Decoders 2.0: Microfabricated Decoders

Style: *Flexible;* Individual projects (teamwork can also be possible upon the wish of students).

To pass, you must: (i) attend at least 3/4 of the class sessions, (ii) participate in all of the invited speaker lectures, and (iii) complete the summary articles, which leads to the final perspective essay. By the end of Class #1, students must decide whether to register or drop the course.

Overview: *Decoders 2.0* is the core class that sets up the foundation for *D1.7* and *D1.8*. The lecture series plant seeds of question and curiosity in the minds of students. Invited speakers present the recent advances in their particular field once every other week. The website and selected publications of the speakers are featured on the course website. The individual project is to write a summary paper based on three papers of the invited speaker. Prepared questions and a draft of the summary papers are to be submitted prior to the speaker's lecture. It is mandatory for students to ask questions during guest lectures. After the guest lecture, students submit the final summary paper and discuss it in the class. The final project is to write a perspective article consisting of the written summary papers. At the end of the course, a booklet of all of the perspective essays is to be uploaded on the class website. The perspective essays are a resource for future students, who take the following *D1.7* and *D1.8*.

Objectives:

1. To gain knowledge from experts in the field,
2. To encourage participation in class by the asking of questions to the invited speakers,
3. To understand the impact of microfabricated devices on society,
4. To foster interest in mechanically adaptive microfabricated devices and their purposes,
5. To write a perspective article based on the knowledge gained by the students.

Schedule:

Class 1: September 6th, 2023

a. Introduction Class and provide the agenda of the semester
    I. Class Engagement
    II. Provide the representative papers of Speaker#1 and encourage students to prepare questions to ask during the presentation in the following week.
b. Course Materials
    I. **Paper 1**: Research Resiliency Through Lean Labs
    Durak, T., Sadat, D., *Advanced Intelligent Systems*, 2000074, 2020.
    II. **Paper 2**: The Toyota Way in Services: The Case of Lean Product Development
    Liker, Jeffrey K and James M. Morgan, *Academy of Management Perspectives*, 20(2), 2006.
    III. **Paper 3**: Triumph of the Lean Production System
    Krafcik, John F., *Sloan Management Review*, Vol. 30, Iss. 1, 1988.

Class 2: September 13th, 2023

c. Invited Speaker #1

Class 3: September 20th, 2023

d. Class Discussions
   I. Discuss & evaluate the summary paper.
   II. Provide the representative papers of Speaker#2 and encourage students to prepare questions to ask during the presentation in the following week.

e. Course Materials
   I. **Paper 1**: Enhanced piezoelectric and acoustic performances of poly(vinylidene fluoride-trifluoroethylene) films for hydroacoustic applications
   Zhang, L., *Phys.Chem. Chem.Phys*., 22, 5711, 2020.
   II. **Paper 2**:Monitoring of the central blood pressure waveform via a conformal ultrasonic device.
   Zhang, L., *Nature Biomedical Engineering* Vol. 2, pages 687–695, 2018.
   III. **Paper 3:** Stretchable ultrasonic transducer arrays for three-dimensional imaging on complex surfaces
   Zhang, L., *Science Advances,* Vol. 4, no. 3, eaar3979, 2018.

Class 4: September 27th, 2023

f. Invited speaker #2

Class 5: October 4th, 2023

g. Class Discussions
   I. Discuss & evaluate the summary paper.
   II. Provide the representative papers of Speaker#3 and encourage students to prepare questions to ask during the presentation in the following week.

h. Course Materials
   I. **Paper 1**: Electrochemical evaluations of Fractal Microelectrodes for Energy Efficient Neurostimulation
   Park, H. *Scientific Reports* 8, Article number: 4375, 2018.
   II. **Paper 2**: Graphene prevents neurostimulation-induced platinum dissolution in fractal microelectrodes.
   Park, H. *2D Mater*., 6 035037, 2019.
   III. **Paper 3**: Towards smart self-clearing glaucoma drainage device
   Park, H., *Microsystems & Nanoengineering*, 4:35, 2018.

