LIVEWIRE
A STIMULATING NIGHT OF NEUROTECHNOLOGY

Friday, March 5, 2021, at 4 p.m. PT
Presented Online
University of Southern California

WHAT TO KNOW

- This event explores the technical, clinical, and ethical implications of emerging brain technologies.
- Speakers include neuroethics scholar Judy Illes, neurologist Eran Klein, and Dong Song, a USC professor of biomedical engineering and co-director of the Center for Neural Engineering.

THE SPEAKERS

JUDY ILLES is a past president of the International Neuroethics Society and director of Neuroethics Canada at the University of British Columbia. A pioneer and eminent scholar in the field of neuroethics, she has made groundbreaking contributions to ethical, social, and policy challenges at the intersection of biomedical ethics and neuroscience, emerging neurotechnologies for neurologic and psychiatric conditions affecting people across the life span, decision-making, cross-cultural values, and the commercialization of healthcare.

ERAN KLEIN is a neurologist specializing in dementia at Oregon Health and Science University (OHSU) and the Portland VA Medical Center. He is part of the neuroethics thrust at the NSF Center for Neurotechnology (CNT) at the University of Washington. He works at the intersection of neurology, neuroscience, and philosophy.

DONG SONG is a research associate professor of biomedical engineering and co-director of the Center for Neural Engineering at USC. His research interests include nonlinear dynamical modeling of the nervous system, hippocampal memory prosthesis, neural interface technologies, and development of novel modeling strategies incorporating both statistical and mechanistic methods. He invented the multiple-input, multiple-output (MIMO) nonlinear dynamical model of spike transformation that serves as the computational basis of hippocampal memory prostheses.

VOCABULARY CORNER

brain-computer interface (BCI) – a direct pathway between the brain and an external device; also known as a mind-machine interface (MMI), neural control interface (NCI), or brain-machine interface (BMI)

deep brain stimulation – the implanting of electrodes in certain areas of the brain to treat conditions such as dystonia, epilepsy, essential tremors, obsessive-compulsive disorder, or Parkinson's disease (other potential uses are being studied)

neuroethics – a subfield of bioethics that focuses on the ethical issues raised by an increasing understanding of, and ability to monitor and influence, the brain

neuroprosthetics – devices that can replace an impaired motor, sensory, or cognitive function

KEY MOMENTS IN THE HISTORY OF BCIS

1924 – Neuroscientist Hans Berger discovers how to record brain activity through electroencephalography (EEG)

1965 – Composer Alvin Lucier creates *Music for Solo Performer*, known as "the brain wave piece" because the performer's brain waves stimulate various instruments

1973 – UCLA professor Jacques Vidal coins the term *brain-computer interface*

1990S – Neurologist Phillip Kennedy invents the neurotrophic electrode, an invasive wireless device that can read the brain's electrical signals

Early 2000s – First humans implanted with BCIs

2010s–present – The Defense Advanced Research Projects Agency (DARPA), a longtime funder of BCI research for military purposes, launches the Neural Engineering System Design program "to develop high-resolution neurotechnology capable of mitigating the effects of injury and disease on the visual and auditory systems of military personnel"

Big tech companies like CTRL-Labs (owned by Facebook) and Elon Musk's Neuralink work on developing commercial neurotechnology devices

FOR FURTHER REFLECTION

◉ What do you think are the most promising uses of the technology you learned about in this event?

◉ What concerns you about this technology?

◉ Why do you think BCI research has historically focused on medical or military applications? What do you think will change as commercial applications are increasingly explored?

◉ Who is the technology that is being developed by Neuralink and other tech companies for? Why would people want to use it? Why would they not want to?

◉ Does the production of multi-brain systems bring us closer together—or divide us further?
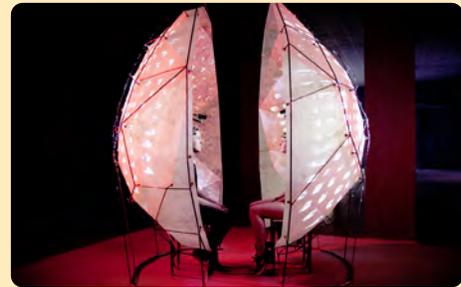

Brain Art

While neurotechnology research has historically been focused on medical and military applications, there is an emerging field of "brain art." Suzanne Dikker's Mutual Wave Machine, for example, is a "crowdsourcing neuroscience experiment" that has been presented as an interactive art installation. Museum- and festival-goers sit inside the Mutual Wave Machine two at a time, wearing EEG headsets that record their brain waves as they interact—all the while immersed in a real-time reflection of their brain-wave synchrony (or EEG signals). The 2019 book *Brain Art*, edited by Anton Nijholt, explores how BCIs can be used for artistic purposes.
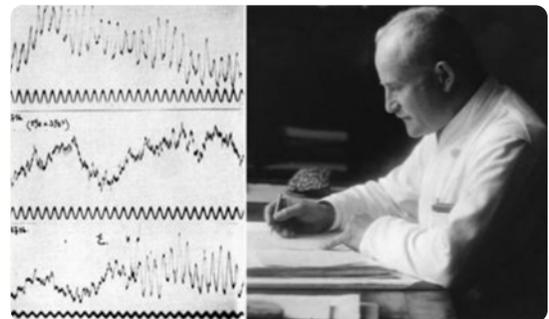
Neuroscientist Hans Berger

