İLKE ERCAN

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RESEARCH INTERESTS:

Emerging and unconventional computing paradigms; Energy efficiency limits of computing; Nanoelectronics; Nanophotonics; Quantum-computing; Physical-information theory; Thermodynamics of computation.

TEACHING INTERESTS:

Introduction to Electrical Engineering, Physics of Semiconductor Devices, Circuit Theory, Electronics, Physical-Information Theory, Probability and Random Processes, Thermodynamics.

Education

UNIVERSITY OF MASSACHUSETTS, Amherst MA, USA

Ph.D., Electrical & Computer Engineering (ECE) **Fall 2008 - Spring 2014**

Advisor: Professor Neal G. Anderson
Area of Study: Heat Dissipation Bounds for Nanocomputing: Methodology and Applications

M.S., Electrical & Computer Engineering (ECE) **Fall 2006 - Summer 2008**

Advisor: Professor Neal G. Anderson
Area of Study: Electron Transport Properties and Information Bounds of Nanoscale Conductors by Microcanonical Approach

MIDDLE EAST TECHNICAL UNIVERSITY, Ankara, Turkey

B.S., Physics, Solid State Physics **Fall 2002 - Summer 2006**
Minor, Logic and Philosophy of Science **Spring 2004 - Summer 2006**

Academic Positions

Principal Educator, Delft University of Technology
Microelectronics Department **Spring 2021 - present**

Associate Professor, University College Roosevelt
Engineering Department **Fall 2019 - Spring 2021**

Assistant Professor, Boğaziçi University
Department of Electrical and Electronics Engineering **Fall 2015 - Spring 2020**

Visiting Scholar, Massachusetts Institute of Technology
Electronic Materials Research Group at MIT (EMAT) **Summer 2018**

Part-Time Instructor, Sabancı University
Foundations Development Program **Spring 2018**

Postdoctoral Research Fellow, TU Darmstadt
Institute for Semiconductor Technology and Nanoelectronics and
Institute for Philosophy **Spring and Summer 2015**

Visiting Faculty, Smith College
Picker Engineering Program **Spring and Fall 2014**

Research Grants

MIT International Science and Technology Initiatives Seed Fund **2018 - present**
Career Development Grant (3501), TÜBİTAK **2017 - 2019**
Start-up Research Grant, Boğaziçi University **2016 - 2019**
Postdoctoral Research Grant (2219), TÜBİTAK **2014 - 2015**

Awards

Excellence in Teaching Award, Faculty of Engineering, Boğaziçi University	**2018**
First Place Best Oral Conference Paper, IEEE 12^{th} International Conference on Nanotechnology	**2012**
Outstanding Teaching Assistant Award, UMass Amherst ECE	**2012**
Best Paper Award, IEEE 11^{th} International Conference on Nanotechnology	**2011**

Scholarships

Graduate Student Travel Grant, UMass Amherst	**2008, 2011 and 2012**
David Navon Scholarship Award, UMass Amherst ECE	**2009**
Haluk Derin Scholarship, UMass Amherst ECE	**2007, 2008 and 2009**

Publications

Journal Articles

1. **İ. Ercan**, Z. D. Sütgöl, and F. O. Özhan, " "Physical Limitations on Fundamental Efficiency of SET-Based Brownian Circuits," *Entropy*, vol. 23 no 4, 406, 2021. doi.org/10.3390/e23040406

2. S. Barışık and **İ. Ercan**, "Thermodynamic Cost of Edge Detection in Artificial Neural Network (ANN)-Based Processors," *International Journal of Parallel, Emergent and Distributed Systems*, Published online: 29 Oct 2020. DOI: 10.1080/17445760.2020.1836639

3. F. Dinç, **İ. Ercan** and A. M. Brańczyk, "Exact Markovian and non-Markovian time dynamics in waveguide QED: collective interactions bound states in continuum, superradiance and sub radiance," *Quantum*, vol. 3, p. 213, 9 December, 2019. DOI: 10.22331/q-2019-12-09-213

