

# Shining to Traditional Medicine

Ting Li<sup>1</sup> and Chenyang Gao<sup>1</sup>

<sup>1</sup> *Institute of Biomedical Engineering, Chinese Academy of Medical Sciences & Peking Union Medical College, China*

liting@bme.cams.cn

## ABSTRACT

Traditional Chinese Medicine (TCM) has a long-standing history of employing therapies like acupuncture and cupping for treating various ailments such as knee pain, lower back pain, and stress urinary incontinence. Despite its widespread use, the physiological basis of these therapies remains relatively underexplored. To address this gap, this study integrates near-infrared spectroscopy (NIRS) in both acupuncture and cupping therapies to provide real-time physiological observations, thus demystifying these "black box" models.

We designed hollow NIRS probes with dual detection channels for real-time measurements during acupuncture at specific acupoints like "Xuehai." The probes recorded significant and consistent increases in oxy-hemoglobin (HbO), deoxy-hemoglobin (Hb), and total blood volume (HbT) around the acupoint during treatment, which reverted to baseline after needle removal. The results indicated that acupuncture induces tissue vasodilation and enhances oxygen consumption, shedding light on its underlying mechanisms. A subject fainted during an acupuncture experiment, with recorded hemodynamic alterations showing a significant increase in Hb and decrease in HbO, indicating tissue deoxidization about 1 minute before fainting. This suggests that NIRS may have potential as an early predictor of fainting. Our developed NIRS probes can be integrated with laser acupuncture, thereby achieving a unified approach to diagnosis and treatment.

For cupping therapy, leveraging the Visible Chinese Human dataset and 3D Monte Carlo modeling, we developed a specialized NIRS instrument integrated into the cupping cup and a second external probe encircling the treatment area. Our device facilitated real-time tracking of changes in oxygenated hemoglobin ([HbO<sub>2</sub>]), deoxygenated hemoglobin ([Hb]), and total hemoglobin ([tHb]) during and post-treatment. In vivo experiments revealed significant hemodynamic alterations adjacent to and within the cupping site, implying blood oxygen redistribution. Our experiment included cupping on the shoulder blade and lower back. The results from the lower back cupping experiment showed a significant difference in blood oxygen changes between patients with lower back pain and healthy individuals, demonstrating the potential of this technology in the clinical application of cupping.

Our innovative NIRS-based apparatuses hold promise for elucidating the physiological mechanisms underpinning acupuncture and cupping. Moreover, they offer real-time monitoring capabilities that could enable adjustments during therapy, potentially improving treatment efficacy. This groundbreaking study not only augments our understanding of TCM but also pioneers new interdisciplinary avenues—specifically, TCM photonics.