Composer Alvin Lucier creates *Music for Solo Performer*
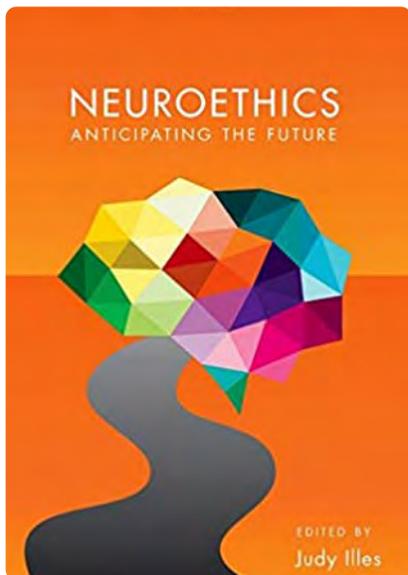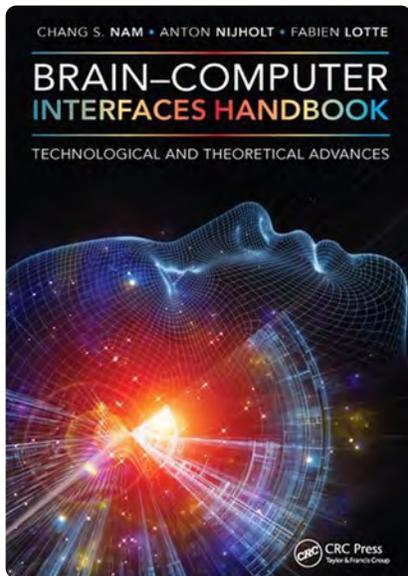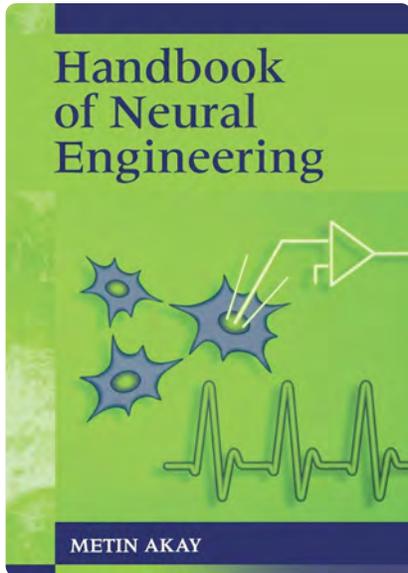
IF YOU LIKED THIS EVENT, YOU MIGHT WANT TO CHECK OUT:

- The International Neuroethics Society
  neuroethicssociety.org
- IEEE Brain's Neuroethics Framework
  brain.ieee.org/publications/ieee-neuroethics-framework
- The Future of Privacy Forum
  fpf.org
- Rafael Yuste's TEDMed talk on mapping brain activity
  tedmed.com/talks/show?id=75798
- BrainGate
  braingate.org
- Suzanne Dikker's Mutual Wave Machine
  suzannedikker.net/mutualwavemachine

DISCOVER MORE AT THE USC LIBRARIES

LISA CROW of the USC Libraries selected the following resources to help you learn more about this evening's event. Electronic resources are accessible through the search bar on the USC Libraries homepage at libraries.usc.edu but may require the user to log in using their USC credentials.

BOOKS

- Metin Akay, *Handbook of Neural Engineering* (Hoboken: Wiley, 2007).
- Chang S. Nam, Anton Nijholt, and Fabien Lotte, *Brain–Computer Interfaces Handbook: Technological and Theoretical Advances* (New York: CRC Press, 2018).
- Judy Illes, *Neuroethics: Anticipating the Future* (Oxford Univ. Press, 2017).

ARTICLES

- Sara Goering and Eran Klein, "Fostering Neuroethics Integration with Neuroscience in the BRAIN Initiative: Comments on the NIH Neuroethics Roadmap," *AJOB Neuroscience 11*, no. 3 (2020), 184–88.
- Judy Illes, "Empirical Neuroethics. Can Brain Imaging Visualize Human Thought? Why is Neuroethics Interested in Such a Possibility?" *EMBO Reports 8, no. S1* (2007), S57–S60.
- Eran Klein, "Informed Consent in Implantable BCI Research: Identifying Risks and Exploring Meaning," *Science and Engineering Ethics 22, no. 5* (2016), 1299–1317.

JOURNAL

Journal of Cognition and Neuroethics

DATABASES

Colloquium Digital Library of Life Sciences

Neuroscience-related Databases

WEBSITES

Brains@Play   BrainMaps.org   TheHumanBrain.info

PRESENTERS

Dong Song   Judy Illes   Eran Klein