4. O. Yakar and **İ. Ercan** "Logic Threshold for Microring Resonator-based BDD Circuits: Physical and Operational Analyses," *Turkish Journal of Engineering*, Vol. 3, issue 4, p.189, October 2019. DOI: 10.31127/tuje.537871

5. F. Dinç and **İ. Ercan** "Single Photon Two-Level Atom Interactions in 1-D Dielectric Waveguide: Quantum Mechanical Formalism and Applications" *Optical and Quantum Electronics (OQEL)*, 50: 390, Published Online October 15, 2018. DOI: 10.1007/s11082-018-1658-y

6. F. Dinç and **İ. Ercan** "Quantum Mechanical Treatment of Two-Level Atoms Coupled to Continuum with an Ultraviolet Cutoff," *Journal of Physics A: Mathematical and Theoretical,* vol. 51, no 35, p. 355, 2018. DOI: 10.1088/1751-8121/aad165

7. **İ. Ercan** and E. Suyabatmaz "Fundamental Energy Limits of SET-Based Brownian NAND and Half-Adder Circuits," *European Physical Journal B*, vol. 91 p. 113, 2018. DOI: 10.1140/epjb/e2018-80619-6

8. **İ. Ercan** and N. Anderson, "Heat Dissipation in Nanocomputing: Lower Bounds from Physical Information Theory," *IEEE Transactions on Nanotechnology,* vol. 12, no. 6, pp. 1047 - 1060, 2013. DOI: 10.1109/TNANO.2013.2276938

9. N. Anderson, **İ. Ercan** and N. Ganesh, "Toward Nanoprocessor Thermodynamics," *IEEE Transactions on Nanotechnology,* vol. 12, no. 6, pp. 902 - 909, 2013. DOI: 10.1109/TNANO.2013.2260352

10. **İ. Ercan** and N. Anderson, "Tight-biding Implementation of the Microcanonical Approach to Transport in Nanoscale Conductors: Generalization and Analysis," *Journal of Applied Physics*, vol. 107 no. 12, pp. 124318-13, 2010. DOI: 10.1063/1.3388055

11. **İ. Ercan** and N. Anderson, "Current and Information in the Microcanonical Picture of Nanoscale Transport," *Journal of Computational Electronics,* vol. 7, no 3., pp. 466 - 470, 2008. DOI: 10.1007/s10825-008-0234-2

12. **İ. Ercan** and S. Katırcıoğlu, "The Electronic Structure of Capped and Uncapped CdS Nanoparticles," *Journal of Nanoscience and Nanotechnology* 8, pp. 645 - 649, 2008. DOI: 10.1166/jnn.2008.A219

Book Chapter

1. **İ. Ercan** and N. Anderson, "Modular Dissipation Analysis for QCA," *Field-Coupled Nanocomputing, N.G. Anderson and S. Bhanja. Eds. Lecture Notes in Computer Science,* vol. 8280, pp. 357-375, Heidelberg, 2014. DOI: 10.1007/978-3-662-43722-3_15

Conference Proceedings

1. O. Yakar, Y. Nie, K Wada, A. Agarwal and **İ. Ercan**, "Energy Efficiency Analyses of Microring-Resonator-Based BDD Logic Circuits," *Proceedings of the IEEE International Conference on Rebooting Computing*, 28 November, 2019. DOI:10.1109/ICRC.2019.8914708

2. **İ. Ercan**, Ö. Susam, M. Altun, and M. H. Cılasun, "Synthesis and Fundamental Energy Analysis of Fault-Tolerant CMOS Circuits," *IEEExplore Proceedings of SMACD'17: International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design,* 12-15 June 2017. DOI: 10.1109/SMACD.2017.7981586

3. **İ. Ercan**, "Fundamental Energy Dissipation Limits in Logic Circuits," *ICT Energy Letters,* vol. 12, pp. 3-4, August 2016. (**Invited Paper**)

