David Rushing Dewhurst

(a) 25 Crab Cove Terrace, Wareham, MA 02571, USA
(w) https://davidrushingdewhurst.com
(e) drd@davidrushingdewhurst.com
(public code) https://gitlab.com/drdewhurst
(p/signal) +1 (508) 944-2116

Professional Experience

Scientist, Charles River Analytics: August 2020 – present

- **PI** on DARPA I2O **ECoSystemic** (eventual consistency in federated financial systems), **MIPs** (modeling influence pathways); Co-PI on DARPA DSO **EDGE** (enhanced situational awareness in autonomous systems control); Modeling team lead on DARPA STO LogX (joint logistics enterprise forecasting) and DARPA MTO SHEATH (hardware trojan horse detection); Lead scientist on DEVCOM and NAVSEA cybersecurity efforts
- Lead capture efforts across multiple business initiatives (supply chain/logistics and sustainment; deployment of probabilistic programming) and government partners (DARPA I2O, STO, BTO; AFLCMC)
- Designed/implemented three universal probabilistic programming languages and probabilistic graphical model library; designed/implemented corporate financial forecasting toolkit

Lead Data Scientist, MassMutual: February 2020 – August 2020

- Designed/implemented automated economic capital risk management system
- Architect and develop comprehensive Bayesian structural time series software

Computer Science Graduate Fellow, MITRE Corporation: June 2017 – September 2019

- Design and implement digital signal processing algorithms for petabyte-scale financial transaction analysis, author empirical studies of US equities market microstructure
- Facilitate financial resilience tabletop exercises (joint with DARPA and NY Fed)
- Received Trailblazer award for establishing new company initiative in computational finance

Education

PhD (February 2020) – *University of Vermont*: Complex Systems and Data Science

- 100% funded: DARPA #W56KGU-17-C-0010 (2018 – 2019); MassMutual (2019 – 2020)

MS (May 2018) – *University of Vermont*: Mathematics

- 100% funded: GTA (2017), DARPA #W56KGU-17-C-0010 (2017 – 2018)

Séminaire de Mathématiques Supérieures (July 2017) –MSRI/University of Montreal

- 100% funded: MSRI scholarship

BA (May 2016) – *University of Vermont*: Economics, Mathematics, and Political Science

Interests

Grey-zone/hybrid conflict

- **Resilient financial systems**: automated cross-subsystem failure mode identification, resilient trading and settlement mechanisms, pure financial strategies to counter financial attacks
- **Cognitive warfare**: detecting, categorizing, and mitigating influence operations in elections, media, and other environments

- **Logistics**: enabling reliable demand signals in austere/low-resource environments

Distributed statistical edge computing

- asynchronous inference of system-wide latent state using many small local models (e.g., as applied to demand estimation or cyberattack detection and characterization)
- scaling down open-world probabilistic programming to low-resource environments
- Unconventional sensing and forecasting using financial market, commercial logistics, and social media data

Knowledge representation

- creating consistent, adaptive, useful, and human-oriented typologies from extremely limited data (e.g., human conversation or email exchange with minimal background information)

Papers

(Time ordering is first appearance on arXiv.org if it appeared there, otherwise date of publication, descending order. C – at Charles River; M – at MassMutual; U – at university.)

1. Van Oort, C.M., Ring IV, J.H., **Dewhurst, D.R.**, Danforth, C.M. and Tivnan, B.F., 2022. Ecological and Coevolutionary Dynamics in Modern Markets Yield Nonstationarity in Market Efficiencies. *Complexity*, 2022. **(C)**
2. Inman, J., Wright, J., Martino, R., Gale, M., Rogers, C., Dora, R., Mitchell, D., Gupta, N., **Dewhurst, D.**, Summerville, D., 2021. FALCHION: Fuzzing Automatically to Locate Compromised Hardware with Isolation to Omit Noise. In Proceedings of GOMACTech 2021, Virtual. 2021. **(C)**
3. **Dewhurst, D.R.**, 2020. Structural time series grammar over variable blocks. arXiv preprint arXiv:2009.06865. Presented at ProbProg 2020. **(C)**
4. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J., and Danforth, C.M., 2020. Probability-turbulence divergence: A tunable allotaxonometric instrument for comparing heavy-tailed categorical distributions. arXiv preprint arXiv:2008.13078. (Submitted for publication.) **(M)**
5. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J., and Danforth, C.M., 2020. Long-term word frequency dynamics derived from Twitter are corrupted: A bespoke approach to detecting and removing pathologies in ensembles of time series. arXiv preprint arXiv:2008.11305. **(M)**
6. Alshaabi, T., Adams, J.L., Arnold, M.V., Minot, J.R., **Dewhurst, D.R.**, Reagan, A.J., Danforth, C.M. and Dodds, P.S., 2021. Storywrangler: A massive exploratorium for sociolinguistic, cultural, socioeconomic, and political timelines using Twitter. Science advances, 7(29), p.eabe6534. **(M)**
7. Alshaabi, T., **Dewhurst, D.R.**, Bagrow, J.P., Dodds, P.S. and Danforth, C.M., 2021. The sociospatial factors of death: Analyzing effects of geospatially distributed variables in a Bayesian mortality model for Hong Kong. Plos one, 16(3), p.e0247795. **(M)**
8. **Dewhurst, D.R.**, Alshaabi, T., Arnold, M.V., Minot, J.R., Danforth, C.M. and Dodds, P.S., 2020. Divergent modes of online collective attention to the COVID-19 pandemic are associated with future caseload variance. arXiv preprint arXiv:2004.03516. **(M)**

