Sounds of New York City.2:
Construction Noise Mitigation and Technology
April 22, 2021, 1:00 p.m. to 4:00 p.m.
via Microsoft Teams

AGENDA

1:00 p.m.— 1:15 p.m.	**Introduction and Recap from SONYC.1**
	Terri Matthews, Town+Gown:NYC
1:15 p.m.— 1:45 p.m.	**Construction Noise and the City—Noise Code and Mitigation**
	Charles Shamoon/NYC DEP
1:45 p.m.—2:45 a.m.	**New Technology from SONYC Project**
	Graham Dove and Charlie Mydlarz, NYU/CUSP
2:45 p.m.—3:15 p.m.	**Upcycling Decommissioned Wind Turbine Blades for Noise Mitigation**
	Lawrence Bank, Georgia Tech
3:15 p.m. – 4:00 p.m.	**Co-creating Knowledge Q and A**

SONYC.1 Background. On August 16, 2019, the Sounds of New York (SONYC) research team presented on the SONYC project, which is a $4.6 million National Science Foundation-funded "smart cities" initiative[1] focused on developing an acoustic sensor network for the monitoring and analysis of urban noise pollution, which includes construction-related noise. SONYC is an academic collaboration between researchers at New York University and Ohio State University and has been working closely with key New York City agencies, in particular, the New York City Department of Environmental Protection, the New York City Department of Health and Mental Hygiene, the New York Department of Parks and Recreation, the New York City Department of Transportation, and the Mayor's Office of Technology and Innovation. With respect to construction noise, the SONYC network would also be able to monitor and quantify the positive acoustic effects of mitigation efforts undertaken by construction contractors, through focused studies, and would help advance novel technological and socio-technical solutions that help address evaluation needs.

The first sensor developed by SONYC has been deployed across more than 55 locations in Manhattan, Queens and Brooklyn. This sensor contains a quad-core 900 MHz CPU with 1 GB RAM and 16 GB of local storage and can continuously monitor sound pressure level (decibel) data, which is transmitted to back-end servers *via* Wi-Fi or Ethernet. The sensors record 10s snippets of encrypted audio, randomly spaced in time to ensure privacy is maintained,[2] and are intended to be mounted ideally on light poles, at around 15' above the ground, clamped to poles at any orientation. The sensor's secure metal housing measures 5" x 4" x 1.5", with an 8" windshield extending from it; require a constant power source to operate, consuming 2W @ 5V of power, which can be supplied via a 5V feed, regular 120V outlet or power-over-ethernet (POE).

SONYC research has also developed machine learning "at the edge" technology run on the sensor processor to automatically identify selected sources of noise being monitored to provide a level of sound-source identification to augment simple sound pressure level (SPL) measurements, which help facilitate a fine-grained understanding of the impact of construction noise. While most cities, like New York, have a legal framework for regulating noise, they lack the resources for its continuous monitoring at city-scale, the technology for understanding how individual sources contribute to noise pollution, the tools to broaden citizen participation in noise reporting and regulation, and the means to empower city agencies to take effective, information-driven action for noise mitigation. SONYC's novel cyber-physical system aims at addressing these gaps.

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[1] See https://www.nsf.gov/awardsearch/showAward?AWD_ID=1544753.

[2] The deployment includes a small street-level sign, close by to the sensor, explaining that it is part of a research project.

The SONYC system includes a distributed network of sensors that uses cutting-edge machine listening methods to obtain a rich description of their acoustic environment and an information flow from the network through a cyber-infrastructure that analyzes, retrieves and visualizes data to facilitate the identification of important patterns of noise pollution. SONYC's research is intended to assist decision-makers at city agencies to strategically deploy the human resources at their disposal to mitigate noise through law enforcement. Additionally, since SONYC sensors can constantly monitor noise pollution, they can also be used by city agencies to validate the effect of any mitigating actions in both time and space, information that can be used to understand and maximize the impact of future mitigation actions. Longitudinal deployment of SONYC sensors at any construction site would allow SONYC to monitor and analyze the particular profile and impact of noise before construction starts, during construction, and after construction has been completed, as well as help city agencies evaluate any particular noise mitigation interventions, provide a detailed sound profile of selected sites.

