Noise echoes in cell communications

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Can't hear? Turn up the white noise, says a team of Rutgers-Camden professors who have produced a mathematical explanation for the benefits of noise. Their findings could lead to major improvements in hearing aid technology.

Dawei Hong, an assistant professor of computer science, Joseph Martin, a professor of biology, and William Saidel, an associate professor of biology, are working together to explain the biological benefits of noise through mathematics. Although the Rutgers-Camden team did study noise in the auditory system, "noise" can also refer to not just what we hear, but a randomness that is essential to all life.

"There is no life without noise; noise is the secret of life," suggests Martin, who points to the constant movement of particles under a microscope to illustrate this phenomena. Unlike a physics experiment that can produce the same result after various attempts, in biology, one particular experiment can yield a multitude of outcomes.

This randomness, however, isn't problematic, but a necessary function for survival. Until now, the role of randomness in sustaining life has been a great and unsolved problem. The collaborative research underway at Rutgers-Camden has led to new understanding of how living organisms might exploit randomness for important processes of sensory processing and cell to cell communication.

In terms of hearing, the Rutgers-Camden research team's mathematical theory improves previous knowledge by offering a single explanation of

the properties of noise in hearing under different conditions. To develop the theory, Hong used a variation on the wavelet technique, which he says is responsible for clarifying the JPG image. The findings could have numerous applications – most obviously in treating hearing loss by artificially increasing the amount of noise in the cochlea of the inner ear, perhaps by an implanted device.

Hong, Saidel and Martin applied this principle of noise to another process called "quorum sensing" – how bacteria signal one another to act collectively when causing an infection. The Rutgers-Camden research team used bacteria as a starting point for observing how noise enhances cell-to-cell communication. A full understanding of how this simple form of communication works might show how to disrupt it, and the resulting infection. The team will next apply their idea to the nervous system, where the cell's entire job is to communicate.

Published in top journals on theoretical biology, this collaborative research between biology and computer science faculty at Rutgers-Camden is part of a thrust to ultimately offer a doctoral program in computational and integrative biology on the Camden campus. "We talk about biological problems and apply mathematical principles," says Martin, who believes the development of the Systems Biology Institute in Camden, which will be managed by Rutgers-Camden, will further advance the systems biology discipline in South Jersey.

Source: Rutgers, the State University of New Jersey