# Monitoring Prefrontal Emotion-Related Activation Using a Spectroscopy Platform

Emotional dysregulation is an increasingly recognized public health issue, contributing to the growing burden of mood and anxiety disorders. Chronic psychological stress induces long-lasting changes in the brain, particularly affecting the prefrontal cortex (PFC), which plays a crucial role in regulating emotions, cognitive control, and decision-making processes. Alterations in PFC function are closely linked to the development of depression, anxiety, and stress-related conditions.

Existing neuroimaging methods such as fMRI provide valuable insights but remain costly, infrastructure-dependent, and unsuitable for frequent or real-time monitoring. Alternative optical approaches such as diffuse correlation spectroscopy (DCS) and near-infrared spectroscopy (NIRS) offer non-invasive measurements of cerebral blood flow (CBF), but are limited by poor spatial resolution, low sensitivity to deep cortical layers, and susceptibility to motion artifacts. Advanced techniques like time-domain diffuse correlation spectroscopy (TD-DCS) and interferometric near-infrared spectroscopy (iNIRS) improve precision but require complex hardware, making them impractical for wider clinical use.

To overcome those limitations we propose parallel detection of multiple channels through interferometric speckle contrast optical spectroscopy (iSCOS).
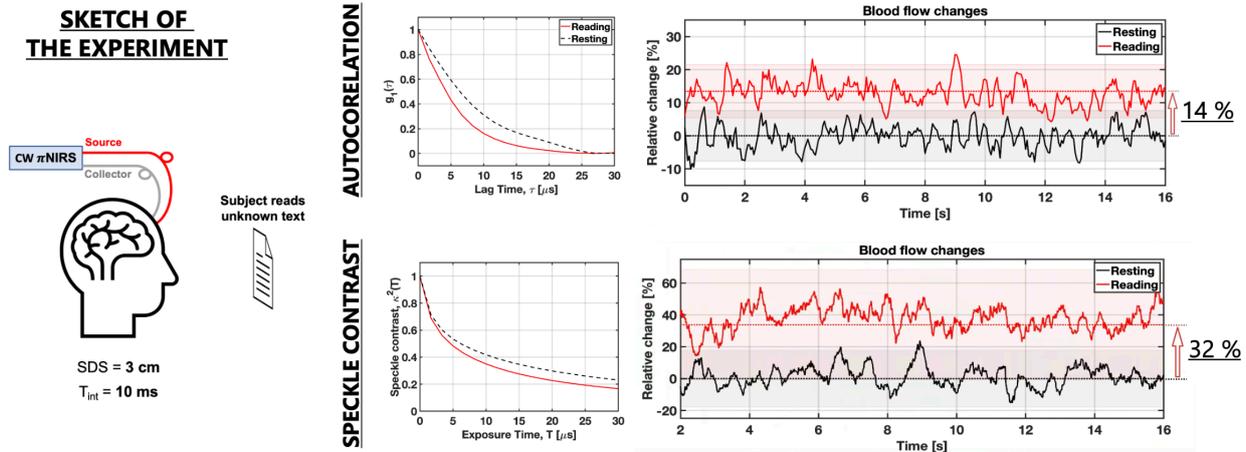
Interferometric speckle contrast optical spectroscopy (iSCOS) uses two-dimensional camera, where each pixel serves as an individual detection channel. The complex signal on each pixel will act like a single detector in iNIRS technique, which will allow us to obtain data ten times shorter than in other approaches.

Two distinct processing methods can be applied to speckle patterns projected onto two-dimensional detector - temporal autocorrelation and spatial speckle contrast analysis. We examined it in vivo during prefrontal activation of a healthy volunteer. Examination of the plots reveals a distinctive feature in the spatial speckle contrast, marked by a bigger separation between the resting and reading states. **This observation highlights the potential of speckle contrast analysis in capturing dynamic changes in cerebral blood flow.**