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Singing Fish: Choir of Electric Fish Makes Debut in Interactive 'Scale' Exhibit at Netherlands Festival

Three Northwestern University faculty members recently presented their collaborative "singing electric fish" installation to thousands of people attending the STRP Festival, one of the largest art and technology festival venues in Europe. Many visitors had the chance to grab a baton and direct the unusual choir.

The audience-interactive exhibit, titled "scale," had its world premiere in November at the 10-day festival held in Eindhoven, The Netherlands.

The multidisciplinary artwork was created by neurobiologist and engineer Malcolm MacIver, visual and conceptual artist Marlena Novak and composer and sound designer Jay Alan Yim. In the installation, 12 different species of electric fish from the Amazon River Basin comprise a "choir" whose sonified electrical fields provide the source tones for an immersive audiovisual experience.

Participants act as conductors, using a modified Nintendo Wii remote. Each "conductor" can cue an individual fish or combine the sounds of several fish together, either in natural or digitally processed modes. The otherworldly sounds are heard through a spatialized audio system; a touch-screen panel allows for changes in volume. Arrays of light-emitting diodes under each tank provide visual feedback to visitors.

The work is designed to offer multiple levels of aesthetic experience. "Initially there is an audiovisual encounter with the dynamically interactive sound sculpture," Novak said. "As one goes to the next level of active participation, there is a sense of personal engagement for each individual who uses the interface directly to 'conduct' the ensemble of fish. The system allows for an additional degree of collaboration when more than one person manipulates the touch-screen at the same time."

The team hopes to foster wider public awareness of the scientific contributions of the electric fish and the fragility of their Amazonian environment. "These remarkable fish have contributed greatly to our understanding of how the brain works, yet few people outside of specialists have

heard of them," said MacIver, Associate Professor of Biomedical and Mechanical Engineering in the McCormick School of Engineering and Applied Science.

The fish are housed in individual tanks arranged in an arc and outfitted with a 12-channel speaker array, with the conductor's podium in the middle. Each fish continually discharges a weak electric field of constant frequency; this field is picked up by sensors and then amplified. By playing these signals through a speaker, a tone corresponding to the field can be heard. The resulting sound from each fish varies (due to species-specific variations in the emitted field), falling within the range of 30 to 1,700 hertz -- from the lowest B natural on a piano to the G-sharp key six octaves higher.

MacIver, Novak and Yim worked together on every major aspect of the work, each bringing complementary skills to the project. MacIver's research focuses on sensory processing and locomotion in electric fish; Novak and Yim, collaborating as localStyle, make intermedia works motivated by the theme of perception and that explore topics such as boundaries relating to physical and intangible properties.

Novak is a faculty member in the department of art theory and practice in the Weinberg College of Arts and Sciences. Yim is an Associate Professor of Composition at the Bienen School of Music.

The lead technician for scale was Northwestern alumnus Kyle Liske. "We were lucky to find Kyle just as he was completing his engineering degree here at McCormick," MacIver said. "He transitioned from being a student assistant for scale to working full time on the project in March. Kyle has been an outstanding asset for the project."

Several faculty members provided important technical guidance, MacIver added, including Michael Peshkin, professor of mechanical engineering.

During the exhibit at the STRP Festival, MacIver, Novak and Yim were on hand to share information with visitors about how electric fish use the discharges to explore their environment, the murky waters of the Amazon.

Thousands of scientific papers on neural processing of sensory information in these fish have pushed forward our understanding of the brain. "For example, in all animals, including humans, most of the input to our sensory systems is due to our own movement," MacIver said. "The neural mechanism for subtracting this self-generated sensory information has been decoded in the electric fish and is likely to be similar to certain circuits in our own brain that performs the same function. This is key to remaining sensitive to things happening around us."

An understanding of the way in which the fish move and sense is also inspiring the development of a new generation of highly maneuverable underwater vehicles, which use weak electric fields to sense things the way the fish does and a propulsion system based on what the fish uses. These vehicles are needed for things like long-term environmental monitoring and for dealing with underwater

problems, such as the recent Gulf of Mexico oil spill.

scale was funded by the Northwestern Center for Interdisciplinary Research in the Arts, the Walter P. Murphy Society, the University Research Grants Committee and the National Science Foundation.

Nearly 30,000 people attended this year's festival. STRP stands for Strijp-S, the name of the industrial site where Philips invented such items as the audiocassette and the CD. The city of Eindhoven is referred to as the "Brainport" of the Netherlands due to the many scientific and technological institutes located in the area.

In addition to technological innovations, Philips sponsored one of the pioneering landmarks of intermedia art in 1958: the famous pavilion designed by Le Corbusier and Iannis Xenakis, in collaboration with the 350-speaker "Poème Electronique" by Edgard Varèse, plus projections and ambient light sequences. This amplifies the Netherlands' tradition of supporting arts and technology by institutes such as V2 (Rotterdam), Sonology (The Hague), STEIM and NIMK (both Amsterdam).

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