Don Blair

CONTACT
INFORMATION

Researcher, Pioneer Valley Open Science

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RESEARCH AND
WORK INTERESTS

Cooperative approaches to scientific research, technology development, and agroecology.
Hydrology, oceanography, land and water management; open science, open source hardware;
commons-based systems.

EDUCATION

University of Massachusetts Amherst, Amherst, MA

M.S. Physics, May 2003
- Areas of Study: *Soft Matter, Complex Systems, Statistical Mechanics*
- Advisor: Professor Jon Machta

B.A., Philosophy, May 1998
- Areas of Study: *Ancient Philosophy, Ethics, Language, Mind*
- Advisors: Professor Gareth Matthews and Professor Jyl Gentzler

ARTICLES

[1] D.W. Blair, C.D. Santangelo, and J. Machta. Packing Squares in a Torus. *Journal of Statistical Mechanics*, P01018 (2012).
doi:10.1088/1742-5468/2012/01/P01018

[2] J.R. Savage, D.W. Blair, A.J. Levine, R.A. Guyer, and A.D. Dinsmore. Imaging the Sublimation Dynamics of Colloidal Crystallites. *Science*, 314, 795 (2006).
doi:10.1126/science.1128649

[3] "Sensor Journalism and Citizen Science: It's About the Social Ergonomics", Sept 9, 2014, Medium.com.

[4] Collected research notes under profile "donblair" on Publiclab.org.

BOOK CHAPTERS

[5] S. Dosemagen, J. Breen, and D. Blair. Forthcoming. "Democratizing Environmental Research: Developing a Grassroots Environmental Research Community through Open Source DIY Tools". In: Enabling Cities, Volume 2.

[6] J. Breen, S. Dosemagen, D. Blair and L. Barry. Forthcoming. "Public Laboratory: Play and civic engagement." In: *The Playful Citizen: Power, Creativity, Knowledge*, eds. J Raessens, S Lammes, R Glas, M de Lange. Netherlands: Amsterdam University Press

[7] C. D'Ignazio, J. Warren, and D. Blair. 2014. "Less is More: The Role of Small Data in 21st Century Governance." In: *Governança Digital*, eds. M. S. Pimenta, D. F. Canabarrao. UFRGS Press.

[8] D. Blair, J. Breen, S. Dosemagen, M. Lippincott, and L. Barry. 2013. "Civic, Citizen, and Grassroots Science: Towards a Transformative Scientific Research Agenda." In: *Accountability Technologies: Tools for Asking Hard Questions*, edited by D. Offenhuber and K. Schechtner. Vienna: Ambra Verlag.

HoneyBear
Developer   Summer 2016 to present

The HoneyBear water monitor project aims to build and test a low-cost, open source CTD for oceanography research. First deployment was on the E/V Nautilus Southern California cruise (NA075) from from 24 to 30 July 201. Second intended deployment is November 2017 in Mexico. The project goals are:
- To allow for accessible, non-proprietary data storage and dissemination.
- To achieve useful accuracies for conductivity, temperature, and depth measurements at the lowest possible cost.
- To design an open, modular platform for oceanography instrumentation that can be forked and extended by other researchers.

Open Water Project
Project Co-Lead   Fall 2013 to Summer 2016

The Open Water Project aims to collaboratively develop and curate a set of low-cost, open source tools, in order to enable communities to collect, interpret, and share insights about local water quality problems.
- Co-founder and current co-leader of the Open Water Project
- Working to develop an initial set of open source water monitoring hardware prototypes, in collaboration with Ben Gamari, Jeff Walker, and others from the Public Lab community
- Working to facilitate engagement of water users, scientists, resource managers, journalists, artists, and environmental justice workers

Riffle
Project Co-Lead, Developer   Fall 2013 to Summer 2016

"Remote, Independent, Friendly Logger for the Environment". The Riffle Project is the Open Water Project's first set of environmental monitor prototypes, designed specifically for water quality and air quality applications. The Riffle development goal is to create an environmental data logger that will be low-cost, fully open-source (software, hardware, and with a non-proprietary data format), and accessible, while being advanced enough to leverage cutting-edge electronics, microfluidics, and communications technologies. Our initial set of collaborators on the project has included:
- The Cambridge Water Department
- InfoAmazonia
- Plymouth State University
- UMass Amherst
- University of New Hampshire
- MIT's Center for Civic Media
- The Mystic River Watershed Association
- Propeller, a New Orleans-based social ventures incubator.

