

The Herb Alpert School of Music at CalArts

Neuromusic – MITM – 201I/501I

Wintersession 2023

Instructor: David Rosenboom

Class Times and Places:

T/Th 2:00 PM - 3:50 PM

1/9/2023 - 1/20/2023

B318

T/Th 2:00 PM - 4:50 PM

1/9/2023 - 1/20/2023

B305B

Unit Weighting: 1.0 Credit

Course Description

Beginning in approximately the late 1960s and continuing to the present day, a new kind of biocybernetics developed that spawned the emergence of biofeedback in the arts and direct, extended musical interfaces with the human nervous system. The instructor's work in this area began around 1969 and has progressed through brainwave music, group contingent feedback systems, self-organizing musical structures with hyperbrain (multiple brain) performances, and today, music involving sound synthesis via electrical interfacing with cultures of living neurons, called music in vitro. In this class, we will survey the history and progression of this rapidly evolving area of practice, from its origins to what is now a large, international community of practitioners in what is often referred to as brain art. After examining a selection of methodologies that have been employed to date, the class can participate in some practical experiments and speculate about future possibilities, such as real-time feedback networking.

Learning Goals

- Historical emergence and progress to date in the fields known as neuromusic, brainwave music, and brain art.
- Introduction to the scientific and technological fundamentals of these fields.
- A survey of applications in related arts and sciences.
- Analysis of the aesthetic motivations of practitioners in these fields.

Course Outcomes

- Be conversant in artistic, philosophical, and scientific motivations in the fields of neuromusic and brain art.

- Understand technical terminologies associated with these fields.
- Be able to implement projects involving interfacing brainwaves to music synthesis methods.
- Engage in additional research related to these fields efficiently and with critical analysis skills.

Assignments

1. Regular reading and listening assignments, some for all students, others may be chosen by students according to particular interests and potential applications.
2. At the end of the first week, submit ~2-5 pages containing notes on reading and listening, along with reflections on those and the concepts presented in lectures and class discussions. At the end of the second week, submit ~2-5 pages reflecting on practical lab experiences, which may include speculative proposals for creative projects. All these may be submitted in hard copy at class time or emailed to the instructor at: david@calarts.edu. The final deadline for all submissions is Monday, January 23rd at 9:00 AM. Late submissions will not be considered in grading.

Reading assignments will be drawn from the following publications. PDF copies of some of them may be made available in a Google Drive Folder for the class.

2022 Brain basics: know your brain. (Bethesda, MD: National Institute of Neurological Disorders and Stroke, National Institutes of Health).
<https://www.ninds.nih.gov/health-information/public-education/brain-basics/brain-basics-know-your-brain>. Accessed January 10, 2023.

Rosenboom, D. 2019. More than one—artistic explorations with multi-agent BCIs. With T. Mullen. In
 Nijholt, A. (ed.). *Brain Art, Brain-Computer Interfaces for Artistic Expression*, 117-143. (Springer Nature Switzerland AG).

Rosenboom, D., T. Mullen and A. Khalil. 2015. Ringing Minds. Part of Mullin, T., et. al., part of MindMusic: playful and social Installations at the interface between music and the brain. In Nijholt, A. (ed.). *More Playful User Interfaces. Interfaces that Invite Social and Physical Interaction*. Series: Gaming Media and Social Effects, 221-229. (London: Springer-Verlag).

Rosenboom, D. 2014. Active imaginative listening—a neuromusical critique. *Frontiers in Neuroscience, Auditory Cognitive Neuroscience, The Musical Brain*, 8, 1-7, DOI=10.3389/fnins.2014.00251. Available online at:
<https://www.frontiersin.org/articles/10.3389/fnins.2014.00251/full>

