SHIMADZU
Excellence in Science

functional Near-Infrared Spectroscopy System for Research

— Examples in the Automotive and Transportation Equipment Fields —

Functional near-infrared spectroscopy (fNIRS), which uses light to visualize the activity of living organisms, measures brain activity safely and in a more natural state. Consequently, it is being used in a wide range of applications, including healthcare, psychology, education, cognitive science, and engineering.

Features

Brain functions can be measured in a posture and environment that closely approximates everyday life.
Two models, applicable to different research applications/environments, are available.

functional Near-Infrared Spectroscopy System for Research

LABNIRS

labnirs

- This is a laboratory model designed for a wide variety of basic research fields.
- A broad range of measurement regions can be customized depending on experimental conditions.

Portable functional Near-Infrared Spectroscopy System for Research

LIGHTNIRS

lightnirs

- The portable model is ideal for field research.
- Expands the possibilities for measuring brain function in a diverse range of applications and research fields.

Expansion Holder

The expansion holder provides even more freedom for selecting measurement areas.

Type A	Type B
For mainly measuring frontal brain areas	For measuring the frontal, temporal, parietal, and occipital areas

Measurement Principle

Brain activity at the surface of the brain is visualized in real time by shining near infrared light, which readily penetrates biological tissue, onto the head and then detecting a portion of that light that is reflected, as it is scattered and absorbed within the body.

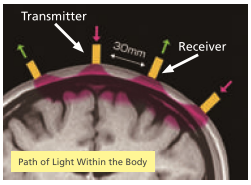
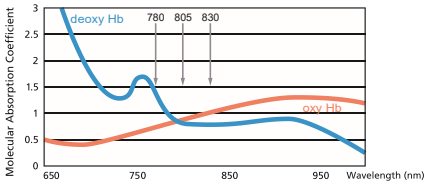
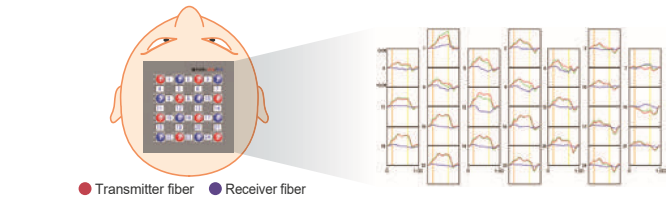


Illustration of Light Propagation



Absorption Spectrum of Hemoglobin



● Transmitter fiber ● Receiver fiber

Example of Fiber-Optic Array Configuration (Total 24 Channels)

Trend Graph of Each Channel

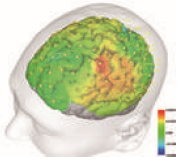
Interpolation Process (2D Image)

Color Display of Each Channel

How to create a 2D image of time-series data

Main Applications

- Drug discovery and medical research:
  Mental illness, neuroscience, drug discovery research, etc.
- Rehabilitation research:
  Exercise therapy, occupational therapy, speech/hearing, etc.
- Industrial applications:
  Neuromarketing, etc.
- Basic research:
  Brain functional network research, multimodality research, etc.
- Information engineering:
  Robotics, ergonomics, kansei engineering, etc.
- Education and psychology:
  Cognitive psychology, social psychology, developmental psychology, etc.



Example of Overlay on MRI Image

Examples of Brain Function Research Related to Humans and Automobiles

Measuring Brain Function During Driving

Evaluating Task Loads During Driving

K. Yanagisawa et al. (2012). "Measurement of driver's brain function by using NIRS (Evaluation of reduction in driver's workload by driving assistance system)" The Transactions of Human Interface Society 14(1-4): 209-217. (In Japanese with English abstract)

Brain Function for Left and Right Curves

N. Oka et al. (2015). "Greater Activity in the Frontal Cortex on Left Curves: A Vector-Based fNIRS Study of Left and Right Curve Driving." PLoS One 10(5): e0127594.

Relationship Between Driving Speed and Brain Activity

K. Yoshino et al. (2013). "Correlation of prefrontal cortical activation with changing vehicle speeds in actual driving: a vector-based functional near-infrared spectroscopy study." Frontiers in Human Neuroscience 7(895): 1-9.

