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## Physicists use fractals to help Parkinson's sufferers

A new portable system for analyzing the walking patterns of people with Parkinson's disease has been developed by researchers in the US and Japan. The system, described in the Institute of Physics publication Journal of Neural Engineering, will help doctors monitor the progress of the disease in patients and so tailor their therapy and drug regime more accurately than previously possible.

Parkinson's disease is a progressive disorder of the central nervous system. Its symptoms include: uncontrollable trembling, difficulty walking, and postural problems that often lead to falls. These symptoms are usually controlled with dopamine agonist drugs. However, these can have a number of side-effects, such as jerking movements. It is also known that the body builds up a tolerance to the drug.

Understanding the nature and severity of symptoms for individual patients, which is reflected in their walking pattern, could help doctors improve a patient's quality of life, by guiding their treatment more effectively, and so reduce side-effects.

Researchers have previously tried to quantify the problems suffered by Parkinson's patients by studying their gait. Now, Masaki Sekine, Metin Akay, and Toshiyo Tamura, of the Department of Gerontechnology, National Institute for Longevity Sciences, in Aichi, Japan and Thayer School of Engineering, New Hampshire USA, working with their colleagues at the Fujimoto Hayasuzu Hospital, in Miy azaki, Japan, have devised a portable system based on a sensor placed on the patient's body that measures movements in three dimensions. The readings from this sensor, known as a tri-axial accelerometer, are fed to a computer, together with measurements of the patients walking speed, and analysed using a fractal system.

Fractals are usually associated with irregular geometric objects that look the same no matter what scale they are viewed at: clouds, branching trees, rugged coastlines, rocky mountains, are all examples of fractals. The idea of a fractal can also be applied to irregular motion. For instance, a healthy heartbeat is now known not be so regular as we might think and follows a fractal pattern of movement instead. Scientists have suggested that fractals might also be used to model the irregular walking pattern of people with Parkinson's disease.

The researchers used the fractal analysis to break down the body motion of healthy elderly subjects and patients with Parkinson's disease into simpler component parts. The aim being to reveal the differences in irregularity and complexity of the way individuals in each group walk. The computer analysis of the data revealed the complexity, as determined by a fractal measure, of the walking patterns of each group. The fractal measure falls between 1 and 2, and the higher the fractal measure (close to 2) the more complex the body motion, or the lower the fractal measure (close to 1) the less complex the body motion.

The authors say that the fractal measure for Parkinson's disease patients is about 1.48, or higher than that of healthy elderly subjects, whereas the healthy elderly subjects have a fractal measure nearer 1.3.

This confirms the fractal nature of the gait in Parkinson's patients, says the team, and provides them with a quantitative means to measure the severity of walking symptoms.

The Journal of Neural Engineering was launched by the Institute of Physics this week and can be viewed online at: http://jne.iop.org.

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Notes to editors:

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3. The paper, 'Fractal dynamics of body motion in patients with Parkinson's disease' by Masaki Sekine, Metin Akay, Toshiyo Tamura, Yuji Higashi, and Toshiro Fujimoto was published in the Journal of Neural Engineering: Volume 1, Number 1, March 2004.

4. The Journal of Neural Engineering was launched this week and can be viewed online at http://jne.iop.org. The solution to many neuroscience problems will involve highly coordinated and highly interdisciplinary research efforts between neurobiologists and engineers. This understanding is crucial not only in allowing us to discover how large numbers of cells can store and process information but also to understand the mechanisms underlying neurological disorders such as stroke, Parkinson's disease, Alzheimer's disease or epilepsy. The launch of Journal of Neural Engineering reflects the need for an accessible dialogue between these disciplines. JNE aims to fulfil this need by providing a forum in which neuroscientists, neurobiologists and engineers can publish their work in one periodical. The journal will encompass all aspects of this emerging field.

5. The Institute of Physics is a leading international professional body and learned society with over 37,000 members, which promotes the advancement and dissemination of a knowledge of and education in the science of physics, pure and applied. It has a world-wide membership and is a major international player in

scientific publishing and electronic dissemination of physics;

setting professional standards for physicists and awarding professional qualifications;

promoting physics through scientific conferences, education and science policy advice.

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