- Rosenboom, D. 2014. Brain-computer music interfacing (BCMI): one place where science and music may meet in deep theoretical territory. In Reck, E. R. and J. Castet. (eds.). *Guide to Brain-Computer Music Interfacing*, v-x. (London: Springer-Verlag).
- Straebel, V. with W. Thoben. 2014. Alvin Lucier's *Music for Solo Performer*: experimental music beyond sonification. *Organized Sound* 19(1) 17-29. (Cambridge, UI: Cambridge University Press).
- Rosenboom, D. 2003. Propositional music from extended musical interface with the human nervous system. In Avanzini, G., Faienza, C., Lopez, L., Majno, M., and Minciocchi, D. (Eds.). *The Neurosciences and Music*, Volume 999 of the Annals of the New York Academy of Sciences, 1-9. (New York: NYAS).
- Rosenboom, D. 1990 and 1997. *Extended Musical Interface with the Human Nervous System: Assessment and Prospectus*. Leonardo Monograph Series, 1. (Berkeley, CA: International Society for the Arts, Sciences, and Technology). Revised version. (1997). (Cambridge, MA: The MIT Press, Electronic Journals, Leonardo Monograph Series, 1). [Second edition online: <http://www.davidrosenboom.com>]
- Rosenboom, D. 1990. The performing brain. *Computer Music Journal*, 14(1), 48–66. [Includes accompanying sound sheet with two recorded excerpts from On Being Invisible with printed notes.]
- Rosenboom, D. 1988. Extended musical interface with the human nervous system: assessment and prospectus. (Abstract of speech given to First International Symposium On Electronic Art, Utrecht, Holland). Leonardo, Electronic Art Supplemental Issue, 121.
- Rosenboom, D. 1975. A model for detection and analysis of information processing modalities of the nervous system through an adaptive, interactive, computerized, electronic music instrument. In *Proceedings of the Second Annual Music Computation Conference, Part 4, Information Processing Systems*, 54–78. (Urbana, IL: Office of Continuing Education in Music, University of Illinois).
- Rosenboom, D. 1975. *Biofeedback and the Arts: Results of Early Experiments*, (ed.). (Vancouver: Aesthetic Research Centre of Canada; and Hanover, NH: Frog Peak Music).
- Rosenboom, D. 1972. Method of producing sounds or light flashes with alpha brain waves for artistic purposes. Leonardo 5, 2 141-145. In Malina, F.J. (ed.). (1973). *Kinetic Art*, 152–156. (New York: Dover Pub.). Japanese translation, (1974). Space Design, 10. (Tokyo: Kajima Institute Pub. Co.).

Straebel, V. with W. Thoben. 2014. Alvin Lucier's *Music for Solo Performer*: experimental music beyond sonification. *Organized Sound* 19(1) 17-29. (Cambridge, UI: Cambridge University Press).

Teitelbaum, R. 1975. In Tune: some early experiments in biofeedback music. In Rosenboom, D. *Biofeedback and the Arts: Results of Early Experiments*, (ed.) 35-59. (Vancouver: Aesthetic Research Centre of Canada; and Hanover, NH: Frog Peak Music).

Grading Policy

Attendance 50%

Written assignments 50%

Weekly Plan

Tuesday, January 10th

- a) Introductory survey of the early history of neuromusic.
- b) Introduction to basic technical aspects of realizing neuromusic (brainwave music) projects and their scientific background.

Thursday, January 12th

- a) Introductory survey of recent developments in neuromusic.
- b) Introduction to more advanced technical and scientific aspects of realizing neuromusic and related interdisciplinary projects today.

Tuesday, January 17th

Practical Lab Session 1 – demonstrations and discussion of analog and digital, wired and wireless, neuromusic setups with participatory experiences for rotating groups of class participants, while others record observations.

Thursday, January 19th

Practical Lab Session 2 – continuation of work begun in previous session with rotating groups of participants and observers and more advanced technical discussions.

Library Materials on Reserve

(CalArts Library call numbers are included where available.)

Books

(Students are encouraged to explore chapters in these books that may not be assigned but may reveal interesting interdisciplinary applications.)

Miranda, E.R. (ed.) 2014. *Guide to Brain-Computer Music Interfacing*. (London: Springer). QP360.7 .G85 2014

Nijholt, A. (ed.). 2019. *Brain Art: Brain-Computer Interfaces for Artistic Expression*. (Cham, Switzerland: Springer.) QA76.9.H85 B73 2019

Nijholt, A. (ed.) 2015. *More Playful User Interfaces: Interfaces that Invite Social and Physical Interaction*. (Singapore: Springer). QA76.9.U83 M67 2015

Rosenboom, D. 1990. *Extended Musical Interface with the Human Nervous System, Assessment and Prospectus*. (Berkeley, CA: International Society for Arts, Sciences and Technology). Note: A 1997 revised edition is available for download on the author's website: <https://davidrosenboom.com/writings> . ML3838.R67 E9 1990

Rosenboom, D. (ed.) 1975. *Biofeedback and the Arts, Results of Early Experiments*. (Vancouver, B.C.: Aesthetic Research Centre of Canada). BF319.5.B5 B555 1976

Music Recordings

(Additional recordings and videos not listed here may be presented in class, some of which are also available online.)

Lucier, A. 1982. *Music for Solo Performer*. (New York, NY: Lovely Music). LM 1014 VR LP Record.

Rosenboom, D. 2000. *Invisible Gold*. (Chester, NY: Pogus). Pogus 210222, CD.

Rosenboom, D. 2019. *Deviant Resonances: Live Electornic Music with Instruments, Voices, and Brains*. (North Hampton, NH: Ravello Records). Ravello 8009 RR, Double-CD.

Rosenboom, D. 2019. *Brainwave Music*. Black Truffle 048 BT, Double-LP Record.