4. N. Anderson, **İ. Ercan** and N. Ganesh, "Toward Nanoprocessor Thermodynamics," *Proceedings of the* 12^{th} *IEEE Conference on Nanotechnology (IEEE NANO, 2012),* 2012. DOI: 10.1109/NANO.2012.6322186 (**First Place Best Oral Conference Paper**)

5. **İ. Ercan** and N. Anderson, "Heat Dissipation in Nanocomputing: Theory and QCA Application," *Proceedings of the* 11^{th} *IEEE Conference on Nanotechnology (IEEE NANO, 2011)*, pp.1289-1294, 2011. DOI: 10.1109/NANO.2011.6144346 (**Best Paper Award**)

6. **İ. Ercan**, M. Rahman and N. Anderson, "Determining Fundamental Heat Dissipation Bounds for Transistor-Based Nanocomputing Paradigms," NANOARCH'11: IEEE/ACM Symposium on Nanoscale Architectures, *Proceedings of the 2011 IEEE/ACM International Symposium on Nanoscale Architectures*, pp. 169 - 174, 2011. DOI: 10.1109/NANOARCH.2011.5941500

7. **İ. Ercan** and N. Anderson, "Structure Dependence of Nanoconductor Current in a Tight-Binding Microcanonical Model," *NANO'08: Proc. of the* 8^{th} *IEEE Conference on Nanotechnology (IEEE NANO, 2008)*, pp. 331 - 334. DOI: 10.1109/NANO.2008.104

8. **İ. Ercan** and N. Anderson, "Structure Dependence of Nanoconductor Current in a Microcanonical Transport Model," *Proceedings of the* 17^{th} *Annual Connecticut Symposium on Microelectronics and Optoelectronics*, pp. 39 - 40, April, 2008.

Oral Presentations

1. **İ. Ercan** and B. Kılınç, "Entropy, Information, and Their Relation to Energy: Implications in Science and Engineering" *Philosophy of Science Around the Mediterranean POND 3: Unity/ Disunity of Science*, Lisbon, Portugal, September 21, 2018.

2. **İ. Ercan**, "Energetic Cost of Information Processing at the Quantum Precipice: A Physical-Information-Theoretic Approach," *KOBIT-2, Quantum Optics and Information Meeting*, İstanbul, Turkey, 1-2 February, 2018. (**Invited Talk)**

3. **İ. Ercan**, "Energy Efficiency Limit in Brownian Circuits," *Micro Energy*, Gubbio, Italy, 3- 7 July, 2017. (**Invited Talk)**

4. **İ. Ercan**, Ö. Susam, M. Altun, and M. H. Cılasun, "Synthesis and Fundamental Energy Analysis of Fault-Tolerant CMOS Circuits," *SMACD'17: International Conference on Synthesis, Modeling, Analysis and Simulation Methods and Applications to Circuit Design,* Giardini Naxos, Italy, 12-15 June 2017.

5. **İ. Ercan**, "Fundamental Energy Dissipation Limits in Logic Circuits," *ICT Energy Science Conference*, Aalborg, Denmark, 16- 19 August, 2016. (**Invited Talk)**

6. **İ. Ercan**, "Making of Measurement on Limits: Examples from Nanoelectronics," *The Making of Measurement Conference,* University of Cambridge, July 24, 2015.

7. **İ. Ercan**, N. Ganesh, and N. Anderson, "Modular Dissipation Analysis for QCA," *FCN 13: The Workshop on Field Coupled Nanocomputing,* Tampa, FL, February 7, 2013.

8. **İ. Ercan**, "A Case Study of Actor-Network Theory: The Structure of Scientific Research on Nanoscale Semiconductor Devices," *ST Global Consortium Science and Technology in Society Conference*, Washington, DC, March 31, 2012.

