YINGCHI

Real-time Spectral Monitoring for Ultra-Precise Cerebral Oxygenation

Real-time spectral monitoring | Laser/LED sources | Flexible whole-brain coverage | short distance channel interference regression
Seamless BCI Integration

Near-Infrared Functional Brain Imaging System

NIRS Ultra | NIRS Revo | Actus Pro | Actus Lab | HemoX Pro | HemoX Lab

fNIRS——" Your Portable Optical MRI"

Functional near-infrared spectroscopy (fNIRS) is a non-invasive optical brain monitoring technique which uses different wavelengths of near infrared light(650-950nm) to measure changes in blood oxygenation and deoxygenation (i.e., the hemodynamic response) across the cortex, which is often considered to be a correlate of brain activation.

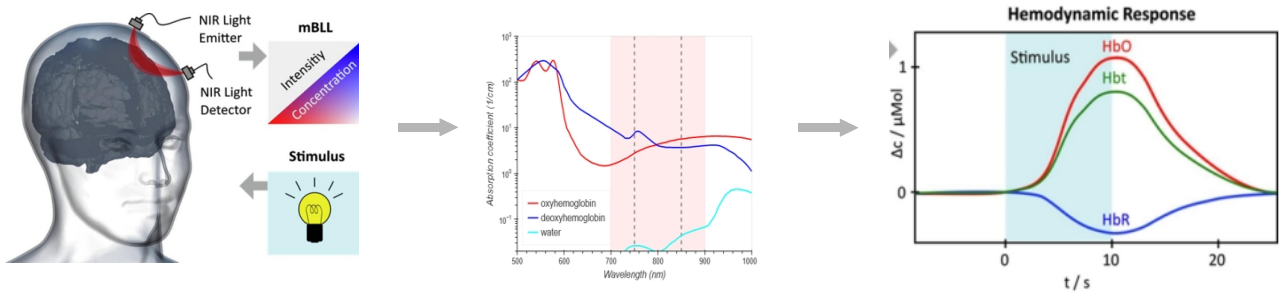


Figure 1: Illustration of the Near-Infrared (NIR) Principle [1]

With fNIRS, specialized optodes are placed on the head, near-infrared light is then emitted through one set of optodes (sources) and noninvasively penetrating the scalp and reaching the cerebral cortex. Light that is not absorbed by the cortex is measured by surrounding detector optodes. By utilizing the modified Beer-Lambert law, the attenuation of light can be determined from the incident and outgoing light information, thus enabling real-time, non-invasive detection of the hemodynamics of the cerebral cortex that occurs in response to neural activity.

Advantages of fNIRS

As a noninvasive functional brain imaging solution, fNIRS offers easy operation, low operational costs, strong interference resistance, and excellent compatibility. It enables flexible brain monitoring across a wide range of real-world scenarios.

Type	Temporal Resolution	Spatial Resolution	Resistance to EM Interference	Mobility	Resistance to Motion Artifacts	Experimental Environment	Experimental Efficiency	Cost
fMRI	Low (≈1–2 s)	High (≈1–3 mm)	Low	requires scanner room	Low	Restricted, lab-based scanner room	Low (long setup & scanning time)	High
fNIRS	Moderate (≈100 ms)	Moderate (≈1–3 cm)	High	wearable	High	Flexible, naturalistic settings	High (setup & measurement fast)	Low
EEG	High (≈1 ms)	Low (≈1cm)	Low	wearable	Low	lab-based room	preparation required, hair washing	Low

