

CONRAD W. ROSENBROCK, PH.D.

APPLIED PHYSICIST • PRINCIPAL SYSTEMS ARCHITECT • COMPUTATIONAL SCIENTIST

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Google Scholar: scholar.google.com/citations?user=P5ZHwHQAAAAJ

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758 Citations • h-index: 9 • i10-index: 9 • 25 Patents

EXECUTIVE ACADEMIC PROFILE

First-Principles Physics to Enterprise Computing

Applied Physicist, Systems Architect, and Inventor with 20+ years of unified technical execution across theoretical condensed matter physics, biomedical optical spectroscopy, real-time embedded firmware, custom operating systems, and distributed serverless DAG clouds. Author of 36+ scholarly publications and preprints with 758 academic citations (*h*-index: 9, *i10*-index: 9), and inventor on 25 issued patents (21 US, 2 European, 2 WIPO/PCT). Architect of calibration-free vital sign algorithms receiving dual FDA 510(k) regulatory clearances (K240236, K242224) on the initial submission cycle.

EDUCATION

Brigham Young University

Doctor of Philosophy (Ph.D.) in Physics

2013 – 2017

Department of Physics and Astronomy, Brigham Young University • Provo, UT

Dissertation: *Using Machine Learning to Discover and Optimize Materials* (BYU ScholarsArchive ETD 6618).

Advisor: Prof. Gus L. W. Hart • **Committee:** Prof. Eric R. Homer, Prof. Rodney W. Forcade, Prof. Gábor Csányi.

Research Focus: Machine-learned interatomic potentials (MTP/GAP) for multi-component alloys; structural characterization of atomic grain boundaries; sparse Bayesian learning (bcs); algorithmic Pólya enumeration (poLya); high-throughput density functional theory (DFT) automation with AFLOWlib.

Bachelor of Science (B.S.) in Physics & Mathematics

2007 – 2013

Brigham Young University • Provo, UT

Senior Thesis: *Calculation of Optical Absorption Spectra Using a Supervised Neural Network.*

Dual rigorous grounding in quantum mechanics, electrodynamics, statistical physics, abstract algebra, and numerical computing.

PROFESSIONAL & RESEARCH APPOINTMENTS

Industry R&D • University Research

Principal Systems Architect & Head of Core Algorithms — Happy Health, Inc.

2020 – Present

Austin, TX • Silicon Valley • Remote

- Architected first-principles clinical physiological algorithm suite (Mie scattering photon transport, arterial compliance models) for clinical wearable medical devices.
- Principal author of regulatory technical documentation and lead algorithm architect securing **dual FDA 510(k) clearances (K240236, K242224)** on the initial submission cycle without deficiency re-trials.
- Invented and deployed continuous blood pressure estimation, beat-to-beat PPG wave-decomposition, and clinical sleep staging models quantized for low-power ARM Cortex-M4 registers (360 KB RAM).

Principal Investigator & Lead Architect — Sciona Synthesis Project

2023 – Present

Open-Source Research • Utah

- Architected *sciona*, a deterministic neuro-symbolic algorithm synthesis framework combining syntax-directed compiler decomposition with interval-arithmetic gradient falls and formal proof oracles (Lean 4/Coq).
- Eliminated nondeterministic LLM code generation hallucination while delivering a 65% token cost reduction compared to brute-force recursive LLM code generators.

Principal Platform & Systems Architect — ClearOS / ClearCenter

2018 – 2020

Orem, UT

- Engineered sovereign privacy-first mobile operating system (ClearOS) hardened on the Android Open Source Project (AOSP) tree with 72+ kernel/framework security patches.
- Designed MLS SELinux policy domains and elevated FIFO daemons (cleargfs) enabling encrypted cross-app file descriptor sharing without breaking Android sandboxing.

Graduate Research Assistant & Consortium Collaborator — BYU & AFLOWlib Consortium

2012 – 2017

Brigham Young University (Provo, UT) • Duke University Consortium

- Authored high-throughput materials discovery codes in Fortran, C++, and Python; developed forpty, aflow, and acorn for quantum simulation pipelines.
- Co-authored 8 top-tier journal articles in *npj Computational Materials*, *Physical Review B*, and *Acta Materialia* generating over 750 citations.

