

İLKE ERCAN

Electrical & Electronics Engineering Department
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RESEARCH INTERESTS:

Emerging nanoelectronic and nanophotonic computing paradigms; Fundamental limits of computation; Physical-information theory; Thermodynamics of computation and information processing in quantum systems; Technology assessment; Science and technology studies.

TEACHING INTERESTS:

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

Education

UNIVERSITY OF MASSACHUSETTS, Amherst MA, USA

- Ph.D., [Electrical & Computer Engineering \(ECE\)](#) **September 2008 — February 2014**
Advisor: [Professor Neal G. Anderson](#)
Area of Study: Heat Dissipation Bounds for Nanocomputing: Methodology and Applications
- M.S., [Electrical & Computer Engineering \(ECE\)](#) **September 2006 – August 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 **September 2002 – June 2006**
Minor, [Logic and Philosophy of Science](#) **February 2004 – June 2006**

Academic Experience

- Assistant Professor, Boğaziçi University
[Department of Electrical and Electronics Engineering](#) **September 2015 – Present**
- Visiting Scholar, Massachusetts Institute of Technology
[The Electronic Materials Research Group at MIT \(EMAT\)](#) **July – August 2018**
- Part-Time Instructor, SabancıUniversity
[The Foundations Development Program](#) **March – May 2018**
- Postdoctoral Research Fellow, TU Darmstadt
[Institute for Semiconductor Technology and Nanoelectronics](#) and
[Institute for Philosophy](#) **February – September 2015**
- Visiting Faculty, Smith College
[Picker Engineering Program](#) **Spring and Fall 2014**
- Graduate Research Assistant, University of Massachusetts Amherst
ECE, [Nanoelectronics Theory and Simulation Laboratory](#) **Jan 2007 – Dec 2013**
ECE, [Wireless Systems Laboratory](#) **June 2008 – May 2009**
PoliSci, [International Dimensions of Ethics Education in Science and Engineering](#) **Summer 2009**
- Project Manager, University of Massachusetts Amherst, Department of Political Science
Qualitative Data Analysis Lab, ([QDAP](#)), [eRulemaking research](#) **Summer 2009**
[QDAP](#), [Issue Adoption in Human Rights Advocacy Networks](#) **Spring 2009**
- Graduate Teaching Assistant, University of Massachusetts Amherst,
[Department of Physics](#) **Spring 2013**
[Department of Electrical & Computer Engineering](#) **Fall 2006 – Fall 2013**

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 Amhers ECE	2012
Best Paper Award, IEEE 11 th International Conference on Nanotechnology	2011

Research Grants

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

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

Preprint

1. F. Dinç, Gamze İslamoğlu, Ozan Yakar and **İ. Ercan** “From Two-Level Systems to Microring Resonators: Time-Dependent Dissipation Analyses,” manuscript submitted October 9, 2018.
2. F. Dinç and **İ. Ercan** “Generalized Approach to Time-Dependent Position Space Analysis of Light-Matter Interactions in 1D Waveguide,” preprint submitted September 13, 2018. [arXiv:1809.05164](https://arxiv.org/abs/1809.05164)

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 Heidelberg, 2014.

Journal Articles

1. 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.org/10.1007/s11082-018-1658-y
2. 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*, Accepted: June 5, 2018.
3. **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.
4. **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.
5. N. Anderson, **İ. Ercan** and N. Ganesh, “Toward Nanoprocessor Thermodynamics,” *IEEE Transactions on Nanotechnology*, vol. 12, no. 6, pp. 902 – 909, 2013.
6. **İ. Ercan** and N. Anderson, “Tight-binding 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.
7. **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.
8. **İ. Ercan** and S. Katircioğlu, “The Electronic Structure of Capped and Uncapped CdS Nanoparticles,” *Journal of Nanoscience and Nanotechnology* 8, pp. 645 – 649, 2008.

Conference Proceedings

1. **İ. Ercan**, Ö. Susam, M. Altun, and M. H. Cilasun, “Synthesis and Fundamental Energy Analysis of Fault-Tolerant CMOS Circuits,” *IEEEExplore 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
2. **İ. Ercan**, “Fundamental Energy Dissipation Limits in Logic Circuits,” *ICT Energy Letters*, vol. 12, pp. 3-4, August 2016. (**Invited Paper**)
3. N. Anderson, **İ. Ercan** and N. Ganesh, “Toward Nanoprocessor Thermodynamics,” *Proceedings of the 12th IEEE Conference on Nanotechnology (IEEE NANO, 2012)*, 2012. (**First Place Best Oral Conference Paper**)
4. **İ. Ercan** and N. Anderson, “Heat Dissipation in Nanocomputing: Theory and QCA Application,” *Proceedings of the 11th IEEE Conference on Nanotechnology (IEEE NANO, 2011)*, pp.1289–1294, 2011. (**Best Paper Award**)
5. **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.
6. **İ. Ercan** and N. Anderson, “Structure Dependence of Nanoconductor Current in a Tight-Binding Microcanonical Model,” *NANO’08: Proc. of the 8th IEEE Conference on Nanotechnology (IEEE NANO, 2008)*, pp. 331 – 334.
7. **İ. Ercan** and N. Anderson, “Structure Dependence of Nanoconductor Current in a Microcanonical Transport Model,” *Proceedings of the 17th Annual Connecticut Symposium on Microelectronics and Optoelectronics*, pp. 39 – 40, April, 2008.