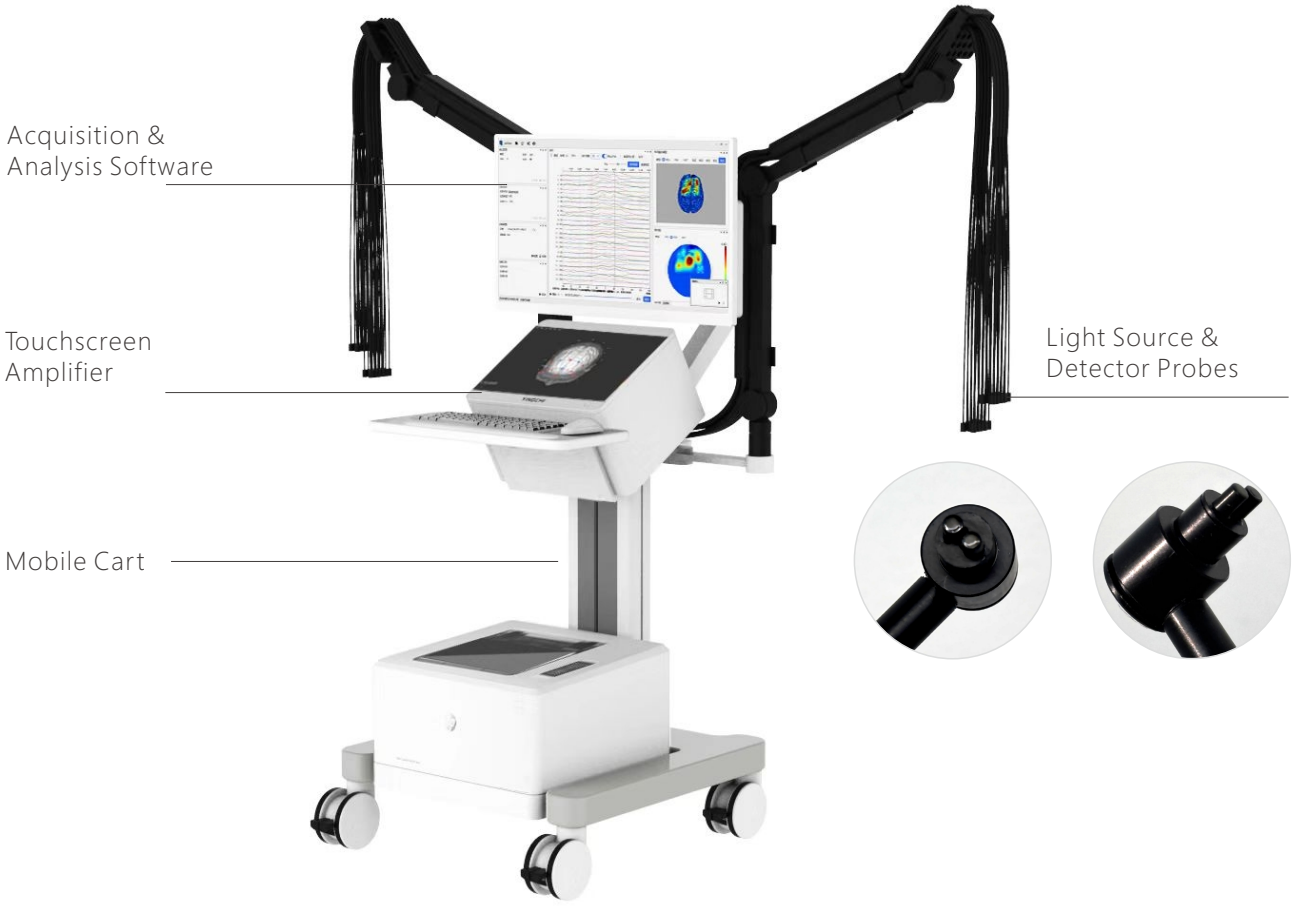
1. Soekadar, S. R., Kohl, S. H., Mihara, M., & von Lühmann, A. (2021). Optical brain imaging and its application to neurofeedback. NeuroImage: Clinical, 30, 102577.

Outstanding SNR for Accurate Cortical Mapping

Comprehensive Safety and Performance Features

Optimized Light Source	Mainstream Light Sources ——Laser: Provides stable, highly monochromatic, and deeply penetrating light. LED: Fixed wavelength and stable power output.
Enhanced Detection	APD Detectors—— High sensitivity for capturing subtle hemodynamic changes, ensuring signal fidelity.
Interference Removal	Short-distance channel —— Eliminates superficial interference to extract true cortical signals.
Comfortable & Stable Wear	Zero-Pressure Probes—— Ensure stable, comfortable, and long-term signal contact.
Software Validation	Real-Time Spectral Metrics —— Dynamically monitor signal authenticity and detect artifacts early.
Millisecond-Level Cross-Device Synchronization	LSL Streaming —— Enables millisecond-level synchronization with other modalities (EEG, TMS, behavioral data) for seamless cross-device integration.