Evaluating Occupant Space and Comfort

Scents

H. Kanal et al. (2008) "Influence on Heart Rate Variability and Neuronal Activity by Inhalation of Fragrance with Different Preference." Kansei Engineering International Journal 7(3), 469-476. In Japanese with English abstract

Lighting

K. Mori (2012). "Light/Sound/Brain: Toward the Fusion of Neuroscience and Media Art." Bulletin of the Institute for Interdisciplinary Studies of Culture, Doshisha Women's College of Liberal Arts. 29: 1-15. In Japanese with English Abstract

Music

M. Shimo et al. (2008) "Evaluation of the level of "music relaxation" utilizing hemo-dynamics by near-infra-red-spectroscopy." Bulletin of the faculty of education, Chiba University, 56 343-348. In Japanese with English abstract

Sensation of Hot and Cold

Lei Hou et al. (2015). "Analysis of brain activity during local hot-cold stimulus using near-infrared spectroscopy (Analysis of brain activity during pain stimulus by cold stimulus)." Transactions of the JSME (in Japanese) 81(830). In Japanese with English abstract

Sense of Happiness

S. Oonishi et al. (2014). "Influence of subjective happiness on the prefrontal brain activity: an fNIRS study." Adv ExpMed Biol 812: 287-293.

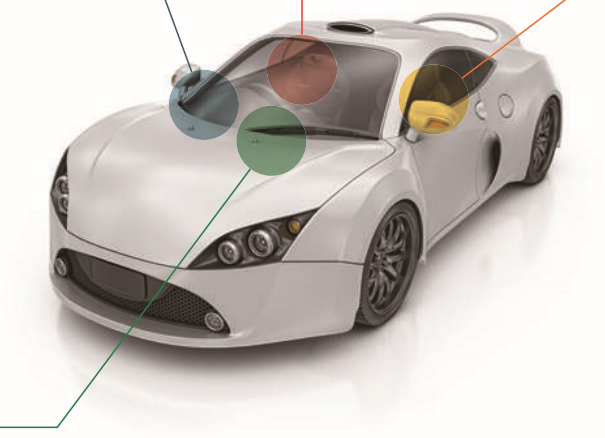
Operability and Driver Attention

Evaluation of Driver Interruptibility

T. Tanaka and K. Fujita (2009). "Discussion on Duration of Uninterruptibility Reduction at Focused Application-Switching." CHINOU TO JOUHO (intelligence and information) 21, 827-836. In Japanese

Switching Attention

N. Yamaguchi et al. (2011). "The Activation in a Prefrontal Area at the Time of Alternating Tasks Enforcement Related to the Age, Performance and Task -A Study in the Use of Near-Infrared Spectroscopy-" Annual Reports of Human Health Sciences, Graduate School of Medicine, Kyoto University: health science 7: 9-16. In Japanese with English abstract



Pleasant and Unpleasant Stimuli

Y. Hoshi et al. (2011). "Recognition of Human Emotions from Cerebral Blood Flow Changes in the Frontal Region: A Study with Event-Related Near-Infrared Spectroscopy." Neuroimage, 21(2), e04-101.

Safety and Proficiency

Study of Probability of Driving Again After Brain Injury

S. Watanabe et al. (2011). "Cerebral Activation Patterns of Patients Operating a Driving Simulator after Brain Injury: A Functional Near-infrared Spectroscopy Study." Japanese Journal of Occupational Medicine and Traumatology 59(5), 238-244. In Japanese with English abstract

Task Proficiency in Virtual Space

Lei HOU, K. Watanuki. (2012). "Measurement of Brain Activity under Virtual Reality Skills Training Using Near-Infrared Spectroscopy." Journal of Advanced Mechanical Design, Systems, and Manufacturing 6(1): 168-178.

Text-Entry Proficiency

S. Kotani et al. (2011). "Proficiency evaluation of three Japanese Input Methods using an eye-controlled communication device for users with disabilities." 2011 IEEE International Conference on Systems, Man, and Cybernetics (SMC), 3230 - 3235.

Related Research

Trains

T. Kojima et al. (2007). "Measurement of Brain Function of Train Driver Using Functional Near-infrared Spectroscopy (fNIRS)." The Japanese Journal of Ergonomics 43(4): 193-200. In Japanese with English abstract

Development of Smart Glasses

O .Amft et al. (2015). "Making regular eyeglasses smart." Pervasive Computing, IEEE 14(3): 32-43.

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