**Supplementary Material**

The ‘*Real Time Monitor*’ tab of the GUI displays the real-time CBF, oxygen extraction fraction (OEF) and cerebral metabolic rate of oxygen (CMRO2) values at both a short-term (5-minute) and a long-term (2-hour) time window (Figure 1-C). Specifically, the software employs a Python script on the background to compute the cerebral physiology parameters from the diffuse optics models and the DOS/DCS data (Hunter, 2007; Newville et al., 2014; Oliphant, 2007). First, the software analyzes the FD-DOS data using a standard semi-infinite model of the head to recover the absorption and scattering coefficients ($μ\_{a}$ and $μ\_{s}^{'}$, respectively) (T. Durduran et al., 2010; Shang et al., 2017). From the absorption coefficient, we can recover the oxy- and deoxy-hemoglobin concentration with:

 $μ\_{a}(λ)=ε\_{HbO}\left(λ\right)HbO+ε\_{HbR}\left(λ\right)HbR+0.75μ\_{a}\_{H\_{2}O}\left(λ\right)$,

where we assumed a 75% water content in tissue. Then, from HbO and HbR we can compute the oxygen extraction fraction (OEF) as (Culver et al., 2003; Jain et al., 2014):

$OEF \~ 1.33 \left(1 –\frac{HbO}{HbO + HbR}\right)$.

For simplicity, we assumed that the oxygen saturation of the blood is 100% and assumed that the percentage of blood volume in the venous compartments is 75% (Jain et al., 2014).

To recover an index of CBF, we used the optical coefficients recovered from the FD-DOS data along with a semi-infinite model of the head to fit the DCS autocorrelation curves (T. Durduran et al., 2010; Turgut Durduran & Yodh, 2014; Yu, 2012). Since we are mostly interested in the cerebral physiological changes, the GUI only displays the largest source-detector separation, as it has the highest sensitivity to the cerebral tissues. Finally, we combine the CBF and oxygenation measurements to derive the cerebral metabolic rate of oxygen (CMRO2) (Valabrègue et al., 2003). The CMRO2 is computed using a steady state model and can be written as $CMRO\_{2}∝ OEF×CBF$.

**References**

Culver, J. P., Durduran, T., Furuya, D., Cheung, C., Greenberg, J. H., & Yodh, A. G. (2003). Diffuse optical tomography of cerebral blood flow, oxygenation, and metabolism in rat during focal ischemia. *Journal of Cerebral Blood Flow and Metabolism*, *23*(8), 911–924. https://doi.org/10.1097/01.WCB.0000076703.71231.BB

Durduran, T., Choe, R., Baker, W. B., & Yodh, A. G. (2010). Diffuse optics for tissue monitoring and tomography. *Reports on Progress in Physics*, *73*(7). https://doi.org/10.1088/0034-4885/73/7/076701

Durduran, Turgut, & Yodh, A. G. (2014). Diffuse correlation spectroscopy for non-invasive, micro-vascular cerebral blood flow measurement. *NeuroImage*, *85*, 5163. https://doi.org/10.1016/j.neuroimage.2013.06.017

Hunter, J. D. (2007). Matplotlib: A 2D Graphics Environment. *Computing in Science & Engineering*, *9*(3), 90–95. https://doi.org/10.1109/MCSE.2007.55

Jain, V., Buckley, E. M., Licht, D. J., Lynch, J. M., Schwab, P. J., Naim, M. Y., Lavin, N. A., Nicolson, S. C., Montenegro, L. M., Yodh, A. G., & Wehrli, F. W. (2014). Cerebral oxygen metabolism in neonates with congenital heart disease quantified by MRI and optics. *Journal of Cerebral Blood Flow and Metabolism*, *34*(3), 380–388. https://doi.org/10.1038/jcbfm.2013.214

Newville, M., Ingargiola, A., Stensitzki, T., & Allen, D. B. (2014). LMFIT: Non-Linear Least-Square Minimization and Curve-Fitting for Python. *Zenodo*. https://doi.org/10.5281/ZENODO.11813

Oliphant, T. E. (2007). SciPy: Open source scientific tools for Python. *Computing in Science and Engineering*. https://doi.org/10.1109/MCSE.2007.58

Shang, Y., Li, T., & Yu, G. (2017). Clinical applications of near-infrared diffuse correlation spectroscopy and tomography for tissue blood flow monitoring and imaging. *Physiological Measurement*, *38*(4), R1--R26. https://doi.org/10.1088/1361-6579/aa60b7

Valabrègue, R., Aubert, A., Burger, J., Bittoun, J., & Costalat, R. (2003). Relation between Cerebral Blood Flow and Metabolism Explained by a Model of Oxygen Exchange. *Journal of Cerebral Blood Flow and Metabolism*, *23*(5), 536–545. https://doi.org/10.1097/01.WCB.0000055178.31872.38

Yu, G. (2012). Diffuse Correlation Spectroscopy (DCS): A Diagnostic Tool for Assessing Tissue Blood Flow in Vascular-Related Diseases and Therapies. *Current Medical Imaging Reviews*, *8*(3), 194–210. https://doi.org/10.2174/157340512803759875