Stationary Brain Imaging — Bringing High-Precision Brain Mapping to Your Lab



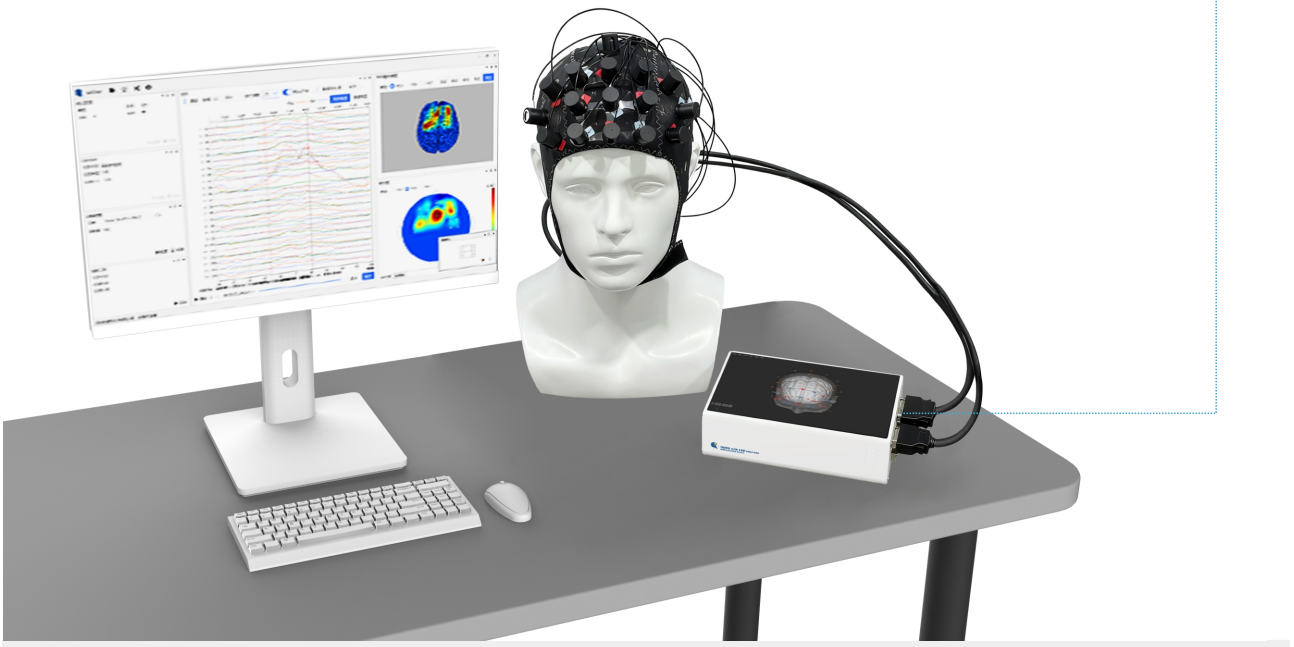
- Laser / LED Sources
- High-Precision APD Detectors
- Ultra-High Data Quality
- Dual-tip optodes for faster and more sensitive detection
- Modular Architecture, Flexible configuration
- Full-Brain Flexible Layout

Number of Sources	4 per module, upgradable to 64 sources
Number of Detectors	4 per module, upgradable to 64 detectors
Wavelengths	Dual
Source Type	LED / Laser selectable
Measurement Cap	Multi-Size
Detector Type	APD
LSL	Yes
Multimodal Compatibility	EEG, TES, Eye Tracking, fMRI, MEG, TMS
Hyperscanning	Yes
short distance channel	Yes

Portable Brain Imaging — Anywhere, Anytime

Slim Touchscreen Amplifier

One-Touch Data Acquisition and Real-Time Visualization, No PC Needed



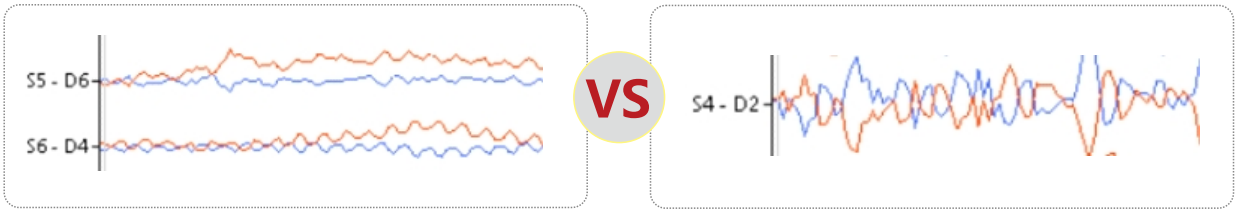
- Compact LED Source
- Ultra-High Data Quality
- Flexible Full-Brain Layout
- Up to 5 Devices Can Be Daisy-Chained
- Dual-tip optodes Design, Faster, more sensitive detection
- Modular Architecture, Flexible configuration

Number of Sources	8 per module, upgradable to 16(single device)
Number of Detectors	8 per module, upgradable to 16(single device)
Wavelengths	Dual
Source Type	LED
Measurement Cap	Multi-Size
Detector Type	SiPD
LSL	Yes
Spectroscopy Technology	Continuous Wave (CW)
Multimodal Compatibility	EEG, TES, Eye Tracking
Hyperscanning	Yes
short distance channel	Yes
Device Cascading	Yes

Real-Time Spectral Metrics — Detect True Signals, Eliminate Artifacts

A simple "green channel" indicator is not enough.