Coqui
Project Co-Lead, Developer   Summer 2014 to Summer 2016

The Coqui is an electronics sensor platform intended to leverage common intuitions about the relationship between sound, light, and physical properties (e.g., "higher frequency flashes or sounds $\Rightarrow$ more alarming") in order to render civic technologies as accessible and useful as possible. The design of the device is also intended to highlight assumptions made by civic tech developers around what perspectives and reactions are shared by their target publics. Because versions of the device could be used for medical applications, it also aims to provoke reflection on certification, regulation, and restrictions on the development of DIY civic technologies.
- Initial design developed collaboratively on publiclab.org
- Further development at MIT Open Water workshops

- Adopted by Florida International University for workshop on sea level rise
- Featured in Emerson College data journalism class.

TEACHING / WORKSHOPS / PANELS	[9] "DIY Sustainability", MIT IAP Course, January 2015, Cambridge, MA.

[10] Co-Organizer, "Water Hackathon", 18 and 22 Nov 2014, Propeller Social and Environmental Accelerator, New Orleans, LA.

[11] Chair, "Open Science Panel", UMass Amherst ICT Summit, March 27, 2013.

[12] Organizer, "Open Science Hardware Workshop", UMass Amherst, July 12th, 2012.

[13] Co-Organizer, "Open Water Workshop", MIT Media Lab, July 14, 2012.

INVITED TALKS   [14] "Open Science and Public Lab", Community-Based Science for Action Conference, 15-17 November 2014, New Orleans, LA.

[15] "The Riffle: an Open Source Hardware Water Quality Monitor", *Next Generation Compliance Advanced Monitoring Tech Demo Day*, 5 Aug 2014, U.S. Environmental Protection Agency, Washington D.C.

[16] "Infragram Plant Health Camera Prototype", *ICT4Ag Digital Springboard for Inclusive Agriculture Conference*, 4-8 November 2013, Kigali, Rwanda.

[17] "Open Science and Public Lab", Leitzel Center for Mathematics, Science, and Engineering, University of New Hampshire, 24 Oct 2013, Durham, NH.
UCLA Institute for Pure and Applied Mathematics Workshop, May 22 - 26, 2006.

CONFERENCE
PRESENTATIONS   [18] "An Open Potentiostat", Pioneer Valley Open Science, Public Lab, and Smoky Mountain Scientific. *Open Hardware Summit*, Sept 6, 2013.

[19] Pioneer Valley Open Science, HackerFarm01007, and Public Lab presentation, *Rhode Island Mini Maker Faire*, Aug 10, 2013. (Winner: Editor's Choice Blue Ribbon).

[20] "Riffle hardware design." FarmHack iFarm meetup, May 16-18th, 2014.

[21] The role of curvature in the jamming of hard spheres on the surface of a spheroid, *Meeting of the American Physical Society*, Baltimore, Maryland, 2013.

[22] Packing Squares in a Torus, *Meeting of the American Physical Society*, Boston, MA, 2012.

[23] Simulated Flocking Dynamics of 2D Self-propelled Hard Particles, *Meeting of the American Physical Society*, New Orleans, Louisiana, 2008.

[24] On the Diameter of Random Clusters, *Greater Boston Areas Statistical Mechanics Meeting*, Brandeis, MA. October 2007.

[25] The Parallel Computational Complexity of the Percolation Model, *Meeting of the American Physical Society*, Denver, CO. March 2007.

[26] Diameter Random Clusters in Potts Models, *Meeting of the American Physical Society*, Denver, CO. March 2007.

[27] Cracks, Meltdowns and Crossover Sizes: An abrupt change in sublimation kinetics associated with the thermally-activated introduction of disclination charge in crystallites, *Meeting of the American Physical Society*, Denver, CO. March 2007.

[28] Simulated Colloidal Melting Kinetics in 2D, *Meeting of the American Physical Society*, Baltimore, MD. March 2006.

[29] "End-shape-dependent behavior in a Simulated 2D Active Matter System," Cells and Materials: Systems Biology and Molecular Modeling. UCLA Institute for Pure and Applied Mathematics Workshop, May 22 - 26, 2006.

