Derek Hart, PhD

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EXPERIENCE

Centers for Disease Control and Prevention (Contracted by ASRT Inc.) **Atlanta, Georgia**

Bioinformatician, Data Manager *Dec 2022 - Present*

- Developed whole-genome assembly workflows with Snakemake and Nextflow to improve tracking of measles and mumps global transmission pathways. Pipelines feature metadata validation, HPC cluster deployment, containerization, and interactive reporting. Compatible with Illumina and Oxford Nanopore data.
- Created RShiny dashboard to clean, filter and visualize a global measles database, to assess the geospatial and phylogenetic distribution of measles worldwide. Uses Javascript libraries Highcharts and D3 to enhance interactivity.
- Automated extraction and aggregation of "Measles Molecular Proficiency Panel Form" data from over 100 countries, enabling significantly faster assessment of molecular lab performance worldwide.
- Collaborated with microbiologists to improve tiling amplicon sequencing assay design for measles and mumps viruses, enabling high sequencing coverage and depth even in high-GC, non-coding regions.
- Received bonus cash award reflecting excellent performance and goals achieved on behalf of the CDC.

Georgia Institute of Technology **Atlanta, Georgia**

Graduate Research Assistant *Jan 2017 - Nov 2022*

- Performed molecular dynamics and Monte Carlo simulations of DNA in an HPC environment to estimate DNA force-extension and sample the free-energy landscape of duplexes during melting transitions.
- Designed a DNA-based, single-molecule FRET assay to exert piconewton forces on short duplexes ($\sim$10 bp).
- Five years of wet lab and microscopy experience. Performed a wide variety of DNA-based molecular biology protocols.
- Published experimental and computational results in high-impact journal Nucleic Acids Research (link).

Graduate Teaching Assistant *Aug 2016 - Aug 2019*

- Mentored electromagnetism and biophysics students during laboratory sections and office hours

EDUCATION

Georgia Institute of Technology **Atlanta, Georgia**

PhD Physics 3.7 GPA *Aug 2016 - Sep 2022*

- **Area of Concentration:** Single-molecule biophysics
- **Thesis:** Hybridization and dehybridization of short oligonucleotides subject to weak tension
- **Minor:** Advanced Optics
- **Award:** Georgia Tech Institute Fellowship

Georgia Institute of Technology **Atlanta, Georgia**

MS Physics *Aug 2016 - May 2018*

Colorado School of Mines **Golden, Colorado**

BS Engineering Physics 3.9 GPA *Aug 2013 - May 2016*

- **Award:** Physics Faculty Distinguished Graduate

PUBLICATIONS

- B. Bankamp, G. Kim, D. Hart, A. Beck, Y. Zhang, M. Mamou, A. Penedos, R. Evans, P. Rota. "Global update on measles molecular epidemiology". (in review)
- A. Beck, E. Lopareva, H. Hwang, D. Hart, M. de Almeida, P. Rota, B. Bankamp. "Rapid Communication: Evaluation of the sensitivity of a measles diagnostic RT-qPCR assay recently observed priming mismatch variants". (in preparation)
- M. Jumabaeva, E. Lopareva, M. Chen, D. Park, D. Hart, B. Bankamp, A. Beck. "Validation of High-Throughput Metagenomic Sequencing of Measles, Mumps and Rubella Viruses Using Simultaneous Complex Probe Enrichment". (in preparation)
- E. Tiller, A. Mathis, A. Beck, D. Hart, C. Dixey, D. Sugerman. "Measles outbreak among undervaccinated children during an unseasonal increase of respiratory virus activity in pediatric populations Columbus, OH, 2022". (in preparation)
- D. Hart, J. Jeong, J. Gumbart, H. Kim. "Weak tension accelerates hybridization and dehybridization of short oligonucleotides". *Nucleic Acids Res.* 51.7. (Apr. 2023), pp 3030-3040

ORAL PRESENTATIONS

- 2024: “Using workflow managers to improve sequencing reproducibility and quality control”. Atlanta Winter Summit. Atlanta, GA.
- 2023: “Design of NGS Bioinformatics Pipeline to Improve Reproducibility and Quality Control”. 21st Global Measles and Laboratory Network Meeting. Virtual conference.
- 2022: “Weak tension accelerates hybridization and dehybridization of short oligonucleotides”. Annual Meeting of the International Physics of Living Systems Network. Montpellier, France.
- 2021: “Nucleic acid melting under small tension”. Annual Meeting of the American Physical Society. Virtual conference.
- 2021: “Kinetics of DNA melting and hybridization under small tension”. Physics of Living System Seminar. Atlanta, Georgia.
- 2019: “How do DNA bending and twisting affect CRISPR-Cas12 binding and cleavage?” Physics of Living Systems Seminar. Atlanta, Georgia.
- 2018: “Tracking Polymer Tangles”. Physics of Living Systems Seminar. Atlanta, Georgia.

TECHNICAL SKILLS

- **Programming**: Python, Bash, R, MATLAB, LaTeX, Groovy, Javascript, C++, SQL
- **Bioinformatics**: Snakemake, Nextflow, HPC, Linux, Git, BLAST, Geneious Prime, CLC Genomics Server, Docker, Singularity, MultiQC, Highcharts, D3
- **DNA Biology**: Primer design, PCR, assay design, ligation, purification, quantification, gel electrophoresis, fluorophore modification, plasmid cloning, restriction digests
- **Modeling & Simulation**: Molecular Dynamics, Monte Carlo, forward-flux sampling, umbrella sampling, oxDNA, Hidden Markov Modeling
- **Data Science**: Pandas, Tidyverse, Scikit-learn, Matplotlib, Seaborn
- **Single-molecule Biophysics**: TIRF microscopy, FRET microscopy, surface passivation, rate kinetics, force spectroscopy
- **Interests**: Bouldering, Cooking, Japanese, D&D, Reading, Piano