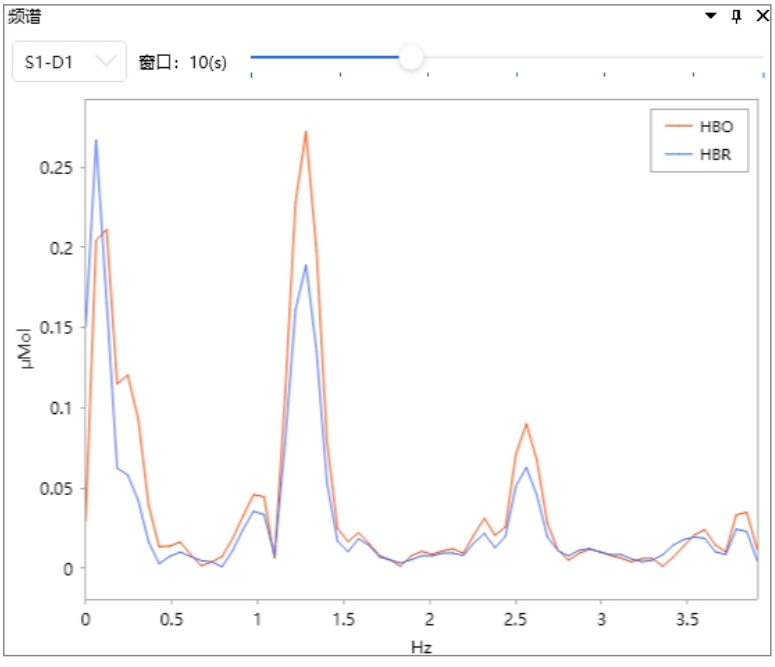
Extensive data shows that certain signal fluctuations can be dominated by non-physiological noise (e.g., electrical noise, motion artifacts), constituting "false signals."



Ultra-Clean, High-Quality fNIRS Signals

High-Noise fNIRS Signals

Heartbeat (~1 Hz) and Respiration (~0.25 Hz) Rhythms — The Physiological Fingerprint Ensuring fNIRS Signal Authenticity.



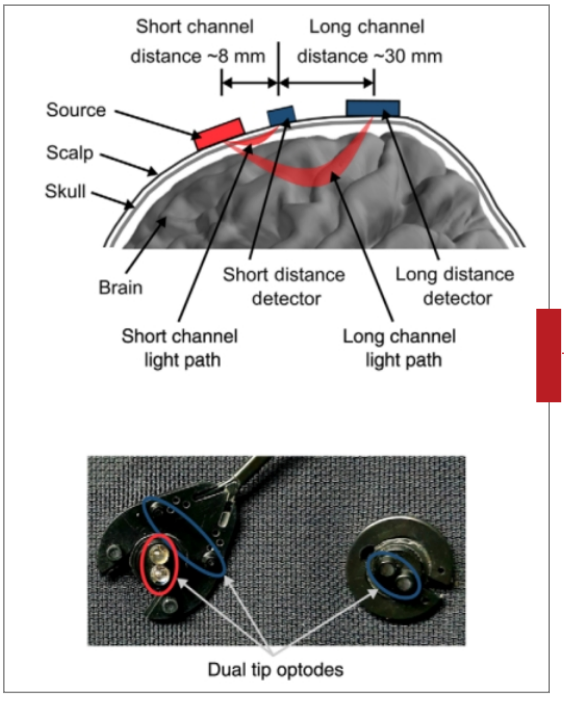
What Our Innovative Real-Time Spectral Monitoring Can Do

- Ensures signals reflect genuine physiological blood oxygen changes.
- Evaluates stability and quality for accurate brain state assessment.
- Multi-view display (spectrogram + waveform) offers comprehensive insights into cerebral blood flow and functional activity.

