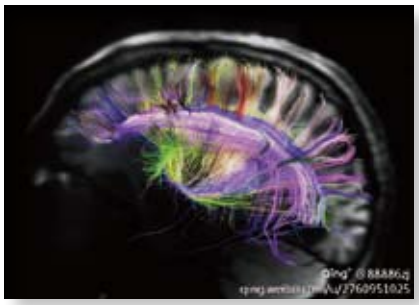
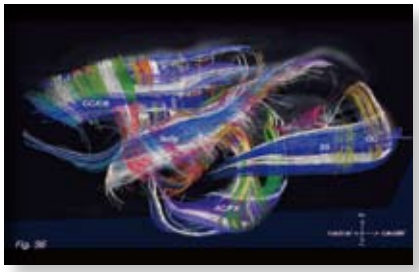
Researchers Present Most Detailed 3-D Images of Brain Connectivity in *Science*

The human brain comprises approximately 100 billion neurons that are interconnected in a dense network made up of an even far greater number of threadlike nerve fibers. In the March 30 issue of *Science*, Prof. Wen-yih Tseng of the College of Medicine and Dr. Van Wedeen of Harvard Medical School reported on their landmark imaging research that has shown the brain's neurons to be organized in a simple three-dimensional geometric grid structure. This research has generated the most detailed images of the brain's structure to date and is expected to bring scientists closer to unraveling many of the mysteries of the brain.

Using sophisticated mathematical analysis of data produced by the most powerful magnetic resonance imaging (MRI) scanner of its kind, the investigators discovered that the nerve fibers of the brains of four species of monkey, as well as of humans, are organized in a simple three-dimensional structure constituted of nerve fibers laid out either parallel or perpendicular to each other, like the rows and columns of a chessboard. The nerve fibers are arranged parallel to the three axes of the body, which run from front to back, left to right, and top to bottom. This type of structure conforms to the dimensions of three-dimensional space and thus might explain how the human brain interprets the three-dimensional location of spatial information accurately.





This simple three-dimensional structure of brain connectivity had remained undiscovered because the traditional method of using chemical tracers in neural pathways to image neurons allowed only the observation of a small portion of nerve fibers rather than overall structural patterns. The team's breakthrough was made possible by the use of advanced MRI method of diffusion spectrum imaging (DSI).

Dr. Wedeen's team is working as part of a consortium of institutions to work on the US National Institutes of Health's Human Connectome Project, which aims to build a network map of the human brain.

At the end of 2011, the Ministry of Economic Affairs began funding Prof. Tseng's research team to develop an MRI system for the study of the connective structure of the brain. The ministry hopes to utilize this project to cultivate professional medical instrument research and development personnel so as to spur the development of Taiwan's medical instrument industry.

Prof. Tseng's research team is presently working closely with medical centers in Taiwan and abroad to investigate the six major neurological diseases of schizophrenia, hyperactivity, autism, dementia, epilepsy and strokes. Prof. Tseng expects to complete the production of Taiwan's first prototype brain connectivity MRI system in 2014 and use it to establish a database of the connective structures of brains from normal subjects and those suffering from neurological diseases.