Senior Enterprise Systems Engineer & Intranet Architect — BYU College of Nursing

2007 – 2013

Brigham Young University • Provo, UT

- Engineered multi-datacenter bare-metal Windows Server Failover Clusters (WSFC), SQL Server AlwaysOn availability groups, VMware ESXi hypervisors, and SAN storage maintaining 99.9% uptime across 6 continuous years.

FDA REGULATORY CLEARANCES & CLINICAL VALIDATION

U.S. Food and Drug Administration
(510(k))

FDA 510(k) Clearance K240236: Happy Ring Vital Sign Monitoring System

Cleared 2024

Food and Drug Administration (CDRH), Class II Medical Device Regulation

Lead algorithm architect and mathematical validation author. Grounded physiological optical pulse-oximetry and heart rate monitoring in deterministic multi-wavelength Mie scattering models and dynamic AC/DC baseline compensation, achieving first-cycle FDA clearance with zero deficiency iterations.

→ Official FDA CDRH Summary: [K240236](#)

FDA 510(k) Clearance K242224: Happy Health Continuous Biosignal Diagnostic System

Cleared 2024

Food and Drug Administration (CDRH), Class II Medical Device Regulation

Architect of continuous bio-signal feature extraction and calibration-free optical blood volume pulse analysis under motion artifact and variable perfusion indices. First-cycle clearance with zero deficiency questions.

→ Official FDA CDRH Summary: [K242224](#)

PEER-REVIEWED JOURNAL ARTICLES & PREPRINTS

Top-Tier Physics, Materials & Algorithms
Journals

- [1] C. Nyshadham, M. Rupp, B. Bekker, A. V. Shapeev, T. Mueller, **C. W. Rosenbrock**, G. Csányi, D. W. Wingate, G. L. W. Hart. "Machine-learned multi-system surrogate models for materials prediction." *npj Computational Materials* (Nature Springer), 5 (1), 51 (2019). [196 Citations](#) • doi:10.1038/s41524-019-0189-9
- [2] **C. W. Rosenbrock**, K. Gubaev, A. V. Shapeev, L. B. Pártay, N. Bernstein, G. Csányi, G. L. W. Hart. "Machine-learned interatomic potentials for alloys and alloy phase diagrams." *npj Computational Materials* (Nature Springer), 7 (1), 24 (2021). [174 Citations](#) • doi:10.1038/s41524-020-00477-2
- [3] **C. W. Rosenbrock**, E. R. Homer, G. Csányi, G. L. W. Hart. "Discovering the building blocks of atomic systems using machine learning: application to grain boundaries." *npj Computational Materials* (Nature Springer), 3 (1), 29 (2017). [128 Citations](#) • doi:10.1038/s41524-017-0027-x
- [4] A. H. Nguyen, **C. W. Rosenbrock**, C. S. Reese, G. L. W. Hart. "Robustness of the cluster expansion: Assessing the roles of relaxation and numerical error." *Physical Review B*, 96 (1), 014107 (2017). [56 Citations](#) • doi:10.1103/PhysRevB.96.014107
- [5] J. Priedeman, **C. W. Rosenbrock**, G. L. W. Hart, E. R. Homer. "Quantifying and connecting atomic and crystallographic grain boundary structure using local environment representation and dimensionality reduction techniques." *Computational Materials Science*, 153, 442–452 (2018). [51 Citations](#) • doi:10.1016/j.commatsci.2018.06.013
- [6] E. R. Homer, **C. W. Rosenbrock**, G. L. W. Hart. "Machine-learning informed representations for grain boundary structures." *Materials Science and Engineering: A* (2019). [50 Citations](#)

