting of the Optical Society of America, Rochester, NY.
2006 *Attendee,* Meeting of the Optical Society of America, Tucson, AZ.
2005 *Poster presenter*, International Conference on Atomic Physics, Rio de Janeiro, RJ,
2004 Brazil.

OUTREACH

2005 President Director of Optical Society of America Student Chapter at UNICAMP, Campinas, SP, Brazil.
2005 Organizer, Workshop on Science and Technology in Optical Communications, Campinas, SP, Brazil.
2005 Coordinator, Physics on Vacation, Campinas, SP, Brazil.
2004 Vice-President Director of Optical Society of America Student Chapter at UNICAMP, Campinas, SP, Brazil.
2004 Coordinator, Physics on Vacation, Campinas, SP, Brazil.
2003 Organizer, II Sergio Porto School of Applied Optics, Campinas, SP, Brazil.
2003 Coordinator, Physics on Vacation, Campinas, SP, Brazil.

COMPUTER SKILLS

- Javascript, Typescript, Node.js and d3.js programming
- Docker
- Blockchain application in distributed databases
- Python programming
- Software package development using test driven development and version control
- Advanced SQL, mongoDB
- Advanced Unix/Linux
- Numerical analysis (MATLAB, Mathematica, Numpy)
- Experience with high performance clusters with SGE Grid (Newton – UTK, Kraken – NICS and Titan – ORNL)
- Experience with job submissions to Anton supercomputer environment
- Metagenome assembly and analysis (BBmap and JGI tools)
- Sequence based homolog identification (BLAST, PSI-BLAST, HMMER, HHSuit)
- Multiple sequence alignment (CLUSTALW, T-COFFEE, MAFFT, MUSCLE, PCMA, FSA, Bali-phy)
- Molecular Evolution and Phylogenetics (PHYML, MEGA, RAxML, ExaML, Bali-phy, PAUP*, BEST, BEAST, Mr. Bayes, Garli, RevBayes)
- Protein structure (VMD, Maestro, UCSF Chimera)
- Molecular Dynamics (NAMD2, Desmond)

updated 12/2019

- Web design and data visualization (HTML, CSS, Javascript, d3.js, Typescript)
- Electron microscopy (Leginon, IMOD)

EXPERIMENTAL SKILLS

- Design and construction of high precision and low noise electronic circuits
- Design and construction of homemade lasers for spectroscopy (Diode laser and Ti:Sa)
- Experience with shielding and grounding in radio frequency circuits
- Data acquisition systems (Labview)
- Ultra low vacuum systems (up to 10^{-11} mbar)
- Operation of 120kV electron microscope – negative stain

OTHERS

2018 – present	Board member of the FLO foundation (flo.foundation)
2017 – present	FLO cryptocurrency core team member (flo.cash)
2015 – present	Founding member of the Art & Science Collective Schema47 (schema47.com)
2013 – 2017	Data Scientist consultant for Vote na Web (Sao Paulo, Brazil) (votenaweb.com.br)

updated 12/2019