short distance channel: The Gold Standard for Minimizing Extracerebral Signals

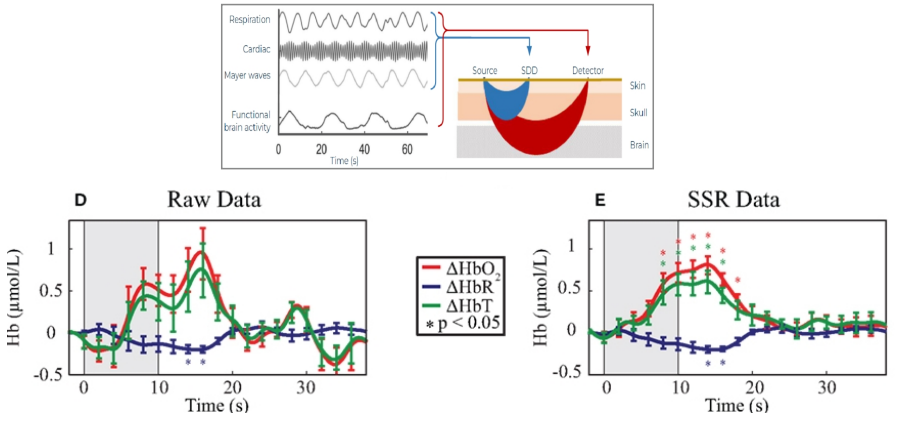
Just as systemic physiological noise—like respiration—can significantly affect fMRI measurements, superficial blood flow signals in fNIRS often obscure true neural activation.

By simultaneously recording scalp and superficial tissue signals with short-distance channels, non-neuronal components can be modeled and regressed out, providing the cleanest, most reliable brain signals.



- Short-Distance Detection — Only 8 mm from the Light Source
- Capture Superficial Signals from Scalp and Skull
- Regress Out Artifacts and Physiological Noise
- Recover "Clean Brain Signals" Reflecting True Neural Activation

Short Distance Channel Regression — Isolation True Cortical Signals from Superficial Interference



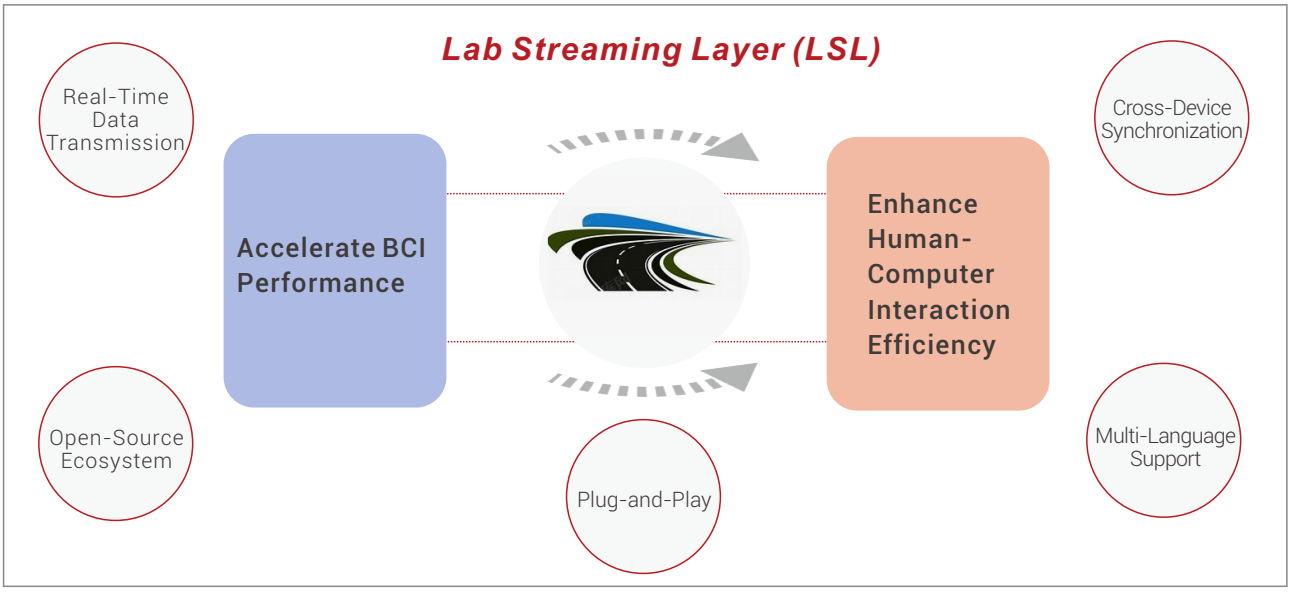
Brigadoi S, Cooper RJ. How short is short? Optimum source–detector distance for short-separation channels in functional near-infrared spectroscopy. Neurophotonics. 2015; 2(2):025005-. https://doi.org/10.1117/1.NPh.2.2.025005 PMID: 26158009.

Gregg, N. M., White, B. R., Zeff, B. W., Berger, A. J., & Culver, J. P. (2010). Brain specificity of diffuse optical imaging: improvements from superficial signal regression and tomography. Frontiers in neuroenergetics, 2, 14.