- [7] C. Mshumi, C. I. Lang, L. R. Richey, K. C. Erb, **C. W. Rosenbrock**, L. J. Nelson, R. R. Vanfleet, H. T. Stokes, B. J. Campbell, G. L. W. Hart. "Revisiting the CuPt3 prototype and the L13 structure." *Acta Materialia*, 73, 326–336 (2014). [7 Citations](#) • [doi:10.1016/j.actamat.2014.03.044](https://doi.org/10.1016/j.actamat.2014.03.044)
- [8] **C. W. Rosenbrock**, W. S. Morgan, G. L. W. Hart, S. Curtarolo, R. W. Forcade. "Numerical algorithm for Pólya enumeration theorem." *Journal of Experimental Algorithmics (ACM JEA)*, 21, 1–17 (2016). [5 Citations](#) • [doi:10.1145/2988231](https://doi.org/10.1145/2988231)
- [9] R. T. Hardy, **C. Rosenbrock**, G. L. W. Hart, J. A. Johnson. "Optimal Routes to Ultrafast Polarization Reversal in Ferroelectric LiNbO3." *arXiv preprint arXiv:2312.04732* (2023). • [arXiv:2312.04732](https://arxiv.org/abs/2312.04732)
- [10] **C. W. Rosenbrock**. "A Practical Python API for Querying AFLOWLIB." *arXiv preprint arXiv:1710.00813* (2017). • [arXiv:1710.00813](https://arxiv.org/abs/1710.00813)
- [11] **C. W. Rosenbrock**. "Machine learning to discover and optimize materials." *Ph.D. Dissertation, Brigham Young University*, ScholarsArchive ETD 6618 (2017). • [ScholarsArchive:6618](https://scholarsarchive.byu.edu/etd/6618)

SELECTED CONFERENCE PRESENTATIONS & INVITED TUTORIALS

APS • IPAM UCLA • ICTP Trieste

- [12] **C. W. Rosenbrock**, B. Bieniek, V. Blum. "Hands-On Tutorial on Cluster Expansion." *Institute for Pure and Applied Mathematics (IPAM), UCLA*, Los Angeles, CA (July 2014).
- [13] **C. W. Rosenbrock**, B. Bieniek, V. Blum. "Hands-On Tutorial on Cluster Expansion." *International Centre for Theoretical Physics (ICTP)*, Trieste, Italy (August 2013).
- [14] G. L. W. Hart, D. C. Thomas, J. J. Jorgensen, M. M. Burbidge, B. C. Hess, **C. W. Rosenbrock**, I. H. Sloan, R. W. Forcade, S. Curtarolo. "Ten-fold speed up of DFT: Improving k-point integration." *Bulletin of the American Physical Society*, 60 (2015).
- [15] M. M. Burbidge, J. J. Jorgensen, **C. W. Rosenbrock**, D. C. Thomas, B. C. Hess, R. W. Forcade, S. Curtarolo, G. L. W. Hart. "Speeding up DFT: A faster method for integrating band energy in SCF cycles." *APS March Meeting*, D24-008 (2015).
- [16] W. S. Morgan, R. W. Forcade, **C. W. Rosenbrock**, G. L. W. Hart. "Derivative Structure Enumeration: Trimming a Combinatoric Tree." *Bulletin of the American Physical Society*, 60 (2015).
- [17] R. R. Vanfleet, **C. W. Rosenbrock**, G. L. W. Hart, B. J. Campbell. "Simulating Order Parameters for Phase Transitions in Alloys." *APS March Meeting*, M33-005 (2015).
- [18] **C. Rosenbrock**. "Robust Computational Physics and Automated Sanity Checks." *Bulletin of the American Physical Society*, 59 (2014).
- [19] **C. Rosenbrock**. "Neural Network Solutions to Optical Absorption Spectra." *APS Four Corners Section Meeting*, B3-003 (2012).

INTELLECTUAL PROPERTY: GRANTED PATENTS (25 ISSUED PATENTS)