Following the 2019 event, Town+Gown created the SONYC Working Group, comprised of staff from the City's construction agencies and other members of Town+Gown, to identify City construction projects that would be suitable for sensoring within the SONYC project. The sensors were to be mounted on City light poles near the construction sites, and Town+Gown worked with DEP, DOT, which regulates the use of City light poles, and SONYC to craft a memorandum of understanding to facilitate and support this City sub-component of the SONYC program. While the MOU neared completion, COVID and the related budget constraints rendered infeasible using this version of the sensor for City construction project.

Construction Noise and the City. The City's Construction Noise Rules and Regulations[3] promulgated by the New York City Department of Environmental Protection (DEP) permit contractors to conduct construction in the City between 7 a.m. and 6 p.m. on weekdays. While construction is an important function and component of the City's local economy, it is noisy and the City's minimal noise rule for smaller construction-related activities provides a list of construction activities with minimal noise impact as well as specific noise mitigation procedures that must be implemented whenever the listed construction activities take place. [4] For construction during all other times, including weekend days, construction owners or their contractors must apply for after-hours authorization. Construction owners or their contractors must also develop a Construction Noise Mitigation Plan (Plan) before the start of construction or renovation, which Plan must be in place for the Department of Buildings to issue a

[3] See New York City Noise Code and View the Rules Concerning Citywide Noise Mitigation.
[4] View the Rules Concerning Minimal Noise Impact Construction Activities.

construction permit. The City's Construction Noise Rules and Regulations provide alternatives for contractors to continue their important construction tasks while having less noise impact on the surrounding environment and create unique noise mitigation plans for each construction site. Additionally, construction owners or their contractors must have a Plan in place when seeking an after-hours construction permit from the Department of Buildings or Department of Transportation (also known as a variance). Copies of the Plan must be available on site for DEP inspection purposes, and fines can be assessed if no Plans are available on site. See Appendix A for resources related to construction noise.

The Federal Center for Disease Control, National Institute of Safety and Heath, National Hearing Conservation Administration granted the 2010 'Safe in Sound' Award to DEP (and its consultants). DEP was also recognized by the U.S. Academy of Engineering's publication, Technology for a Quieter America.

SONYC.2—The New TTP Sensor. SONYC has been working with industrial design firm Loft LLC to design a new version of its noise monitoring sensor that is suitable for domestic deployment, as an NSF funded transfer to practice (TTP) extension. This new SONYC TTP sensor will be deployed at the homes of people with ongoing problem noise (e.g., from construction, carting and deliveries, bars and night clubs, and street disturbance.)

SONYC TTP sensors contain a quad-core 1.4 GHz CPU with 1 GB RAM and 64 GB of local storage. They continuously monitor sound pressure level (decibel) data, which is transmitted to back-end servers via cellular data, using a pre-installed SIM card at no cost to the end-user. They also generate acoustic data at or above the accuracy required by city agencies. The sensors record 10s snippets of encrypted audio, randomly spaced in time to ensure privacy is maintained. In addition to collecting SPL and audio data, the SONYC TTP sensor is linked to a web-based reporting tool that enables end-users to log details about specific instances of problem noise.

SONYC TTP sensors are designed to be securely mounted on the outside of end-users' windowpanes, using 3M Command strips. The sensor's secure housing measures 4" x 6" x 1.5". Sensors require a constant power source to operate, which is provided from within the end-user's home via a low-profile but rugged silicon cable that allows windows to fully close. They consume less power than a standard phone charger (5W @ 5V). Each sensor deployment includes signage to notify neighbors that noise is being monitored and explain that this is within the context of a research project.

SONYC research is continuing to develop machine learning at the edge technology that will

run on the sensor to automatically identify the sources of noise being monitored. This will provide sound-source identification data to augment simple sound pressure level (SPL) measurements. To increase the effectiveness of this, SONYC TTP sensors support human-in-the-loop machine learning that enables end-users to provide additional information to support model training. This can help in evaluating particular noise mitigation interventions, provide a detailed sound profile identifying temporal patterns in problem noise, and help facilitate a fine-grained understanding of noise impacts. SONYC research continues to support and develop its partnership with NYC DEP towards data-informed enforcement planning.

Decommissioned Wind Turbine Blades for Construction Noise Mitigation. "Re-Wind," an interdisciplinary research team comprising experts from City University of New York, Georgia Institute of Technology, University College Cork and Queen's University Belfast, is researching up-cycle uses of decommissioned blades as an alternative to unsustainable disposal methods such as landfill and incineration. Among the current ideas for potential uses, in the Re-Wind DESIGN ATLAS,[5] are as barriers to road and highway traffic noise. The noise absorption capacity of this material may make construction noise mitigation applications possible. This will take understanding of the construction process and the imagination of those in the construction industry.

