

# Nil Zeynep Gurel

Ph.D. Candidate in Electrical and Computer Engineering, Georgia Institute of Technology

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## Research Interests

• wearables • medical devices • active sensing • physiological modulation • physiological monitoring • bio-inspired sensing

I am interested in the intersection of biomedical instrumentation, signal processing, and machine learning with focus on mood and performance improvement.

## Educational Background

- '16-'20 (expected) Ph.D. in Electrical and Computer Engineering, GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, GA (GPA:4/4)  
Minor in Biomedical Engineering  
Dissertation: *Real-Time Physiological Biomarkers of Noninvasive Vagus Nerve Stimulation for Acute Stress*  
ADVISOR : Omer T. Inan; COMMITTEE : Omer T. Inan, Robert Butera, J. Douglas Bremner, Hua Wang, and Javier Hernandez
- '14-'16 M.Sc. in Electrical and Computer Engineering, UNIVERSITY OF MARYLAND, College Park, MD (GPA:3.7/4)  
Thesis: *Frequency Domain Characterization of Optic Flow and Vision-Based Ocellar Sensing for Rotational Motion*  
ADVISORS : Timothy Horiuchi (UMD) and Sean Humbert (UC Boulder)  
COMMITTEE : Timothy Horiuchi, Robert W. Newcomb, and Pamela Abshire
- '10-'14 B.Sc. in Electrical and Electronics Engineering, BOGAZICI UNIVERSITY, Istanbul, TR (highest honors, GPA:3.6/4)
- '12-'13 Exchange Studies in Electrical Engineering, UNIVERSITY OF WASHINGTON, Seattle, WA (highest honors, GPA:3.97/4)

## Honors, Awards & Fellowships

### Research Awards

- '19 Runner-up Best Poster Award, IEEE BHI
- '18 Runner-up Best Paper Award, IEEE BSN [DOI]
- '18 Finalist Award for Best Paper, IEEE EMBC [DOI]  
(One of the Top 15 papers per reviewer feedback)
- '17 Best Poster Award, NextFlex Flexible Hybrid Electronics Workshop

### Professional Awards

- '19 Nexus NextProf Future Faculty Workshop Award  
(An academic career workshop for diverse leaders in engineering hosted at GT, organized by UC Berkeley, U Michigan, GT)  
(One of the 65+ selected participants nationwide from all engineering disciplines with funded accommodation and travel)
- '19 iREDEFINE Workshop Award  
(An academic career workshop to increase diverse workforce in ECE, hosted in conjunction with ECEDHA Conference)  
(One of the two selected participants with GT-funded accommodation and travel)
- '18 Rising Stars in EECS  
(An academic career workshop for women in EECS, hosted at MIT, organized by MIT, Stanford, Carnegie Mellon)  
(One of the 60+ selected participants nationwide and international with funded accommodation and travel)
- '18 iREDEFINE ECE Professional Development Award  
(One of the 10 selected participants nationwide with NSF-funded accommodation and travel)

### Conference Travel Awards

- '16-'18 IEEE BSN-BHI'18, IEEE EMBC'18, Molecular Med Tri-Con'16

### Fellowships

- '15-'16 Teaching Assistant Training and Development Fellowship  
(Awarded due to excellent student feedback for teaching by University of Maryland.)
- '14-'15 Clark School of Engineering Distinguished Graduate Fellowship (~\$70k)