GRANTS AND
AWARDS

In Preparation

[1] NSF 13-608 Advancing Informal STEM Learning (AISL) In this proposal, Emerson College, Plymouth State University, and Public Laboratory for Technology Science in partnership with the MIT Center for Civic Media and the Future of News Initiative at the MIT Media Lab are creating an *Environmental Storytelling Institute* - a year-long series of hands-on workshops around environmental research and storytelling.

Awarded

[2] Peter de Florez '38 Humor Fund Committee for the Babbling Brook Project at MIT. With: Catherine D'Ignazio, James Coleman, and Glorianna Davenport. "The Babbling Brook is a large, red, networked flower sculpture that monitors water conditions in the body of water where it is placed, combines that data with current weather conditions, and proceeds to tell very bad jokes in a Text-to-Speech robot voice about that data." Scheduled installations on MIT campus at at the Living Observatory in Plymouth, MA.

[3] Propeller Social Venture Water Fellowship, Sept 3, 2014, in support of the Riffle project.

[4] Winning Team (First Prize), "Mighty Mom Utility Belt", for MIT Breast Pump Hackathon, Sept 20-21, 2014, MIT Media Lab.

Not Awarded

[5] NSF Proposal: 1442846. Title: CYBERSEES: TYPE 1: "Designing a Global-to-local, replicable, open-source science and engineering network in support of community-based environmental monitoring." July, 2014.

PROFESSIONAL
EXPERIENCE

MIT Media Lab

Research Affiliate, Center for Civic Media　　　　　　　　　Dec 2014 to August 2017

- Investigated best practices in community-based approaches to scientific research, land and water management, and pollution monitoring.
- Worked with Director's Fellow Katy Croff Bell on applying open source hardware and software techniques in oceanography.
- Deployed open source hardware prototypes on the E/V Nautilus exploration vessel.

Food+Future

Researcher / Developer　　　　　　　　　　　　　　　　　Dec 2016 to June 2017

- Developed and installed solar-powered, LoRa radio open source hardware soil moisture and temperature monitors at Skyline Farm in Woodstock, VT as part of microclimate assessment project
- Developed open source electronics and software for Poly, a controlled growing environment intended for middle schools
- Worked closely with chemists to develop open source software toolchains for spectroscopic analysis with Ocean Optics spectrometers using Jupyter and Python for the Illuminate project

Public Lab

Fellow　　　　　　　　　　　　　　　　　　　　　　　July 2014 to Dec 2016

- Developed critiques and commentary on current approaches to citizen science and crowdfunding from commons-based and digital labor perspectives
- Contributed to discussions on the structure of Public Lab initiatives

- Facilitated community participation in Public Lab programs
- Sustainable support structures for Public Lab and civic engagement initiatives through grants and the development of novel transactional structures / business models.
- Developed practices around the curation and support of projects within the Public Lab community

Parts and Crafts
Facilitator and collaborator.   Summer 2014

- Worked with summer campers aged 5 to 12 engage cooperatively on electronics, crafts, and group activities, including robotics, water monitoring, and aerial mapping.
- Working on strategies for extending the organization's approach to include a local, family-hackerspace model.

FarmHack
Special Advisor to Citizen Science Initiatives   July 2012 to present

The FarmHack community facilitates and curates the development of open source tools for sustainable agriculture and land management. Their focus on 'solving problems in the long-term' - where, for example, healthy soil is considered a biological machine that help remediate contaminated water, while producing food - is a natural complement to Public Lab's monitoring and accountability work.
- Facilitated discussion and helped organize meetups that join the FarmHack and Public Lab communities.
- Worked collaboratively on programming strategy around citizen science initiatives within the FarmHack community
- Contributed to online infrastructure development and planning, and agriculture-focused technology development

Pioneer Valley Open Science Institute
Co-Founder   July 2012 to present

The Pioneer Valley Open Science Institute consists of professors, graduate students, librarians, school teachers, and media professionals who have worked together to develop and reflect upon the application of an open source ethos in scientific research. It is an informal "institute", with infrequent meet-ups, and has heretofore consisted mostly of organized contributions and 'development sprints' on technologies related to Public Lab and FarmHack.

National Center for Digital Government
Fellow   2012 to 2013

Fellowship activities included:
- Contributed to discussions of labor, hierarchy, and power dynamics in open source communities
- Participated in research and analysis on the relationship between DIY, crowd-based systems and existing institutional power, via the Workshop on the Knowledge commons [LINK]
- Elaborated a view of 'curation' as a common theme when applying an open source ethos in an academic context

ESPCI/CNRS
Researcher   Summer 2009

Contributed to a model of the stochastic dynamics of growth and shrinkage of single actin filaments, comparing two possible mechanisms of ATP hydrolysis: a vectorial mechanism, in which the filament grows only from one end, and a stochastic mechanism that allows for insertion of subunits at random locations within the filament. Supervisor: Professor David Lacoste.