9. **İ. Ercan** and N. Anderson, "Heat Dissipation in Nanocomputing: Theory and QCA Application," *IEEE NANO'11:* 11^{th} *IEEE Conference on Nanotechnology*, Portland OR, August 18, 2011. (**Best Paper Award**)

10. **İ. Ercan**, M. Rahman and N. Anderson, "Determining Fundamental Heat Dissipation Bounds for Transistor-Based Nanocomputing Paradigms," *NANOARCH '11: IEEE/ACM Symposium on Nanoscale Architectures*, San Diego, CA, June 2011.

11. **İ. Ercan** and N. Anderson, "Structure Dependence of Nanoconductor Current in a Tight-Binding Microcanonical Model," *IEEE* 8$^{\text{th}}$ *International Conference on Nanotechnology*, Arlington, TX, August 19, 2008.

12. **İ. Ercan** and N. Anderson, "Structure Dependence of Nanoconductor Current in a Microcanonical Transport Model," 17$^{\text{th}}$ *Annual Connecticut Symposium on Microelectronics and Optoelectronics*, Storrs, CT, April 9, 2008.

Poster Presentations

1. E. Suyabatmaz and **İ. Ercan**, "Energy Efficiency in a SET-Based Brownian Two-Bit Sort Circuit: Theory and Simulations," 3$^{\text{rd}}$ *IEEE International Conference on Rebooting Computing,* Tysons, VA, 7-9 November, 2018.

2. S. Barışık and **İ. Ercan**, "Thermodynamic Cost of Edge Detection in Artificial Neural Network (ANN)-Based Processors," 3$^{\text{rd}}$ *IEEE International Conference on Rebooting Computing,* Tysons, VA, 7-9 November, 2018.

3. O. Yakar and **İ. Ercan**, "Fundamental Analysis of Microring-Resonator-Based BDD Logic Circuits," *Poster presented at Fotonik: 20*$^{\text{th}}$ *National Workshop on Optics, Electro-optics and Photonics* Ankara, Turkey, 14 September 2018.

4. F. Dinç and **İ. Ercan**, "Filtering Behaviour of Two Level Atom-Photon System Inside One-dimensional Dielectric Waveguide," *Poster presented at KOBIT-2, Quantum Optics and Information Meeting* Istanbul, Turkey, 1-2 February 2018.

5. N. G. Anderson, **İ. Ercan**, and N. Ganesh, "Revealing Fundamental Efficiency Limits for Complex Computing Structures," *Poster presented at the* 4$^{\text{th}}$ *IEEE Rebooting Computing Summit,* December 2015.

6. **İ. Ercan** and N. Anderson, "Current and Information in the Microcanonical Picture of Nanoscale Transport," Poster Presentation in 12$^{\text{th}}$ *International Workshop on Computational Electronics*, Amherst, MA, November 8-10, 2007.

7. **İ. Ercan** and S. Katırcıoğlu, "The Electronic Structure of Capped and Uncapped CdS Nanoparticles," Poster Presentation in *NANOMAT International Workshop on Nanostructured Materials*, Antalya, Turkey, June 21-23, 2006.

Colloquia and Public Lectures

1. **İ. Ercan**, "Fiziksel Enformasyon Teorisi: Kavramlar ve Yanlış Anlamalar (Physical Information Theory: Concepts and Misunderstanding)," 5$^{\text{th}}$ *Systems and Control Engineering Graduate Student Camp*, The Chamber of Electrical Engineers (EMO), Nesin Math Village Şirince, Spring 2017. **(Invited Lecture)**

2. **İ. Ercan**, "Integrative Approach to Education in Turkey," *Boğaziçi University IEEE Student Branch STEAM Workshop,* October 1, 2016. (**Invited Talk**)

3. **İ. Ercan**,"From Maxwell's Demon to Nanocircuits: A Physical Information Theoretic Approach to Computing," *Koç University Department of Physics GSSE Seminar Series,* March 4, 2016. **(Invited Talk)**

4. **İ. Ercan**, "Heat Dissipation Bounds for Nanocomputing: Methodology and Applications," *Institut für Halbleitertechnik und Nanoelektronik Nanoelektronik-Kolloquium,* TU Darmstadt, April 17, 2015.