9. Arnold, M.V.,**Dewhurst, D.R.**, Alshaabi, T., Minot, J.R., Adams, J.L., Danforth, C.M. and Dodds, P.S., 2021. Hurricanes and hashtags: Characterizing online collective attention for natural disasters. PLoS one, 16(5), p.e0251762. **(M)**
10. Alshaabi, T., Arnold, M.V., Minot, J.R., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J., Muhamad, R., Danforth, C.M., and Dodds, P.S., 2020. How the world's collective attention is being paid to a pandemic: COVID-19 related 1-gram time series for 24 languages on Twitter. PLoS one 16, no. 1 (2021): e0244476. **(M)**
11. Alshaabi, T., **Dewhurst, D.R.**, Minot, J.R., Arnold, M.V., Adams, J.L., Danforth, C.M. and Dodds, P.S., 2021. The growing amplification of social media: measuring temporal and social contagion dynamics for over 150 languages on Twitter for 2009–2020. EPJ data science, 10(1), pp.1-28. **(M)**
12. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Gray, T.J., Frank, M.R., Reagan, A.J. and Danforth, C.M., 2020. Allotaxonometry and rank-turbulence divergence: A universal instrument for comparing complex systems. arXiv preprint arXiv:2002.09770. (Submitted for publication.) **(M)**
13. **Dewhurst, D.R.**, Li, Y., Bogdan, A. and Geng, J., 2020, July. Evolving *ab initio* trading strategies in heterogeneous environments. In Proceedings of the 2020 Genetic and Evolutionary Computation Conference (pp. 76-84). **(M)**
14. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J. and Danforth, C.M., 2019. Fame and Ultrafame: Measuring and comparing daily levels of being "talked about" for United States' presidents, their rivals, God, countries, and K-pop. arXiv preprint arXiv:1910.00149. (Submitted for publication.) **(U)**
15. **Dewhurst, D.R.**, Danforth, C.M. and Dodds, P.S., 2020. Noncooperative dynamics in election interference. Physical Review E, 101(2), p.022307. **(U)**
16. **Dewhurst, D.R.**, Alshaabi, T., Kiley, D., Arnold, M.V., Minot, J.R., Danforth, C.M. and Dodds, P.S., 2020. The shocklet transform: a decomposition method for the identification of local, mechanism-driven dynamics in sociotechnical time series. EPJ Data Science, 9(1), p.3. **(U)**
17. **Dewhurst, D.R.**, Arnold, M.V. and Van Oort, C.M., 2019, July. Selection mechanisms affect volatility in evolving markets. In Proceedings of the Genetic and Evolutionary Computation Conference (pp. 90-98). ACM. **(U)**
18. **Dewhurst, D.R.**, Van Oort, C.M., Ring IV, J.H., Gray, T.J., Danforth, C.M. and Tivnan, B.F., 2019. Scaling of inefficiencies in the US equity markets: Evidence from three market indices and more than 2900 securities. arXiv preprint arXiv:1902.04691. (Submitted for publication.) **(U)**
19. Tivnan, B.F., **Dewhurst, D.R.**, Van Oort, C.M., Ring IV, J.H., Gray, T.J., Tivnan, B.F., Koehler, M.T., McMahon, M.T., Slater, D.M., Veneman, J.G. and Danforth, C.M., 2020. Fragmentation and inefficiencies in US equity markets: Evidence from the Dow 30. PloS one, 15(1), p.e0226968. **(U)**
20. **Dewhurst, D.R.**, Danforth, C.M. and Dodds, P.S., 2018. Continuum rich-get-richer processes: Mean field analysis with an application to firm size. Physical Review E, 97(6), p.062317. **(U)**

21. Dodds, P.S., **Dewhurst, D.R.**, Hazlehurst, F.F., Van Oort, C.M., Mitchell, L., Reagan, A.J., Williams, J.R. and Danforth, C.M., 2017. Simon's fundamental rich-get-richer model entails a dominant first-mover advantage. Physical Review E, 95(5), p.052301. **(U)**

Talks

1. **Dewhurst, D.R.** (June, 2022). Rapid exact restoration of federated market state after systemic failure. Presented at the 90th Military Operations Research Society (MORS) Symposium, Marine Corps University, Quantico, VA, USA.
2. **Dewhurst, D.R.** (July, 2020). Evolving *ab initio* trading strategies in heterogeneous environments. Presented at the Genetic and Evolutionary Computational Conference (GECCO 2020), Remote.
3. **Dewhurst, D.R.** (January, 2020). The shocklet transform and STAR algorithm: A decomposition method for the identification of local, mechanism-driven dynamics in sociotechnical time series. Presented at Dynamics Days 2020, Hartford, CT, USA.
4. **Dewhurst, D.R.** (July, 2019). Selection mechanisms affect volatility in a market of evolving agents. Presented at the Genetic and Evolutionary Computation Conference (GECCO 2019), Prague, Czech Republic.
5. **Dewhurst, D.R.** (May, 2019). Fragmentation and inefficiencies in US equities markets: A network perspective. Presented at the 4th workshop on Statistical Physics for Financial and Economic Networks at NetSci 2019, Burlington, VT, USA.