LSL Precision Synchronization — Enabling High-Speed Brain-Computer Interfaces

Powered by the Lab Streaming Layer (LSL) protocol, our software supports external trigger inputs and real-time fNIRS data streaming to multiple third-party platforms.

With a bidirectional and open architecture, the system integrates effortlessly into existing research ecosystems—no custom interface required—offering unmatched flexibility and expandability for experimental design.



LSL: The Key to Seamless, Real-Time Data Integration

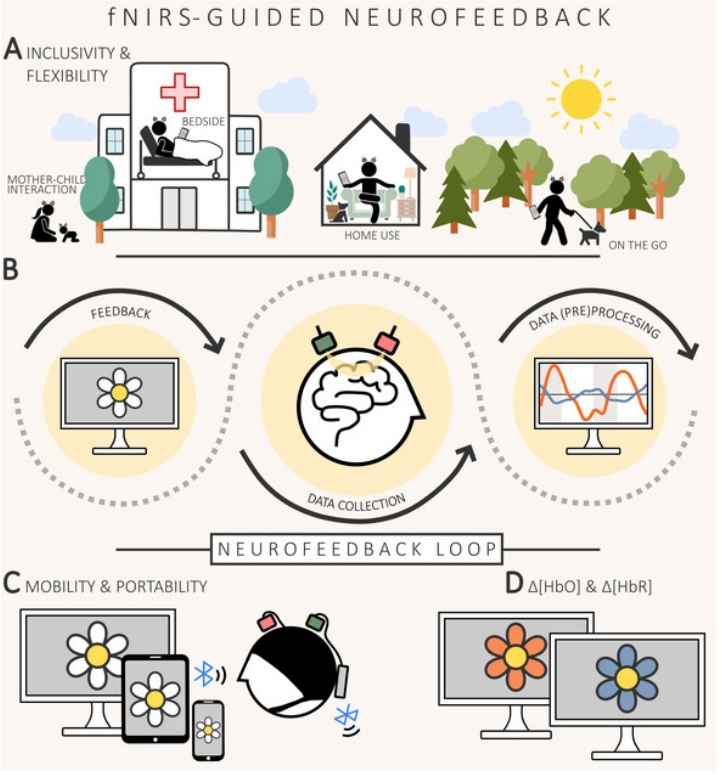
- LSL Real-Time Streaming — Turning fNIRS from a Recording Tool into an Interactive Brain Interface
- Accelerates BCI: Rapid, accurate conversion of brain intent into commands for real-world applications.
- Supports Closed-Loop Neurofeedback: Automated signal acquisition → decoding → behavioral feedback.

fNIRS Neurofeedback — Train Your Brain, Enhance Your Focus

We offer a "Attention Enhancement" Neurofeedback Suite

Neurofeedback delivers real-time feedback on brain activity, helping individuals train and optimize their neural performance.

Thanks to its inclusivity and flexibility, fNIRS neurofeedback is set to become a powerful alternative to EEG- and fMRI-based neurofeedback, with clear advantages in bedside, home-based, and mobile applications.

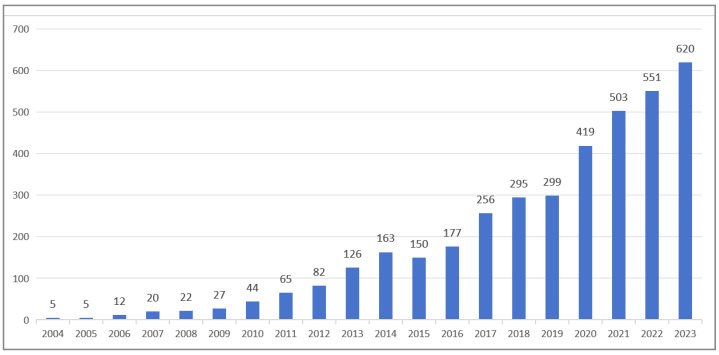


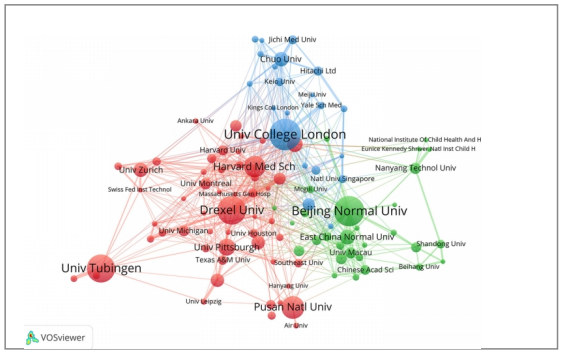
Neurofeedback Diagram [1]

The "Attention Enhancement" Neurofeedback Suite presents your attention level in a clock-dial format: the pointer moves smoothly when focused and pauses when distracted. Through this visual, real-time feedback, users can clearly perceive fluctuations in their attention and improve their ability to self-regulate focus.

