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Editorial and Business Offices:
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(202-785-2255)

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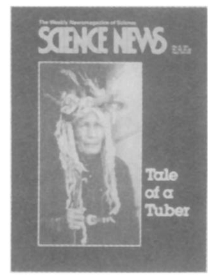
This Week

Research Notes

Articles



Cover: A Blackfoot holy woman wears a headdress traditionally used in the sun dance, a thanksgiving ceremony once common among Plains Indians. The dried, twisted roots adorning the front of the headdress resemble those of the prairie turnip, a vegetable that new research suggests may once have been a staple of the Blackfoot diet. (Photo: Glenbow Museum/NA-737-1)

Departments

Letters

Something old, something new

A phenomenon analogous to stochastic resonance ("The Signal Value of Noise," SN: 2/23/91, p.127) has been known and exploited for several decades in astronomical photography. Light acts on the grains in a photographic emulsion to produce metallic silver clusters, which must exceed a certain size to be developed (i.e., amplified) subsequently. Faint stars are unable to produce clusters exceeding the critical threshold. Pre- or post-exposure "fogging" by a short-duration, low-level, even illumination increases the size of the latent image clusters, which are then revealed by development. Natural illumination can also provide such fogging, giving the paradoxical effect that fainter stars (signal) may be detected when there is a faint background sky glow (noise) than when the sky is perfectly black.

Storm Dunlop
Chichester, Sussex
England

"Stochastic resonance" sounds like a fancy name for a very old technique known as "dithering." This is the method of introducing a small random signal in a servomechanism to overcome static friction in mechanical actuators by causing them to "tremble" continuously. It results in increased control resolution (i.e., sensitivity). Low-amplitude noise applied to any system with a detection or operational threshold, such as the Schmitt trigger mentioned in the article, will add to input signals to produce action at a lower level than would otherwise occur.

Kenneth H. Beck
Chairman, TAC Technical Instrument Corp.
Trenton, N.J.

Electronic readouts have rendered obsolete the ancient custom of tapping a meter with one's finger to improve its sensitivity, but "The Signal Value of Noise" brings that lost art back to the most sophisticated realms of science.

The noise/signal relationship can work both ways. The signal may increase a system's sensitivity to noise. Consider the Earth as a bistable system — either alive or lifeless. In light of the article's example of a ball sitting in one of two overlapping wells separated by a small barrier, consider human pollution to be the signal pushing Earth toward the well of lifelessness, and normal variations of climate to be the noise. Although the pollution signal is evidently not yet strong enough to send us to oblivion, it may have pushed Earth to a point where an uncommon (but "normal") change of climate finishes us off.

I might add that all celestial evidence indicates that life is a much less stable condition than lifelessness.

Pondurenga Das
Berkeley, Calif.

When I was young I often played with a toy that had small steel balls inside a box. The object was to thread the balls through a maze by tilting it. I learned early on that if I rapidly

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tapped the box while gently tilting it, it would require less tilt to get the balls to start moving and would result in less violent motions. Physicist Rajarshi Roy might say that I was adding noise to the motions and getting amplification of the tilt, but I would say that I was increasing the apparent "temperature" of the steel balls by adding a small amount of random motion. The "temperature" increase resulted in lower "viscosity" as measured by the static friction between the balls and the box.

Could it be that the results researchers are getting in "stochastic resonance" are simply another expression of the much older idea of heat?

James Carlson
Shrewsbury, Mass.

I think I can present a case of biological stochastic resonance that I frequently encounter in my dental practice. Many times after seemingly successful local anesthesia, such as a mandibular nerve block, the patient experiences pain upon treatment. Such a block does not completely prevent all sensory signals from being transmitted, but reduces them sufficiently so that the average person's threshold is not exceeded and the brain does not register pain. The patient who has what we call a low threshold and does experience pain could be flooding the sensory neural network with "noise" caused by his or her apprehension, fear and agitation. This could cause enough enhancement of the weak signal that does get through for the brain to register pain.

The possible proof of this theory is that when we reduce this "noise" by giving such patients analgesia, nitrous oxide plus oxygen, keeping them conscious at all times but reducing their apprehension, etc., their perception of pain usually disappears and symptoms of profound local anesthesia appear.

Theodore J. Blinder
Havertown, Pa.

Could the beneficial role of noise as an amplifier of weak signals help to explain why some sophisticated listeners still prefer the sound of a long-playing record to that of a compact disk? Although the essentially noise-free CD sound is more faithful to the original by many objective measures, perhaps the faint background noise on an LP helps the listener perceive weak, subtle musical effects.

Thomas Frenkel
Sunnyside, N.Y.

I was intrigued by your article on stochastic resonance, the "counterintuitive" principle that allows signals to become more effective through the introduction of random noise.

It seems to me that this principle may help explain one of the major paradoxes of our time: why humanity has continued to progress even after the advent of television.

Carleton S. Coon Jr.
Washington, Va.

Keeping a lock on Pandora's box

English professor Bruce Henricksen (Letters, SN: 2/9/91, p.83) implies that access to "nonmilitary, unclassified" computing systems should be unrestricted, and he cites the library and the university as models for the sharing of ideas. Unfortunately, such open access is something most people would *not* want – e.g., open access to their medical records, their bank records, their credit histories, their income tax histories or their police records. At universities, student grades and faculty personnel files are not open records, nor are results of prepublication research – all of which are often kept on computers. And librarians closely guard records of what items individuals have checked out for personal use. In industry, trade secrets, customer mailing lists, accounting and purchasing records and personnel evaluations are all kept confidential. The list can be extended to include many more "nonmilitary, unclassified" records with a legitimate privacy requirement.

Another problem with unrestricted access to arbitrary systems is the difficulty of knowing when access is merely to browse and when it is a prelude to (or attempt at) something less benign. As someone who works in computer security research, I can assure you that access is usually the first step in cases of theft, sabotage and other forms of computer security threat. Restricting access is the best way to prevent malicious individuals from slipping into a system under the guise of innocent curiosity.

In an ideal world, Professor Henricksen's view of open access to computers might well be the ideal. Unfortunately, the real-world need for (and rights to) privacy, and the need to keep systems secure from tampering, mean that we must continue to restrict access to a significant number of our computer systems.

Eugene H. Spafford
Assistant Professor of Computer Sciences
Purdue University
West Lafayette, Ind.