Simple rubber device mimics complex bird songs

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For centuries, hunters have imitated their avian prey by whistling through their fingers or by carving wooden bird calls. Now a team of physicists at Harvard University in Cambridge, Massachusetts, has reproduced many of the characteristics of real bird song with a simple physical model made of a rubber tube.

"We wanted to know if you [could] build a simple device, which has minimal control but reproduces some non-trivial aspects of bird song," says L Mahadevan, a professor at Harvard. The work is being presented today at the American Physical Society Division of Fluid Dynamics meeting in Long Beach, CA.

Bird song -- a complex sound full of intricate patterns and rich harmonics -- has long been studied by neuroscientists. Their research has explained much about how young birds learn these songs from adults and the complex neurological changes that allow them to control their voices.

But Aryesh Mukherjee, a graduate student in Mahadevan's laboratory, suggests that this neural control need not be as complicated as it could be. He suspects that the physics of a bird's vocal tract could explain much of the complexity of its voice, even with relatively simple neural control.

His bird call device consists of an air source, which creates a flow through a stretched rubber tube (modeled after a bird's vocal tract), and a linear motor that presses on the tube in a fashion analogous to a contracting muscle.

"Using this very simple device that pokes a tube, I see these beautiful sounds being produced without a sophisticated controller," says Mukherjee.

When analyzed on a spectrogram, the harmonics and other characteristics of the sounds made by the physical model closely resemble the songs of a zebra finch.

Another researcher in the lab, Shreyas Mandre, now an assistant professor at Brown University, is building mathematical models that seek to capture some of the underlying principles. His model, which represents the voice as a stretched string with dampened vibrations, creates digital bird calls that are also very similar to the real thing.

"Once we understand the physics better, we'll be able to mimic the sound much better," says Mandre.

The principles underlying the models aren't limited to single species of birds. The researchers believe that -- with a few tweaks -- their models could mimic a variety of bird calls.

More information: The presentation, "Bird song: in vivo, in vitro, in silico" is on Sunday, November 21, 2010. Abstract: meetings.aps.org/Meeting/DFD10/Event/132278

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