1.Klein, F., Kohl, S. H., Lührs, M., Mehler, D. M., & Sorger, B. (2024). From lab to life: challenges and perspectives of fNIRS for haemodynamic-based neurofeedback in real-world environments. Philosophical Transactions B, 379(1915), 20230087.

Application





The number of fNIRS publications and the publishing institutions[1]

fNIRS is widely applied in classic and emerging academic research fields.

- Cognitive neuroscience
- Hyperscanning
- Psychological education
- Rehabilitation
- Traffic and drive
- BCI

Top 20 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2013 - 2023
human brain	2013	12.62	2013	2017	
optical topography	2013	10.78	2013	2015	
near-infrared spectroscopy	2013	7.48	2013	2014	
cerebral blood flow	2013	6.19	2013	2014	
cognitive neuroscience	2013	5.73	2013	2015	
adult head	2013	5.58	2013	2015	
stimuli	2013	5.51	2013	2017	
human	2013	5.22	2013	2017	
independent component analysis	2013	4.64	2013	2016	
diffuse optical tomography	2014	5.96	2014	2015	
bold signal	2014	4.84	2014	2015	
evoked potential	2015	5.5	2015	2017	
motion artifact	2015	4.64	2015	2018	
visual cortex	2016	6.6	2016	2017	
neural basis	2016	4.86	2016	2020	
optical pathlength	2014	5.04	2018	2020	
task analysis	2020	6.83	2020	2023	
selection	2020	4.95	2020	2021	
major depressive disorder	2018	5.18	2021	2023	
scale	2019	4.83	2021	2023	

Hot Keyword[1]

The development trend of fNIRS

- From single fNIRS research to multi-modal research.
- From single brain region to full-brain coverage.
- Personalized and precise clinical application.
- Interdisciplinary research.
- From task-state activation to a dual emphasis on task-state/rest-state brain activation/brain network.
- Expansion of research depth and breadth through technologies such as hyperscanning.

1. Zhang, J., Yu, T., Wang, M., Zhang, Y., Li, H., Chen, H., ... & Yan, L. (2023). Clinical applications of functional near-infrared spectroscopy in the past decade: a bibliometric study. Applied Spectroscopy Reviews, 1-27. DOI: 10.1080/05704928.2023.2268416.

Trending Research Areas: Hyperscanning, from Single brain to Multiple brains

fNIRS is one of the typical tools in the field of "Hyperscanning"

- Movement-Friendly – Supports natural interactions without compromising data quality.
- Real-World Social Interaction – Enables face-to-face communication, joint gaze, and outdoor recordings.
- Stable Multi-Person Synchronization – Ensures reliable hyperscanning triggers across participants.
- Flexible & Inclusive – Suitable for children, elderly, and clinical population.
- Brain Coverage – Monitor key networks for social cognition and interactive brain dynamics.

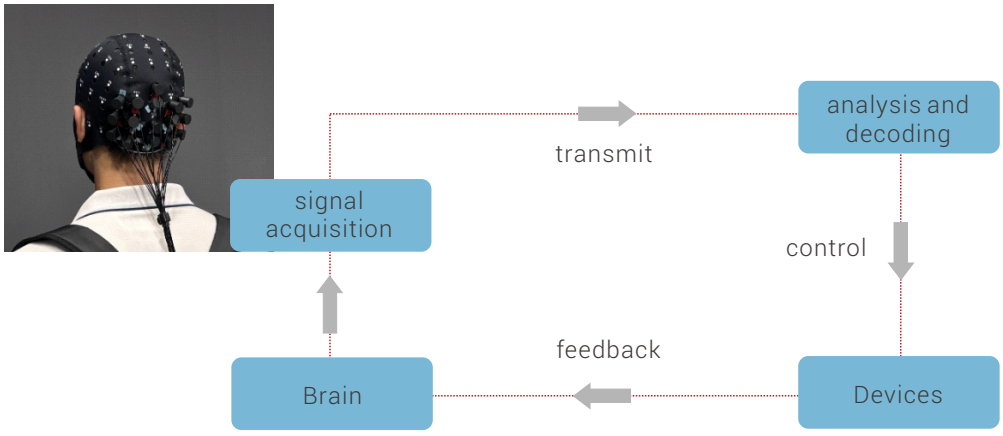
Hyperscanning research field

Classroom Interaction	Real-time monitoring teaching and attention synchronization
Parent-child relationship	Observation of brain synchronization in intimate relationships
Team decision-making and collaborative tasks	Analysis of Coupling among Multiple Brains
Musical ensemble / Dance coordination	The neural mechanism for synchronizing rhythm with movements
Therapist-Patient Empathy Study	Analysis of the brain-to-brain synchronization of empathy resonance

1.Liu, T., & Pelowski, M. (2014). Clarifying the interaction types in two-person neuroscience research. Frontiers in human neuroscience, 8, 276.