5. **İ. Ercan**, "Heat Dissipation Bounds for Nanocomputing: Methodology and Applications," *Smith College Picker Engineering Program*, December 18, 2014. **(Invited Talk)**

6. **İ. Ercan**, "Heat Dissipation Bounds for Nanocomputing: Methodology and Applications," *Boğaziçi University, Department of Electrical and Electronics Engineering,* May 26, 2014. **(Invited Talk)**

7. **İ. Ercan**, "Teknolojilerin Sınırlarınıve Gelişmelerini Etkileyen Faktörler (Factors Affecting the Limits and Evolution of Technologies," *SabancıUniversity, Science Canteen*, May 21, 2014. **(Invited Public Lecture)**

Courses Taught

TU Delft

EE1P11: Classical and Quantum Mechanics (co-instructor in Quantum Mechanics), EE1P21: Electricity and Magnetism (co-instructor), EE1L21: EPO-2 Smart Robot Challenge (tutor)

University College Roosevelt

SCIMATH 101: Calculus for Scientists, ENGPROJ102: Sensing Systems for Sustainability, ENGELEC101: Basic Electronics and Circuits

Sabancı University

NS 102: Science of Nature (Brain Module)

Boğaziçi University

EE 101: Orientation to Electrical Engineering, EE 202: Electrical Circuits II, EE 313: Probability for Electrical Engineers, EE 335: Electronics Laboratory, EE 58M: Intro to the Physical-Information-Theory

Smith College

EGR 220: Circuit Theory, EGR 390: Advanced Topics in Engineering: Semiconductor Technologies

University of Massachusetts, Amherst

Engin 112: Introduction to Electrical and Computer Engineering, ECE 211: Circuit Analysis I, ECE 212: Circuit Analysis II, ECE 314: Introduction to Probability and Random Processes, ECE 344: Semiconductor Devices and Materials, EE 572: Optoelectronics, PHYS 132: Introductory Physics Laboratory

Professional Service Contribution

Ad-Hoc Reviewer: Scientific Reports, Journal of Applied Physics, IEEE Transactions on Nanotechnology, IEEE Transactions on Very Large Scale Integration Systems

Co-Editor and Ad-Hoc Reviewer: Springer Lecture Notes on Computer Science State-of- the-Art-Survey Series Special Volume on Field-Coupled Nanocomputing

Technical Skills

MATLAB, Python, LabVIEW, Lumerical, Fortran, Gaussian98, Origin Pro, GNU Plot, Mathematica, LaTeX, Atlas.ti, CAT, Microsoft Office and other common applications for Microsoft Windows, Apple OS X, and Linux.

Outreach Activities

University College Roosevelt

Eleanor Green Office, Faculty Advisor **August 2019 - present**

Sabancı University

Gender Studies Center (SUGender), STEM Education Academic Consultant **Summer 2017 - Fall 2018**

Boğaziçi University

IEEE Women in Engrineering Affinity Group, Faculty Advisor **Fall 2015 - 2019**

Sexual Harassment Prevention Committee, Member **Fall 2015 - 2019**

Smith College

Wearable Electronics Workshop, Facilitator **Fall 2012**

Museum of Art Family Day, Science Education Consultant **Fall 2006**

University of Massachusetts Amherst, Science, Technology and Society Initiative

Internatinal Dimensions of Ethics Education in Science and Engineering, Focus Group Member **Fall 2008**

Professional Affiliations

Institute of Electrical and Electronics Engineers (IEEE) **2006 - present**
The Society of Women Engineers (SWE) **2011 - 2014**
International Association of Computing And Philosophy (IACAP) **2010 - 2014**
American Association of University Women (AAUW) **2011 - 2014**

Languages

Turkish (mother tongue), English (fluent written and spoken), Dutch (advanced beginner).

Updated: June 7, 2021