Class 6: October 11th, 2023

i. Invited Speaker #3

Class 7: October 18th, 2023

j. Class Discussions
   I. Discuss & evaluate the summary paper.
   II. Provide the representative papers of Speaker#4 and encourage students to prepare questions to ask during the presentation in the following week.

k. Course Materials
   I. **Paper 1:** Conformal Piezoelectric Energy Harvesting and Storage from Motions of the Heart, Lung, and Diaphragm.
   Dagdeviren, C., *PNAS,* 111, 5, 1927-1932, 2014.
   II. **Paper 2:** Conformal piezoelectric systems for clinical and experimental characterization of soft tissue biomechanics.
   Dagdeviren, C., *Nature Materials*, 14, 728-736, 2015.
   III. **Paper 3:** Energy Harvesting from the Animal/Human Body for Self-Powered Electronics.
   Dagdeviren, C., *Annual Review of Biomedical Engineering*, 19, 1, 85-108, 2017.

Class 8: October 25th, 2023

l. Invited Speaker #4

Class 9: November 1st, 2023

m. Class Discussions
   I. Discuss & evaluate the summary paper.
   II. Provide the representative papers of Speaker#5 and encourage students to prepare questions to ask during the presentation in the following week.

n. Course Materials
   I. **Paper 2:** Optogenetic stimulation of hippocampal engram activates fear memory recall
   Ramirez, S., *Nature,* Vol. 484, 381-387, 2012.
   II. **Paper 2:** Activating positive memory engrams suppresses depression-like behaviour
   Ramirez, S., *Nature,* Vol. 522, 335-351, 2015.
   III. **Paper 3**: Identification and optogenetic manipulation of memory engrams in the hippocampus
   Ramirez, S., *Frontiers in Behavioural Neuroscience,* Vol. 7, 1-9, 2014.

Class 10: November 8th, 2023

o. Invited Speaker #5

Class 11: November 15th, 2023

p. Class Discussions
   I. Discuss & evaluate the summary paper.
   II. Provide the representative papers of Speaker#6 and encourage students to prepare questions to ask during the presentation in the following week.

q. Course Materials
   I. **Paper 1:** Parametric Study of Zigzag Microstructure for Vibrational Energy Harvesting
   Karami, A., *Journal of Microelectromechanical Systems*, Vol. 21, no. 1, 2012.
   II. **Paper 2:** Coupled out of plane vibrations of spiral beams for micro-scale applications
   Karami, A., *Journal of Sound and Vibration,* 329 5584–5599, 2010.
   III. **Paper 3:** Energy harvesting from controlled buckling of piezoelectric beams
   Karami, A., *Smart Mater. Struct*. 24 115005, 2015.

Class 12: November 22nd, 2023

a. Invited Speaker #6

Class 13: November 29th, 2023

b. Class Discussions
   IV. Discuss & evaluate the summary paper.
   V. Provide the perspective papers of invited speakers

c. Course Materials
   VI. **Paper 1**: A Clear Advance in Soft Actuators.
   Rogers, J.A., *Science*, 341, 6149, 968-969, 2013.

   VII. **Paper 2**: Electronics for the Human Body.
   Rogers, J.A., *Journal of the American Medical Association,* 313, 6, 561-562, 2015.

   VIII. **Paper 3**: Wearable Electronics: Nanomesh On-Skin Electronics.
   Rogers, J.A., *Nature Nanotechnology*, 12, 839-840, 2017.

   IX. **Paper 4**: Toward Self-Powered Sensor Networks.
   Wang, Z.L., *Nano Today,* ,512-514, 2010.

   X. **Paper 5**: Preface to the Special Section on Piezotronics.
   Wang, Z.L., *Advanced Materials,* 24, 34, 4629, 2012.

   XI. **Paper 6**: New Wave Power.
   Wang, Z.L., *Nature,* 542, 159-160, 2017.

   XII. **Paper 7:** Epidermal Electronics: Skin Health Monitoring.
   Lacour, S.P., *Nature Materials,* 14, 659-660, 2015.

XIII. **Paper 8:** Flexible Electronics: Tiny Lamps to Illuminate the Body.
Someya, T., *Nature Materials,* 9, 879-880, 2010.