Oral Presentations

1. **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**)
2. **İ. Ercan**, “Fundamental Energy Dissipation Limits in Logic Circuits,” *Micro Energy*, Gubbio, Italy, 3- 7 July, 2017. (**Invited Talk**)
3. **İ. Ercan**, Ö. Susam, M. Altun, and M. H. Cilasun, “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.
4. **İ. Ercan**, “Fundamental Energy Dissipation Limits in Logic Circuits,” *ICT Energy Science Conference*, Aalborg, Denmark, 16- 19 August, 2016. (**Invited Talk**)
5. **İ. Ercan**, “Making of Measurement on Limits: Examples from Nanoelectronics,” *The Making of Measurement Conference*, University of Cambridge, July 24, 2015.
6. **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.
7. **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.
8. **İ. Ercan** and N. Anderson, “Heat Dissipation in Nanocomputing: Theory and QCA Application,” *IEEE NANO’11: 11th IEEE Conference on Nanotechnology*, Portland OR, August 18, 2011. (**Best Paper Award**)
9. **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.
10. **İ. Ercan** and N. Anderson, “Structure Dependence of Nanoconductor Current in a Tight-Binding Microcanonical Model,” *IEEE 8th International Conference on Nanotechnology*, Arlington, TX, August 19, 2008.

11. **İ. Ercan** and N. Anderson, “Structure Dependence of Nanoconductor Current in a Microcanonical Transport Model,” *17th Annual Connecticut Symposium on Microelectronics and Optoelectronics*, Storrs, CT, April 9, 2008.

Poster Presentations

1. O. Yakar and **İ. Ercan**, Fundamental Analysis of Microring-Resonator-Based BDD Logic Circuits, *Poster presented at Fotonik: 20th National Workshop on Optics, Electro-optics and Photonics* Ankara, Turkey, 14 September 2018.
2. 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.
3. N. G. Anderson, **İ. Ercan**, and N. Ganesh, Revealing Fundamental Efficiency Limits for Complex Computing Structures, *Poster presented at the 4th IEEE Rebooting Computing Summit*, December 2015.
4. **İ. Ercan** and N. Anderson, “Current and Information in the Microcanonical Picture of Nanoscale Transport,” Poster Presentation in *12th International Workshop on Computational Electronics*, Amherst, MA, November 8-10, 2007.
5. **İ. Ercan** and S. Katircioglu, “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),” *5th Systems and Control Engineering Graduate Student Camp, The Chamber of Electrical Engineers (EMO), Nesin Math Village* Şirince, Spring 2017. (**Invited Lecture**)
2. **İ. Ercan**, “From Maxwells Demon to Nanocircuits: A Physical Information Theoretic Approach to Computing,” *Koç University Department of Physics GSSE Seminar Series*, March 4, 2016. (**Invited Talk**)
3. **İ. Ercan**, “Heat Dissipation Bounds for Nanocomputing: Methodology and Applications,” *Institut für Halbleitertechnik und Nanoelektronik Nanoelektronik-Kolloquium*, TU Darmstadt, April 17, 2015.
4. **İ. Ercan**, “Heat Dissipation Bounds for Nanocomputing: Methodology and Applications,” *Smith College Picker Engineering Program*, December 18, 2014. (**Invited Talk**)
5. **İ. Ercan**, “Heat Dissipation Bounds for Nanocomputing: Methodology and Applications,” *Boğaziçi University, Department of Electrical and Electronics Engineering*, May 26, 2014. (**Invited Talk**)
6. **İ. Ercan**, “Teknolojilerin Sınırlarını ve Gelişmelerini Etkileyen Faktörler (Factors Affecting the Limits and Evolution of Technologies),” *Sabancı University, Bilim Kantini (Science Canteen)*, May 21, 2014. (**Invited Public Lecture**)

Courses Taught

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: An Introduction to the Physical Information Theory

Smith College

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

University of Massachusetts

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, LabVIEW, Fortran, Gaussian98, Origin Pro, GNU Plot, Mathematica, L^AT_EX, Atlas.ti, CAT, Microsoft Office and other common applications for Microsoft Windows, Apple OS X, and Linux.

Outreach Activities

Sabancı University

Gender Studies Center (SUGender), STEM Education Academic Consultant **June 2017 – Present**

Boğaziçi University

IEEE Women in Engineering Affinity Group, Faculty Adviser **Fall 2015 – Present**

Sexual Harassment Prevention Committee, Member **Fall 2015 – Present**

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

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

Professional Affiliations

Institute of Electrical and Electronics Engineers (IEEE) **2006 – Present**

International Association of Computing And Philosophy (IACAP) **2010 – Present**

The Society of Women Engineers (SWE) **2011 – Present**

American Association of University Women (AAUW) **2011 – 2014**

Languages

Turkish – native, English – professional, Spanish – intermediate, German – intermediate.

Updated: October 15, 2018