

Medical Solutions

For the daily and trade press

Erlangen, 2005

Background Information: Functional Magnetic Resonance Imaging

Thinking, feeling, seeing, tasting – these phenomena occur more or less unconsciously in the body. And possibly just for this reason, they have always fascinated and interested researchers. However, researchers were unable for many years to track brain activity without injecting contrast agent or introducing cables into the patient's body. For more than a decade, a special imaging procedure has been able to visualize these impressions without the need for contrast agent, cables, or electrodes: functional magnetic resonance imaging (fMRI) provides insights into the functions and metabolic processes of the brain.

Function

A standard magnetic resonance imaging system produces images of the inside of the body. But fMRI shows much more: it displays the anatomical features of the brain as well as locations in the brain where specific sensory impressions or thought processes are active. Like a camera, fMRI records changes in brain activity in real time. This amazing procedure is possible because oxygen consumption and blood flow always increase in the brain wherever an activity is being performed. If a healthy volunteer hears a noise for example, the neural regions in the areas of the brain that are responsible for "hearing" are active. These neurons require energy to work, and as a result blood flow is activated and the number of corpuscles loaded with oxygen increases. Corpuscles containing oxygen have different magnetic characteristics compared to those without oxygen. This distinction is utilized in fMRI.

The biophysical process described is called the Blood Oxygen Level Dependent (BOLD) Effect. It utilizes the differing characteristics between blood that is low and blood that is rich in oxygen. These differences are displayed as color changes in an MR image, calculated using complex computer processes and shown on the monitor. The procedure only visualizes the active regions of the brain.

A benefit to research

fMRI is able to track thoughts and feelings – and is becoming increasingly important in researching mental disorders. Psychiatrists and psychotherapists view this procedure as a unique opportunity to establish the relationship between mental health disorders and their neural foundations. Researchers are now able to thoroughly investigate mental illnesses such as schizophrenia, anxiety, and obsessive-compulsive disorder.

Medical Solutions from Siemens

To obtain higher resolution and more meaningful images with this procedure, the signal intensity of the magnetic resonance imaging system has to be increased. For this stronger magnetic fields have to be used. At Med, this led to the development of MRI systems with very high field strengths – first 3 Tesla, and later 7 Tesla. With a strength 140,000 times that of the Earth's magnetic field, 7 Tesla systems are the most powerful magnetic resonance imaging systems in the world. Faster image acquisition, higher spatial and temporal resolution, as well as more precise spectroscopy of various biochemical metabolic products in humans and animals are now possible.

Siemens Medical Solutions is one of the world's largest suppliers to the healthcare industry. The company is known for bringing together innovative medical technologies, healthcare information systems, management consulting, and support services, to help customers achieve tangible, sustainable, clinical and financial outcomes. From imaging systems for diagnosis, to therapy equipment for treatment, to molecular medicine to hearing instruments and beyond, Siemens innovations contribute to the health and well-being of people across the globe, while improving operational efficiencies and optimizing workflow in hospitals, clinics, home health agencies, and doctors' offices. Recent acquisitions in the area of in-vitro diagnostics – such as Diagnostic Products Corporation – mark a significant milestone for Siemens as it becomes the first full service diagnostics company. Employing approximately 36,000 people worldwide and operating in more than 130 countries, Siemens Medical Solutions reported sales of 8.23 billion EUR, orders of 9.33 billion EUR and group profit of 1,06 billion EUR for fiscal 2006 (preliminary figures). Further information can be found under: <http://www.siemens.com/medical>