## Publications

### Journal articles

#### Manuscripts published/in press

- [J13] **NZ Gurel**, M Huang, MT Wittbrodt, H Jung, SL Ladd, MH Shandhi, YA Ko, L Shallenberger, JA Nye, BD Pearce, V Vaccarino, AJ Shah, JD Bremner, OT Inan, “Quantifying Acute Physiological Biomarkers of Transcutaneous Cervical Vagal Nerve Stimulation in the Context of Psychological Stress”, *Brain Stimulation*, S1935-861X(19): 30346-58, 2019 [DOI]
- [J12] **NZ Gurel**, AM Carek, OT Inan, O Levantsevych, N Abdelhadi, M Hammadah, WT O’Neal, H Kelli, K Wilmot, L Ward, SD Rhodes, BD Pearce, PK Mehta, M Kutner, E Garcia, AA Quyyumi, P Raggi, JD Bremner, AJ Shah, “Comparison of Autonomic Stress Reactivity in Young Healthy versus Aging Subjects with Heart Disease”, *PLOS ONE*, 14(5): e0216278, 2019 [DOI]
- [J11] **NZ Gurel\***, H Jung\*, S Hersek, OT Inan, “Fusing Near-Infrared Spectroscopy with Wearable Hemodynamic Measurements Improves Classification of Mental Stress”, *IEEE Sensors Journal*, 19(19), pp. 8522-8531, 2018 [\*co-first authors] [DOI]
- [J10] JD Bremner, MT Wittbrodt, AJ Shah, **NZ Gurel**, BD Pearce, OT Inan, P Raggi, TT Lewis, AA Quyyumi, V Vaccarino, “Confederates in the Attic: Posttraumatic Stress Disorder, Cardiovascular Disease, and the Return of Soldier’s Heart”, *The Journal of Nervous and Mental Disease*, in press, 2019
- [J9] AO Bicen, **NZ Gurel**, A Dorier, OT Inan, “Improved Pre-ejection Period Estimation from Ballistocardiogram and Electrocardiogram Signals by Fusing Multiple Timing Interval Features”, *IEEE Sensors Journal*, 17(13), pp. 4172-4180, 2017 [DOI]

#### Manuscripts under review

- [J8] **NZ Gurel**, H Jung, MT Wittbrodt, SL Ladd, AJ Shah, V Vaccarino, JD Bremner, OT Inan, “Automatic Detection of Target Engagement in Transcutaneous Cervical Vagal Nerve Stimulation Using Peripheral Cardiopulmonary Measurements”, *under review*, 2019
- [J7] MT Wittbrodt, **NZ Gurel**, JA Nye, SL Ladd, AJ Shah, MH Shandhi, M Huang, Z Alam, BD Pearce, N Murrah, YA Ko, L Shallenberger, V Vaccarino, OT Inan, JD Bremner, “Noninvasive Vagal Nerve Stimulation Decreases Brain Activity during Trauma Scripts”, *under review*, 2019
- [J6] AH Gazi, **NZ Gurel**, KL Scott, MT Wittbrodt, AJ Shah, V Vaccarino, JD Bremner, OT Inan, “Modeling Kinetics of Peripheral Cardiovascular Biomarker Responses to Transcutaneous Cervical Vagus Nerve Stimulation”, *under review*, 2019
- [J5] JD Bremner, MT Wittbrodt, **NZ Gurel**, MH Shandhi, MH Rapaport, JA Nye, BD Pearce, V Vaccarino, AJ Shah, J Park, M Bikson, OT Inan, “Application of Noninvasive Vagal Nerve Stimulation to Stress-Related Psychiatric Disorders”, *under review*, 2019
- [J4] Y Jiao, YA Ko, **NZ Gurel**, A Hankus, SL Ladd, MT Wittbrodt, L Shallenberger, N Murrah, M Huang, A Haffer, J Alkhalaf, H Jung, O Levantsevych, JA Nye, MH Shandhi, V Vaccarino, AJ Shah, OT Inan, JD Bremner, BD Pearce, “Levels of Pituitary Adenylate Cyclase-Activating Polypeptide (PACAP) in Traumatic Stress and the Modulatory Effect of Noninvasive Cervical Vagus Nerve Stimulation (nVNS)”, *under review*, 2019

#### Manuscripts in preparation


- [J3] **NZ Gurel**, MT Wittbrodt, H Jung, MH Shandhi, V Vaccarino, AJ Shah, BD Pearce, OT Inan, JD Bremner, *in preparation*, 2019
- [J2] **NZ Gurel**, MT Wittbrodt, H Jung, MH Shandhi, V Vaccarino, AJ Shah, BD Pearce, JD Bremner, OT Inan, *in preparation*, 2019
- [J1] **NZ Gurel**, B Nevius, D Ward, FL Hammond, OT Inan, *in preparation*, 2019

### Peer-reviewed conference proceedings, abstracts, live demos

- [C12] **NZ Gurel\***, AH Gazi\*, KL Scott, MT Wittbrodt, AJ Shah, V Vaccarino, JD Bremner, OT Inan, “Timing Considerations for Noninvasive Vagal Nerve Stimulation in Clinical Studies”, *American Medical Informatics Association Annual Symposium (AMIA ’19)*, Washington, DC, 2019 [oral, 10-pages, session offering credit to practicing clinical informaticians, \*co-first authors]
- [C11] **NZ Gurel**, MT Wittbrodt, AJ Shah, V Vaccarino, OT Inan, JD Bremner, “Noninvasive Vagal Nerve Stimulation Effects on