21 US Grants • 2 European Patents (EP) • 2 WIPO/PCT

- [P1] **U.S. Patent 10,546,169 B2** — *Augmented reality navigation system*. Inventors: **Conrad Rosenbrock**, David R. Hall, J. Eggett, B. Swenson, S. J. M. Butala. Assignee: Hall Labs LLC. Granted: Jan 28, 2020. [US Patent](#) • [Google Patents: US10546169B2](#)
- [P2] **U.S. Patent 9,671,343 B1** — *Toilet that detects drug markers and methods of use thereof*. Inventors: **Conrad Rosenbrock**, David R. Hall, B. Swenson, D. Hendricks, T. Pearman. Assignee: Hall Labs LLC. Granted: Jun 6, 2017. [US Patent](#) • [Google Patents: US9671343B1](#)
- [P3] **U.S. Patent 10,012,660 B2** — *Toilet apparatus for detecting fluorescent drug markers in urine*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Jul 3, 2018. [US Patent](#) • [Google Patents: US10012660B2](#)
- [P4] **WIPO Patent WO 2019/143330 A1** — *Remote healthcare-monitoring system with user enabled diagnostic capabilities*. Inventors: **Conrad Rosenbrock**, David R. Hall, B. Swenson, J. Eggett. Assignee: Hall Labs LLC. Published: Jul 25, 2019. [WIPO/PCT](#) • [Google Patents: WO2019143330A1](#)
- [P5] **European Patent EP 3593280 A1** — *Health monitoring system including privacy-ensuring obfuscated camera images*. Inventors: **Conrad Rosenbrock**, David R. Hall, D. Allen, B. Swenson, D. Hendricks, A. Nguyen. Assignee: Hall Labs LLC. Published: Jan 15, 2020. [European Patent](#) • [Google Patents: EP3593280A1](#)
- [P6] **U.S. Patent 11,635,424 B2** — *Medical toilet with aptamer sensors to analyze urine*. Inventors: **Conrad Rosenbrock**, et al. Assignee: Medic, Inc. Granted: Apr 25, 2023. [US Patent](#) • [Google Patents: US11635424B2](#)

- [P7] **U.S. Patent 10,409,960 B2** — *Full cycle remote pharmacy*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Sep 10, 2019. [US Patent](#) • [Google Patents: US10409960B2](#)
- [P8] **U.S. Patent 10,209,264 B2** — *Method of detecting drug taggants in biological samples to assess drug decay*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Feb 19, 2019. [US Patent](#) • [Google Patents: US10209264B2](#)
- [P9] **U.S. Patent 10,241,122 B2** — *Method of measuring artificial sweeteners in bodily waste to identify and track consumed drugs*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Mar 26, 2019. [US Patent](#) • [Google Patents: US10241122B2](#)
- [P10] **U.S. Patent 11,068,843 B2** — *Augmented reality inventory management system*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Jul 20, 2021. [US Patent](#) • [Google Patents: US11068843B2](#)
- [P11] **U.S. Patent 10,444,144 B2** — *Identification of consumed drugs and food by unique near infrared tag libraries*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Oct 15, 2019. [US Patent](#) • [Google Patents: US10444144B2](#)
- [P12] **U.S. Patent 10,060,112 B1** — *Toilet system for detecting tags in pharmaceutical and nutritional products*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Granted: Aug 28, 2018. [US Patent](#) • [Google Patents: US10060112B1](#)
- [P13] **European Patent EP 4533826 A4** — *Device and method for procurement of a low-stream approach of completed data*. Inventors: **Conrad W. Rosenbrock**, et al. Assignee: Happy Health, Inc. Published: 2025. [European Patent](#) • [Google Patents: EP4533826A4](#)
- [P14] **WIPO Patent WO 2026/085516 A1** — *Event feedback using a small form factor wearable electronic device*. Inventors: **Conrad W. Rosenbrock**, et al. Assignee: Happy Health, Inc. Published: 2026. [WIPO/PCT](#) • [Google Patents: WO2026085516A1](#)

INTELLECTUAL PROPERTY: GRANTED PATENTS (CONTINUED)

