



The Cooper Union Audio Lab

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The Cooper Union



- 150 year-old premier institution of higher learning in downtown Manhattan
- Schools: Art, Architecture, Engineering, Humanities
- Perennially ranked top in the country
- All students receive full-tuition scholarships

The Albert Nerken School of Engineering



- Average enrollment of 500 students
- Four principal departments:
Mechanical, Electrical, Chemical,
and Civil Engineering
- High caliber students, small classes
- Hands-on, project based learning

The Cooper Union Audio Lab

- 1000 sq. ft. studio classroom
- Nexus of research and educational activities in acoustics and audio
- Extensive facilities and instrumentation
- Unique curriculum combines advanced engineering with design work



Mission



- Educate in acoustics, audio, and electronic music production and presentation
- Instill advanced technical knowledge and design and practical skills
- Foster interdisciplinary programs involving students from Art and Architecture
- Research activities in acoustics, audio, and music

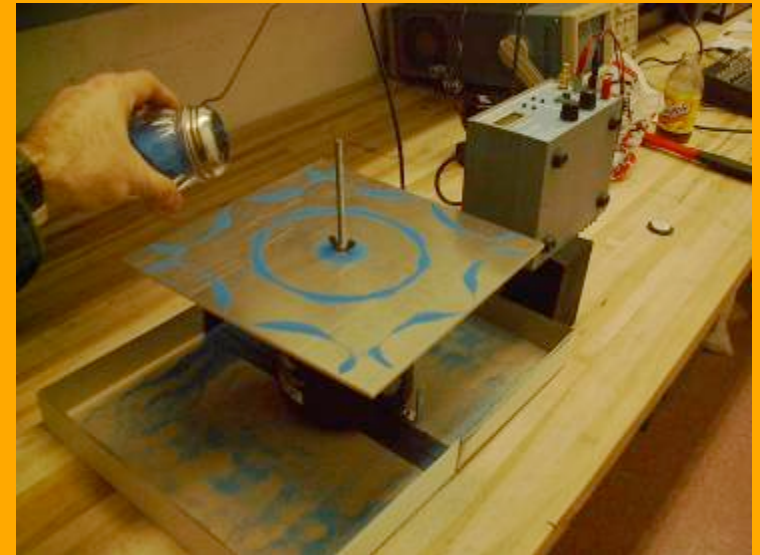
Courses



- Acoustics
- Musical instrument design
- Audio and electronic music
- Senior projects
- Master's students
- Public programs

Courses: Acoustics

- 1) Acoustic metrics: the dB, frequency bands
- 2) Human hearing
- 3) Physics of air
- 4) Wave equation for sound, power balance, sound absorption
- 5) Resonance, acoustic radiation, point source, sound from a disk
- 6) Reflection and absorption, acoustical materials
- 7) Architectural acoustics
- 8) Atmospheric acoustics, sound outdoors
- 9) Loudspeakers and sound systems
- 10) Passive and active noise control



Courses: Electronic Music

- 1) Sampling and microphones
- 2) Psychoacoustics
- 3) The Pro Tools audio editor
- 4) Introductory physics of sound
- 5) Room and hall acoustics
- 6) Multi-track arranging for dance music
- 7) Loudspeaker and sound system engineering
- 8) Music production, MIDI, and studio sound systems
- 9) Live presentation of pre-recorded music and the DJ
- 10) Event planning and execution



Courses: Musical Instrument Design

- 1) Musical scales and temperament
- 2) Acoustical theory of consonance
- 3) Free and driven oscillations
- 4) Percussion instruments
- 5) Plucked string instruments
- 6) Monochord construction project
- 7) Bowed string instruments
- 8) Wind instruments
- 9) Flute construction project
- 10) New instrument design and construction



Research and Design Projects

- 1) Investigations of architectural acoustic structures
- 2) Active noise and sound control
- 3) Design of human interfaces for live performance
- 4) Design and tuning of large scale sound systems
- 5) Development of specialized acoustical materials
- 6) Multi-channel simulations of acoustic environments
- 7) Electronic music production and recordings



Public Events

- Annual exhibition featuring students' original sonic compositions, sculptures, and performances



Facilities



- 900 cu. ft. full-coverage anechoic chamber
- Fully portable 5,000 watt JBL Professional™ sound system
- DJ mixing console
- Five Pro Tools™ audio workstations
- Mechanical and electrical lab benches and instrumentation

Equipment - Sound

Computer Audio Interfaces:

- USB Pre sound interface
- 3 x Pro Tools MBox systems
- 2 x Pro Tools Digi 001 systems

Computer Sound Systems:

- 2 x Mackie 824 bi-amplified studio monitors
- 2 x M-Audio BX5 powered monitors
- 3 x Beyerdynamic DT770 studio headphones

Main Sound System - Electrical:

- Mackie 24 channel, 8 bus mixing console with meter bridge
- 2 x Mackie 12 channel mixers
- dBX 260 Drive-Rack active crossover and controller
- dBX 166XL stereo compressor limiter
- Crown XLS 402 stereo power amplifier
- Crown XLS 602 stereo power amplifier
- 2 x Crest 2600 stereo power amplifiers

Main Sound System – Loudspeakers:

- 2 x JBL SR4725X two-way loudspeaker systems
- 2 x JBL 18-Inch subwoofers
- 2 Portable aiming racks (for above)

Equipment - Music

DJ Console:

- 2 x Technics SL-1210M5G turntables
- Stanton S-550 dual CD Player
- Portable Console with shock-mounts for turntables (for above)
- Crown Ultra-Tech stereo power amplifier
- 2 x JBL MP215 two-way loudspeakers w tripods

Musical Instruments:

- Pearl 5-drum, 3-cymbal drum set
- Trumpet
- Flute
- Clarinet
- Cello
- Guitar (acoustic)
- Xylophone
- Electronic 88-key keyboard
- Upright piano
- Grand piano keyboard with Moog PianoBar

Equipment - Measurement/Analysis

Sound Level Measurement:

- Bruel & Kjaer Type 2231 sound level meter
- Bruel & Kjaer Type 1625 filter set
- Bruel & Kjaer Type 4231 calibrator
- Norsonic Type 116 sound level meter and calibrator

Sound Analysis:

- Bruel & Kjaer Type 2034 dual-channel signal analyzer
- SMAART Live dual channel analysis software
- Hewlett Packard four-channel digital oscilloscope

Acoustic Measurement:

- Bruel & Kjaer Type 2804 dual microphone power supply
- Bruel & Kjaer Type 4165 microphone

Vibration Measurement:

- Bruel & Kjaer Type 4809 vibration exciter
- Bruel & Kjaer Type 2635 charge amplifier
- Bruel & Kjaer Type 4912 portable stroboscope
- Bruel & Kjaer Type 4384 $\frac{1}{8}$ inch accelerometer
- Wilcoxon Research 1 inch accelerometer
- Endevco Isotron miniature accelerometer

Discussion Point – DJ Set Programming



- DJ musicality derives from transitions and program
- Program consists of constant tempo well-interpolated sequence of tracks
- Derives from progression of:
 - Sub-genres / styles
 - Drum patterns
 - Harmonic basis
 - Lyrics
 - Keys
 - Energy
- ❑ What are the corresponding objective measures?
- ❑ What role do they play in the programming process?