XIV. **Paper 9:** Bionic Skin for a Cyborg You.
Someya, T., *IEEE Spectrum,* 51-56, 2013.

XV. **Paper 10:** The Rise of Plastic Bioelectronics.
Someya, T., *Nature,* 540, 379-385, 2016.

XVI. **Paper 11:** Nanopiezoelectric Biointerfaces.
McAlpine, M., *SPIE,* 2013.

XVII. **Paper 12:** Sensing Gastrointestinal Motility.
McAlpine, M., *Natural Biomedical Engineering,* 1, 775-776, 2017.

XVIII. **Paper 13:** Materials and Mechanics for Stretchable Electronics.
Rogers, J.A., *Science,* 327, 5973, 1603-1607, 2010.

XIX. **Paper 14**: Epidermal Electronics.
Rogers, J.A., *Science,* 333, 6044, 838-843, 2011.

XX. **Paper 15**: Stretchable, Multiplexed pH Sensors with Demonstrations on Rabbit and Human Hearts Undergoing Ischemia.
Rogers, J.A., *Advanced Healthcare Materials,* 3, 1, 59-68, 2014.

XXI. **Paper 16**: Self-Powered, One-Stop, and Multifunctional Implantable Triboelectric Active Sensor for Real-Time Biomedical Monitoring.
Wang, Z.L., *Nano Letters,* 16, 10, 6042-6051, 2016.

XXII. **Paper 17**: Sustainably powering wearable electronics solely by biomechanical energy.
Wang, Z.L., *Nature Communications,* 7, 12744, 2016.

XXIII. **Paper 18**: Single-Thread-Based Wearable and Highly Stretchable Triboelectric Nanogenerators and Their Applications in Cloth-Based Self-Powered Human-Interactive and Biomedical Sensing.
Wang, Z.L., *Advanced Functional Materials*, 27, 1, 16044462 2017.

XXIV. **Paper 19:** Flexible and Transparent Silicon-on-Polymer Based Sub-20 nm Non-planar 3D FinFET for Brain-Architecture Inspired Computation.
Hussain, M. M., *Advanced Materials,* 26, 18, 2794-2799, 2014.

XXV. **Paper 20:** Transformational Silicon Electronics.
Hussain, M. M., *ACS Nano,* 8, 2, 1468-1474, 2014.

XXVI. **Paper 21**: Paper Skin Multisensory Platform for Simultaneous Environmental Monitoring.

Hussain, M. M., *Advanced Materials Technology,* 1, 1, 1600004, 2016.

XXVII. **Paper 22**: Printable elastic conductors with a high conductivity for electronic textile applications.
Someya, T., *Nature Communications,* 6, 7461, 2015.

XXVIII. **Paper 23**: A Transparent Bending-Insensitive Pressure Sensor.
Someya, T., *Nature Nanotechnology,* 11, 472-478, 2016.

XXIX. **Paper 24**: Ultraflexible Organic Photonic Skin.
Someya, T., *Science Advances,* 2, 4, 2016.

XXX. **Paper 25:** Piezoelectric Ribbons Printed onto Rubber for Flexible Energy Conversion.
McAlpine, M., *Nano Letters,* 10, 2, 524-528, 2010.

XXXI. **Paper 26:** Enhanced Piezoelectricity and Stretchability in Energy Harvesting Devices Fabricated from Buckled PZT Ribbons.
McAlpine, M., *Nano Letters,* 11, 3, 1331-1336, 2011.

XXXII. **Paper 27:** Graphene-based Wireless Bacteria Detection on Tooth Enamel.
McAlpine, M., *Nature Communications,* 3, 763, 2011.

Class 14: December 6th, 2023

d. Class Discussions

XXXIII. Discuss & evaluate the summary paper

XXXIV. Final: Perspective article due