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New modeling of brain's circuitry may bring better understanding of Parkinson's disease

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Researchers from the School of Science at Indiana University-Purdue University Indianapolis have developed a mathematical model of the brain's neural circuitry that may provide a better understanding of how and why information is not transmitted correctly in the brains of Parkinson's disease patients. This knowledge may eventually help scientists and clinicians correct these misfires.

Work led by Leonid L. Rubchinsky, Ph.D., associate professor of mathematical sciences in the School of Science at IUPUI, examines the exchange of electric signals within the Parkinson affected brain, demonstrating that repetitious, overlapped firing of neurons can lead to waves of overly synchronized brain activity. A report on the model appears in the September 2011 issue of the journal Chaos*: An Interdisciplinary Journal of Nonlinear Science*, a publication of the American Institute of Physics.

"This mathematical model of the brain's circuitry provides insight that we could not obtain from animal or human brains in experimental or clinical studies. With this new modeling we, and others, can now better study the mechanisms of information transmission in the Parkinsonian brain – both how the mechanisms work and how they fail. We can also learn about the properties of the cells that are responsible. All this knowledge is critical to the eventual development of therapies to correct defective transmissions found in the brains of those with Parkinson's disease," said Rubchinsky, who is affiliated with the Center for Mathematical Modeling and Computational Sciences in the School of

Science at IUPUI.

Parkinson's disease is a progressive disorder causing degeneration of neurons in the substantia nigra, a region of the brain which produces the chemical dopamine. Symptoms of Parkinson's disease include tremor, rigidity or stiffness, slowness of movement and impaired balance and coordination. Approximately 60,000 new cases are diagnosed annually in the United States according to the National Institutes of Health. Currently there is no cure for Parkinson's disease.

"Technically we have the tools needed for deep brain stimulation – stimulators, long lasting batteries and implantable chips – but we don't have the algorithms – the formulas and other mathematical tools necessary to know what we are trying to stimulate and how. Our model, and others that will follow, should make deep brain stimulation a feasible therapy for Parkinson's disease within the next decade," said Rubchinsky, who is also a researcher with the Stark Neurosciences Research Institute at the IU School of Medicine.

Provided by Indiana University-Purdue University Indianapolis School of Science

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