- Anger Response”, *IEEE Conference on Biomedical Health Informatics (BHI '19)*, Chicago, IL, 2019 [poster, 1-page] [PDF]
- [C10] AH Gazi, **NZ Gurel**, KL Scott, MT Wittbrodt, AJ Shah, V Vaccarino, JD Bremner, OT Inan, “Preliminary Modeling of the Kinetics of Photoplethysmogram Changes Following Noninvasive Vagus Nerve Stimulation”, *IEEE Conference on Biomedical Health Informatics (BHI '19)*, Chicago, IL, 2019 [poster, 1-page] [PDF]
-  **Runner-up Best Poster Award**
- [C9] Y Jiao, YA Ko, **NZ Gurel**, A Hankus, SL Ladd, MT Wittbrodt, L Shallenberger, N Murrah, M Huang, A Haffer, J Alkhalaf, H Jung, O Levantsevych, JA Nye, MH Shandhi, V Vaccarino, AJ Shah, OT Inan, JD Bremner, BD Pearce, “Levels of Pituitary Adenylate Cyclase-Activating Polypeptide (PACAP) in Posttraumatic Stress Disorder and Modulatory Effect of Noninvasive Cervical Vagus Nerve Stimulation”, *Neuroscience (SfN '19)*, Chicago, IL, 2019 [poster, 1-page]
- [C8] **NZ Gurel**, MH Shandhi, JD Bremner, V Vaccarino, SL Ladd, L Shallenberger, AJ Shah, OT Inan, “Toward Closed-loop Transcutaneous Vagus Nerve Stimulation using Peripheral Cardiovascular Physiological Biomarkers: A Proof-of-concept Study”, *IEEE Conference on Wearable and Implantable Body Sensor Networks (BSN '18)*, Las Vegas, NV, 2018 [oral, 4-pages, Top 3% among accepted papers] [DOI]
-  **Runner-up Best Paper Award**
- [C7] **NZ Gurel**, H Jeong, HE Kloefkorn, S Hochman, OT Inan, “Unobtrusive Heartbeat Detection from Mice Using Sensors Embedded in the Nest”, *IEEE Engineering in Medicine and Biology Conference (EMBC '18)*, Honolulu, HI, 2018 [oral, 4-pages, Top 15 among the accepted ~1500 proceedings] [DOI]
-  **Finalist Award for Best Paper**
- [C6] **NZ Gurel\***, D Ward\*, FL Hammond, OT Inan, “Live Demonstration: A Soft Thermal Modulation System with Embedded Fluid Channels for Neuro-Vascular Assessment”, *IEEE Biomedical Circuits and Systems Conference (BioCAS '18)*, Cleveland, OH, 2018 [live demo, 1-page, \*co-first authors] [DOI]
- [C5] H Jeong, **NZ Gurel**, HE Kloefkorn, S Hochman, OT Inan, “Performance of Unobtrusive Detection of High Frequency Heart Rate Variability in Mice using an Instrumented Nest”, *IEEE Life Sciences Conference (LSC '18)*, Montreal, Canada, 2018 [oral, 4-pages] [PDF]
- [C4] D Ward\*, **NZ Gurel\***, OT Inan, FL Hammond, “A Soft Thermal Modulation and Physiological Sensing System for Neuro-Vascular Assessment”, *IEEE Conference on Robotics and Biomimetics (ROBIO '18)*, Kuala Lumpur, Malaysia, 2018 [oral, 8-pages, \*co-first authors] [DOI]
- [C3] **NZ Gurel**, H Jung, A Hankus, SL Ladd, MH Shandhi, M Huang, SD Rhodes, L Shallenberger, BD Pearce, AJ Shah, V Vaccarino, OT Inan, JD Bremner, “Toward Wearable Sensing Enabled Closed-Loop Non-invasive Vagus Nerve Stimulation: A Study of Real-Time Physiological Biomarkers”, *Neuromodulation Conference and North American Neuromodulation Society Meeting (NEUROMODEC '18)*, New York, NY, 2018 [poster], *Brain Stimulation*, 12(2), e13, 2019 [abstract] [DOI]
- [C2] JD Bremner, **NZ Gurel**, MT Wittbrodt, JA Nye, Z Alam, I Herring, L Shallenberger, A Haffer, O Levantsevych, N Murrah, YA Ko, BD Pearce, MH Shandhi, AJ Shah, V Vaccarino, OT Inan, “Non-invasive Vagal Nerve Stimulation Paired with Stress Exposure in Posttraumatic Stress Disorder (PTSD)”, *Brain Stimulation*, 12(2), 438, 2019 [abstract] [DOI]
- [C1] JD Bremner, MT Wittbrodt, **NZ Gurel**, JA Nye, Z Alam, V Vaccarino, SL Ladd, L Shallenberger, M Huang, YA Ko, BD Pearce, MH Shandhi, AJ Shah, OT Inan, “Brain Correlates of Non-invasive Vagal Nerve Stimulation in Stress”, *Neuromodulation Conference and North American Neuromodulation Society Meeting (NEUROMODEC '18)*, New York, NY, 2018 [poster], *Brain Stimulation*, 12(2), pp. e3-e4, 2019 [abstract] [DOI]