UMass Amherst Department of Physics

Researcher and Teaching Assistant   July 2000 to August 2007

- Tutored undergraduate physics students from the Five Colleges in mathematics and physics, with a focus on classical mechanics and introductory and intermediate electromagnetism coursework.
- Worked on an array of research projects (see below), primarily in the areas of soft matter and statistical physics, pursuit of a doctoral degree in physics (pending).

PREVIOUS
PROJECTS

RStudio + Github in support of an open science publication platform

Developer   2014

With Jeff Walker, worked on strategy for leveraging a commonly-used data analysis suite, RStudio, which allows for weaving together code, comments, images, and equations in LaTeX and Markdown, along with a popular data version control system, to prototype a system for a highly-replicable, version-controlled publication platform. Topics discussed / prototyped included:

- Use of timestamps and contributor history for proper attribution of contributions
- Integration with the Public Lab online platform
- Integration with MIT Library infrastructure

Makers @ Amherst Media

Collaborator and Developer   2013-2014

- Developed strategies around the form and approach of community science and technology initiatives at Amherst Media, an organization with a long history of civic engagement and community service.
- Co-organized initial 'Maker' events at Amherst Media, bringing together members of the Five Colleges and Amherst Middle School students.
- Participated in discussions around supporting the use and development of a local 'Maker' community in the Pioneer Valley.

Hack For Western Mass

Co-organizer   July 2013

A gathering of 'local people solving local problems'. For several weeks, organizations in the community with unmet web and technology development needs were contacted, resulting in a list of possible hackathon projects. The process culminated in a two-day hackathon on the UMass Amherst campus, which brought together over 100 developers, working on an array of projects:

- Mapping local wells and water quality
- Teen mother educational opportunities
- Mapping 'safety net' service needs
- Expanding Northampton's tree canopy
- Auditing and visualizing federal money in local communities
- A seed swap database
- Promoting local banking
- Opening up prison phone data archives
- Working on OpenStreetMaps for Western Mass

Thermal Flashlight

Developer   2012 to 2013

Helped develop initial printed circuit board prototypes for Public Lab's 'Thermal Flashlight' design, an open source tool for inexpensive visualization of thermal leaks in the home.

Infragram

Developer 2013 to 2014

Helped to develop initial hardware software for prototype versions of Public Lab's prototype plant-health camera, which relies on the differential absorption of particular electromagnetic frequency bands by healthy photosynthesizing plants. Work included:
- using computer vision techniques on a Raspberry Pi to use image features to assist in image overlay
- modifying Raspberry Pi hardware in order to allow for synchronized, multispectral camera attachments
- developing the first online web form and image processing prototype for Public Lab's Infragram image analysis tool.

UMass Open Science Hardware Workshop

Co-organizer July 2012

Workshop brought together over 50 members of the Five College research community in order to demo and discuss open source tools useful for traditional laboratory research settings. Topics including calibration, the development of a supportive community around open hardware, and various approaches to storing and curating data. Demonstrations included open source technology for:
- Controlling digital cameras
- Temperature feedback and control
- Laboratory equipment automation
- Wireless communication
- Sensors
- Data acquisition and logging
- Breadboarding an Arduino

Live, Web-based Twitter Analysis Tool

Developer 2012

Initially developed for the 2012 UMass Amherst ICT Summit: a Processing-based tool that performs word counts on tweets associated with a user-defined hashtag, and visualizes these words with 'bubbles' whose diameter is proportional to word frequency. Planned extensions include the ability to pull up associated Tweets by interacting with bubbles; imagined uses included:
- generating a live 'word cloud' for a given topic
- use at conferences and in classrooms for moderating topics on a Twitter 'backchannel'

Flocking, Swarming, and Active Matter with N. Menon

Theory, Simulation

Studied the end-shape dependence of density fluctuations, distance and orientational correlations, and structures in simulated granular systems (Monte Carlo), with implications for both granular materials and biological systems with limited long-range sensing capabilities (bacteria).