Trending Research Areas: BCI, facilitating cognitive enhancement and neural rehabilitation

A complete BCI system involves signal acquisition, decoding, device control, and closed-loop feedback, with signal acquisition as the core determinant of performance.
fNIRS-based BCIs detect cortical blood oxygen changes. During imagined movements, specific brain regions show characteristic HbO/HbR patterns, which the system decodes into control commands.



fNIRS technology from YingChi provides a "safe, portable and stable" method for obtaining brain signals for brain-computer interfaces. It is particularly suitable for clinical rehabilitation and daily applications, helping to achieve more intelligent and reliable human-computer interaction.

Motion Imagery Control / Rehabilitation and Assisted Communication [1]

1.Khan, R. A., Naseer, N., Qureshi, N. K., Noori, F. M., Nazeer, H., & Khan, M. U. (2018). fNIRS-based Neurorobotic Interface for gait rehabilitation. Journal of neuroengineering and rehabilitation, 15(1), 7.

Trending Research Areas: Multimodal Brain Mapping, From Signals to Behavior

Multimodal technologies integrate EEG, TMS, tES, and psychological–behavioral methods, combining neural recording and modulation to reveal the brain's dynamic networks and provide a full-chain solution.

Technical Value

- Integrated observation from neural mechanisms to behavioral performance.
- Cross-validation of signals and results.
- Synchronized data acquisition and joint analysis (supports LSL / trigger synchronization).
- Applicable to education, rehabilitation, brain–computer interfaces, psychology, and sports science research.

The multimodal application of fNIRS is becoming a key driving force in cognitive neuroscience and clinical translation.

Cognitive research: fNIRS + EEG

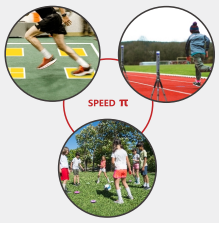
Reveal the complete spatiotemporal picture of brain dynamic activities, such as when and which brain regions break down the acoustic components of speech in infants.

Clinical rehabilitation: fNIRS + TMS

Assessment and tracking of brain functional remodeling during the rehabilitation process.

Development and Education: fNIRS + Psychological Testing System

Focusing on the cognitive and learning mechanisms of children and adolescents, assists researchers in comprehensively analyzing individual cognition.



Competitive Training and Sports Rehabilitation: fNIRS + Speed-Agility Training System

Capture the activation patterns of the cortex in the "high-intensity action + decision response" process of the brain; quantify the neural plasticity changes.

Building a Smart, Integrated Brain Science Platform

We provide EEG, fNIRS, TMS, computerized psychological testing, and speed–agility training systems, achieving full integration and seamless multimodal signal acquisition. We are committed to building comprehensive brain science solutions linking neural signals and behavioral performance.

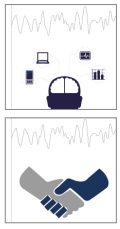
fNIRS + EEG: Complementary Signals

Synchronized acquisition enables dual-dimensional "electrical–hemodynamic" monitoring, enhancing data reliability.

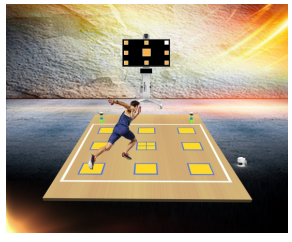
fNIRS+ TMS/tES: Causal Research

Noninvasive stimulation techniques combined with real-time hemodynamic recording, forming a "stimulation–response–feedback" closed loop.

fNIRS+psychological/speed–agility training: Integration of Psychology and Behavior



Building a Full-Link "Brain– Mind– Behavior" Evidence Chain.



Service/Support——We Care for You

We conduct international Webinars broadcast via “Brain Hacker”. Brain Hacker is an audio-visual live-streaming platform allowing us to share forefront knowledge, new technologies and clinical developments in neuromodulation.

Our webinars are presentations from invited global brain science experts to educate, promote, acknowledge and inform on current trends, break-throughs, achievements, research and clinical applications of TMS.

Social Media

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