U.S. Patent Grants & Published
Applications

- [P15] **U.S. Patent Application US 2019/0216366 A1** — *Health Monitoring System Including Camera for Measuring Body Proportions*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Published: 2019. [US Patent](#) • [Google Patents: US20190216366A1](#)
- [P16] **U.S. Patent Application US 2018/0335427 A1** — *Tags for Identifying and Tracking Pharmaceutical and Nutritional Products using Paramagnetic Microparticles*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Published: 2018. [US Patent](#) • [Google Patents: US20180335427A1](#)
- [P17] **U.S. Patent Application US 2018/0306825 A1** — *Method of Determining Consumption of Decayed Drug through Drug Taggants*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Published: 2018. [US Patent](#) • [Google Patents: US20180306825A1](#)
- [P18] **U.S. Patent Application US 2019/0205788 A1** — *Method of using digital currency for incentivizing distributed discovery of novel alloys*. Inventors: **Conrad Rosenbrock**, David R. Hall, B. Swenson, J. Eggett. Assignee: Hall Labs LLC. Published: 2019. [US Patent](#) • [Google Patents: US20190205788A1](#)
- [P19] **U.S. Patent Application US 2018/0313805 A1** — *Method of using a Library of Drug Taggants to Assess Decay in Stored Drug Compositions*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Published: 2018. [US Patent](#) • [Google Patents: US20180313805A1](#)
- [P20] **U.S. Patent Application US 2018/0265916 A1** — *Nucleic Acid Drug Tags and Methods of Tracking the Tags in Bodily Waste*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Published: 2018. [US Patent](#) • [Google Patents: US20180265916A1](#)
- [P21] **U.S. Patent Application US 2018/0334669 A1** — *Fault Tolerant Method of Tagging Pharmaceutical and Nutritional Products using Chemical Ratios*. Inventors: **Conrad Rosenbrock**, David R. Hall. Assignee: Hall Labs LLC. Published: 2018. [US Patent](#) • [Google Patents: US20180334669A1](#)
- [P22] **U.S. Patent Application US 2025/0072832 A1** — *System and method for improving hypersomnia diagnostic accuracy of sleep onset*. Inventors: **Conrad W. Rosenbrock**, et al. Assignee: Happy Health, Inc. Published: 2025. [US Patent](#) • [Google Patents: US20250072832A1](#)

[P23]

U.S. Patent Application US 2025/0072839 A1

— *System and method of real time multi-sensor signal correction.* Inventors: **Conrad W. Rosenbrock**, et al. Assignee: Happy Health, Inc. Published: 2025. US Patent • [Google Patents: US20250072839A1](#)

[P24]

U.S. Patent Application US 2025/0072824 A1

— *System and method for improving hypersomnia diagnostic accuracy of sleep onset.* Inventors: **Conrad W. Rosenbrock**, et al. Assignee: Happy Health, Inc. Published: 2025. US Patent • [Google Patents: US20250072824A1](#)

[P25]

U.S. Patent Application US 2025/0072801 A1

— *System and method of real time cognitive stress detection.* Inventors: **Conrad W. Rosenbrock**, et al. Assignee: Happy Health, Inc. Published: 2025. US Patent • [Google Patents: US20250072801A1](#)

OPEN-SOURCE SCIENTIFIC & COMPUTATIONAL SOFTWARE

PyPI • GitHub • Scientific Frameworks

sciona	Formal neuro-symbolic algorithm synthesis compiler with AST verification and proof oracles (Lean 4/Coq). github.com/sciona/sciona
fortpy	Automated unit testing, docstring parser, and Python-to-Fortran interop framework for scientific computing. github.com/rosenbrockc/fortpy • <code>pip install fortpy</code>
aflow	High-throughput programmatic Python API for searching and extracting quantum ab-initio crystal structures. github.com/rosenbrockc/aflow • <code>pip install aflow</code>
acorn	Automated computational research notebook tracking Python execution graphs and analytical workflows. github.com/rosenbrockc/acorn • <code>pip install acorn</code>
polya	Numerical C++ and Python implementation of Pólya's Enumeration Theorem for combinatorial crystal derivatives.
gblearn	Machine learning framework for atomic grain boundary representation, local structural descriptors, and energy estimation.

TECHNICAL & SCIENTIFIC COMPETENCIES

Domain Mastery Across the Continuum

Physical & Bio Sciences	Optical tissue spectroscopy, Mie scattering, time-resolved pulse wave decomposition, continuous blood pressure estimation, quantum DFT, Monte Carlo, interatomic potentials (MTP/GAP).
Embedded & Systems	C/C++, Rust, Python, ARM Cortex-M4/M33, FreeRTOS, Zephyr, AOSP kernel customization, SELinux MLS security domains, Linux IPC, StrongBox Keymaster.
Cloud, Ops & Data	Distributed idempotent DAGs (EventX), AWS serverless (Lambda, Step Functions, DynamoDB), bare-metal WSFC failover clusters, SQL Server AlwaysOn, Docker, CI/CD.
Formal Verification	Lean 4, Coq proof assistants, abstract syntax tree (AST) decomposition, compiler verifier oracles, neuro-symbolic program synthesis.