Colloidal Physics with A. Levine, J. Machta, A. Dinsmore, J.R. Savage, and M. Das

Theory, Computer Simulation

Performed Brownian dynamics simulations of the sublimation kinetics of colloidal crystallites, and found an abrupt increase in the sublimation rate at a particular crystallite size, elucidating the results of recent colloidal experiments. Explored possibility that crossover in the kinetics is due to the thermally activated introduction of a disclination charge leading to large internal

stresses that result in a fission event, and a break-up of the remaining crystallite. Currently developing an alternative, droplet-evaporation model for the same phenomenon.

Graph-theoretic Diameter of Random Cluster Models   with J. Machta
Theory, Computer Simulation

Used Swendsen-Wang Monte Carlo simulations in order to measure the scaling behavior of the fractal dimension of the diameter D of q-state Potts Model clusters, where D is defined in the graph-theoretic sense of the "longest shortest path" along bonds in a cluster. Developed a novel algorithm for determining D efficiently, and present results for $q = 1, 2, 3, 4$ in 2D and 3D lattices. Attempting to relate the scaling exponent for D to other known exponents.

Packing of Polygons on Compact Geometries   with B. Mbanga, C. Burke, T. Atherton
Theory, Computer Simulation

Employed analytic and simulated annealing methods to study the packing of squares on a flat torus, and have found a rich array of dense packing solutions. Future work will include using the recent population annealing algorithm to explore the densest packings of additional shapes in finite and compact geometries, as well as an exploration of the dependence of packing density and patterns on particle aspect ratio.

Computational Complexity   with J. Machta
Theory, Computer Simulation

Motivated both by recent attempts to elucidate the nature of "phase transitions" in computational complexity, and by the general project of characterizing the complexity physical systems according to their "parallel computational depth", explored the parallel computational complexity of the Percolation (Potts q = 1) model. Developed an algorithm for identifying infinite clusters at bond occupation probabilities p above the critical value p_c, and found (via numerical Monte Carlo simulation) a phase transition in computational complexity at p_c, thus relating a phase transition in computational complexity to a structural phase transition.

Biophysics   with M. Muthukumar, H. Siegelman
Theory, Computer Simulation

- *Bioscillations*. Preliminary research into the synchronization of gene expression oscillations in the cells of the Mammalian suprachiasmatic nucleus, which regulates Circadian rhythms, through the study of a lattice network of Kuramoto oscillators.
- *Bacteriophage*. Brownian Dynamics simulations of packaging and ejection forces in bacteriophage.

PROFESSIONAL
ASSOCIATIONS

Artisan's Asylum – community education and technical support

Pirateship – local hackerspace with radical leanings

FarmHack – open source agriculture

Workshop on the Knowledge Commons – research on commons-based knowledge production

SKILLS

Computing
- Languages: C, Python, C++, Fortran, Javascript, LATEX
- Packages: Pylab, Scipy, R, Matlab, Octave, Mathematica, Processing
- Hardware: printed circuit board design and production with Eagle CAD

Physics, Mathematics, Analysis
Conversant in research methods related to statistical mechanics, social and neuronal networks, collective behavior, foams, granular materials, complex systems, random graphs, packing col-

loidal physics, graph theory / coloring, stochastic epidemic models / percolation, spin systems, Monte Carlo algorithms, and graph theory.

POPULAR PRESS AND REPORTS

Gillies, J. "Pursuing DIY, open-source water quality monitoring from rural Colombia to Mystic River, Mass.", *Environmental Monitor*, March 13, 2014.

Berry, R. and Cevey, S. "Hacking Journalism at the MIT Media Lab", *The Guardian*, July 18, 2014.

Pitt, F. "Public Lab: Homebrew Hardware", *Sensors and Journalism*, May, 2014. Tow Center for Digital Journalism, Columbia University.

Levingston, K. "Mighty Mom Breast Pumping Toolbelt Wins MIT Hackathon", *Boston.com*, Sept 21, 2014.

BALLOONS

UMass Amherst Physics Weather Balloon, April 20, 2012. Collected temperature and pressure data using custom open hardware instrumentation.

TUBES

Zip-tube: an open-source, reusable, easy-to-sterilize system for liquid transport. Matt Carney, Tal Achituv, and the Mighty Mom Team. MIT Breast Pump Hackathon, Sept 21, 2014.

MORE INFORMATION

More information and auxiliary documents can be found at http://dwblair.github.io.