## Technical reports & posters

- [T2] **NZ Gurel**, J Conroy, T Horiuchi, S Humbert, “Frequency Domain Characterization of Optic Flow and Vision-based Ocular Sensing for Rotational Motion”, *US Army Research Laboratory ARL-TR-7974*, Adelphi, MD, 2017 [technical report] [PDF]
- [T1] D Ward\*, **NZ Gurel\***, OT Inan, FL Hammond, “Soft, Fluidic Modulation of Skin Temperature”, *NextFlex Flexible Hybrid Electronics Workshop*, Atlanta, GA, 2017 [\*co-first authors]
-  **Best Poster Award**

## Research Experience

- '16- Ph.D. Student and Graduate Research Assistant, **Inan Research Laboratory**
- Present Research on noninvasive wearable sensing and actuation applied to physiological monitoring and modulation. Received two

paper awards, two poster awards, four professional awards, three conference travel awards for individual or combination of projects. Notable projects:

- Closed-loop noninvasive vagal nerve stimulation • Instrumented headband for mental stress quantification
- Soft thermal modulation system for neurovascular assessment • Instrumented bed & kitchen scale for rodents
- Noninvasive autonomic nervous system quantification

'15-'16 Graduate Research Assistant, Autonomous Vehicle Laboratory

- Bio-inspired sensing for micro-aerial vehicles: designed a multimodal system to quantify rotational motion based on optic flow (digital) and luminance-based ocellar (analog) sensing. Characterized both sensing modalities to compare for fast visual processing in response to sudden disturbances.

## Teaching Experience

Fall '19 Guest Lecturer, *Biomedical Sensing Systems [ECE4781]*, GEORGIA INSTITUTE OF TECHNOLOGY

Conducted lectures on noninvasive peripheral stimulation and wearable sensing.

Spr '19 Guest Lecturer, *Biosystems Analysis [ECE4782]*, GEORGIA INSTITUTE OF TECHNOLOGY

Conducted hands-on lectures on feature extraction, feature engineering, dimensionality reduction, and machine learning.

Fall '14 Graduate Teaching Assistant for *Analog and Digital Electronics [ENEE303]*, UNIVERSITY OF MARYLAND

Prepared and lectured weekly recitations, quizzes, and office hours. Received teaching fellowship, evaluated per student feedback.

## Proposal Development Experience

'19-Present Working on two NIH proposals: one R01 and one R43/R44.

'16-Present Preparing the following deliverables for the DARPA Targeted Neuroplasticity Training (TNT) Program: quarterly reports, six-week progress teleconference materials, and PI meeting materials.

## Media Coverage

Dec '19 Interview to appear in the bi-annual IEEE Women in Engineering Magazine, *Leslie Prives, IEEE WIE*

Aug '19 Gurel Chosen for NextProf Nexus Workshop, *Jackie Nemeth, Georgia Tech*

Dec '18 Three ECE Students Become Rising Stars in Academia, *Ashlee Gardner, Georgia Tech*

Jun '18 Gurel Invited to Rising Stars Workshop, Takes Part in iREDEFINE, *Jackie Nemeth, Georgia Tech*

Jun '18 Toward Wearable Sensing Enabled Closed-Loop Non-invasive Vagus Nerve Stimulation, *MIT EECS*

Mar '18 Gurel Receives Paper Prize at IEEE BSN Conference, *Jackie Nemeth, Georgia Tech*

Dec '17 Georgia Tech and NextFlex Team-Up to Make the Internet-of-Things More Flexible & Power Efficient, *Christa Ernst, GT Research Horizons*

## Student Advising & Mentoring

'17- GEORGIA INSTITUTE OF TECHNOLOGY: One M.Sc and four Ph.D. students

Present • K. Scott (Ph.D., ECE, 2019) • A. Gazi (Ph.D., ECE, 2018-2019) • B. Nevius (M.Sc., BME 2018-2019) • H. Jung (Ph.D., ECE, 2017-2018) • D. Ward (M.Sc., MechE, 2017-2018, currently pursuing Ph.D.)