One potential construction noise mitigation application, closer to the traffic noise barriers discussed in the Re-Wind DESIGN ATLAS would be innovative uses for horizontal infrastructure construction either as specific noise barriers or in as falsework with added noise absorption features. Another potential application would be innovative uses in falsework for vertical building construction. Falsework in vertical construction can include hoardings (or construction fences), scaffolding[7] and formwork, which entails "special skill requirements and engineering concern" and "cost concerns continue to drive contractors toward efficient use of temporary work [including] means of integrating falsework into the final product."[8]

The benefit of using decommissioned turbine blades—likely parts cut from them—in falsework is that, if not possible to integrate into the final product, they would be able to be re-used on other projects, creating cost savings opportunities while avoiding them becoming part of the post-completion construction and demolition waste stream that mostly winds up in landfills.

[5] See 10.13140/RG.2.2.13426.32960; Nov 2018 This work is licensed under Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0)
[7] See https://www1.nyc.gov/site/buildings/business/project-categories-cons-equip.page.
[8] Gerald Finkel, *The Economics of the Construction Industry* (Armonk: M.E. Sharpe, 1997), p. 18.

Private investment in interim processing facilities and manufacturing of higher value construction materials is likely, however, be necessary, to manufacture such new uses.

See below for images for noise barrier uses.

Designs and graphics by Alex Poff and Chloe Kiernicki**,** students in the School of Architecture at Georgia Tech on the Re-Wind team.

DEP Construction Noise Contact Sheet

All contractors should have the Construction Noise Contact Sheet posted on a fence outside their construction site.

Download the Construction Noise Contact Sheet

Construction Noise Mitigation Form

In accordance with DEP Noise Code, Section 24-220 of the New York City Administrative Code, any individual or entity performing construction work in the city, shall adopt and implement a noise mitigation plan for each construction site when any device or activity is conducted as defined in Section 24-219. The attached sample form of a noise mitigation plan is intended to inform the user of the required plan elements that a responsible party must include when the listed devices are being used on site, and the mitigation strategies and best management practices that are being employed as defined in Title 15RCNY Section 28-102.

Construction Noise Mitigation Form

Download the Construction Noise Mitigation Public Access File

Construction Noise Alternative Mitigation Form

When required by DEP Noise Code, Section 24-221 of the Administrative Code and or Title 15 RCNY Section 28-104, a complete and accurate Alternative Noise Mitigation Plan (ANMP) must be filed when strict compliance with the noise mitigation rules is not possible. When an ANMP is required, all construction activities that fall under it must be postponed until it is filed and approved by the DEP. After review and approval by DEP's technical staff, the plan must be readily posted at the job site.

Construction Alternative Noise Mitigation Form

Download the Construction Alternative Noise Mitigation Public Access File

Vendor Guidance for Smaller Construction Jobs

The following is intended to provide guidance to construction contractors with respect to finding and selecting suitable noise control products used on smaller construction jobs. These products and vendors may be helpful to contractors for achieving compliance with the New York City Noise Regulations.

Download the Vendor Guidance Document for Smaller Construction Jobs

Construction Noise Control Products and Vendor Guidance Sheets

The following is intended to provide guidance to construction contractors with respect to findings and selecting suitable noise control products. These products and vendors may be helpful to contractors for achieving compliance with the New York City Noise Regulations. These items are provided only as suggestions for contractors to consider and should not be construed as an official endorsement of any product and/or vendor by the City of New York. Contractors are free to choose other products/vendors that meet the requirements of such

Code. This sheet will be updated from time to time as new noise control technologies gain acceptance.

Download the Construction Noise Control Products and Vendor Guidance Sheets

After Hours Construction Noise Protocol

LL 53 of 2018 requires DEP to publish, on the City's website, the manner by which noise levels are measured during after-hours inspections. The Noise Code already requires DEP inspector readings to be taken in LMAX with the sound level set to slow response unless otherwise noted. This protocol provides more detailed guidance so the public is aware of the manner in which inspections are conducted.

- Download the After-Hours Construction Noise Complaint Inspection SOP

Download the 2018 Annual Report