'15-'16 UNIVERSITY OF MARYLAND: A team of 13 undergraduates with diverse backgrounds from Gemstone Honors Program with Robert W. Newcomb. The team completed a proof-of-concept prototype for stationless bikeshare for the campus.

## Work Experience

'13-'14 Research and Development Engineer, Techneon, Istanbul, TR

Sensor circuit design, board assembly test firmware, remote monitoring desktop application, electromagnetic compatibility support, CE certification documentation (93-42-EEC, EN60601-1, IEC 60601-2-24) for an infusion pump system.

- Sum '12 Intern (Defense Systems Technologies), Aselsan, Ankara, TR  
Designed a controller area network-based communication interface and desktop application for guns used on field.
- Sum '11 Intern (Software Group), IBM Turkey, Istanbul, TR  
Implemented customizations on Java-based IBM Maximo Asset Management software.

## Professional Activities

- Apr '19 Co-organizer of the NSF/NIH DIGITAL CLINICAL TRIALS WORKSHOP: CREATING A VISION FOR THE FUTURE held on the main NIH campus, Bethesda, MD. (BROCHURE) (DAY 1 VIDEOCAST) (DAY 2 VIDEOCAST)
- '15- Reviewer of the articles in the following journals and conferences:
- Present
- IEEE Transactions on Electron Devices (IEEE T-ED) (2019)
  - 2019 IEEE International Engineering in Medicine and Biology Conference (EMBC '19)
  - 2019 American Medical Informatics Association Annual Symposium (AMIA '19)
  - IEEE Journal on Biomedical Health Informatics (IEEE JBHI) (2016-Present)
  - 2019 IEEE International Conference on Biomedical Health Informatics (BHI '19)
  - Computers in Biology and Medicine (2016-2019)
  - ACM Transactions on Applied Perception (ACM TAP) (2017-2018)
  - 2019 International Conference on Biological Information and Biomedical Engineering (BIBE '19)
  - IEEE Transactions on Circuits and Systems II (IEEE TCAS-II) (2015-2017)
  - 2016 IEEE International Symposium on Circuits and Systems (ISCAS '16)

## Diversity & Outreach

- Oct '19 Volunteer for the YOUNG GURU ACADEMY (YGA) of Turkey to give hands-on lectures to introduce TWIN SCIENCE KITS to the primary school students in underprivileged areas of Georgia to promote diversity and inclusion in STEM.
- Aug '19 ECE RUSH Volunteer: presented opportunities on research for bioengineering technical interest group for transfer students, undecided majors, ECE freshmen.
- Jun '19 H.O.T. DAYS @ GEORGIA TECH DAY CAMP Lecturer: designed a wearable electronics module for high school students to instill interest in ECE. Lecturer of two hands-on modules for 39 high school students. Module includes basic circuit design, firmware programming, prototyping. (WEEK 1 VIDEO) (WEEK 2 VIDEO)

## Workshops Delivered

- Fall '16 *Encouraging Critical Thinking in Classroom*  
Workshop for graduate teaching assistants, UNIVERSITY OF MARYLAND
- Spr '15 *Presentation and Instruction Techniques*  
Workshop for graduate teaching assistants, UNIVERSITY OF MARYLAND

## References

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Adjunct Associate Professor, Coulter Department of Biomedical Engineering  
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J. Douglas Bremner, MD  
Professor, Psychiatry and Behavioral Sciences and Radiology, Emory School of Medicine  
Director, Emory Clinical Neuroscience Unit, Emory University, Atlanta, GA  
Director, Mental Health Research, Atlanta VA Medical Center, Decatur, GA  
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Research Assistant Professor, Department of Biomedical Engineering, McCormick School of Engineering

Research Assistant Professor, Department of Anesthesiology, Feinberg School of Medicine

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Robert J. Butera, PhD

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