Ryerson University Faculty of Science

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Advances in Functional Brain Imaging: Ryerson Researchers Test a Proposed Hyperspectral Functional NIRS (fNIRS) System

How to make brain imaging more cost-effective and convenient? In the Department of Physics, Ryerson researchers, under the supervision of Dr. Vladislav Toronov, have undertaken a series of experiments to test a groundbreaking technological alternative to the traditional MRI.

Nosrati, supervised by Dr. Toronov, and her fellow researchers Kristin Vesely and Tom Schweizer wanted to check if fNIRS can detect event-related changes in the brain. Given the portability of fNIRS (systems can be strapped onto study participants' heads while they perform real-world tasks), they also added a highly practical aspect to these investigations. The team tested not only the efficacy of fNIRS, but simultaneously took the opportunity to explore the effects of distracted driving.

In the study, the team used Ryerson's in-house fNIRS system "based on a portable spectrometer with cooled CCD detector and a driving simulator with a fully functional steering wheel and foot pedals." They had 16 participants perform different driving tasks, then distracted them during driving conditions by asking general knowledge true/false questions.

Nosrati says, "We studied the brain function during complex driving tasks and assessed the impact of distraction during those tasks. We proposed a novel hyperspectral NIRS signal processing algorithm for accurate deconvolution of cytochrome-c-oxidase signal. We validated our results with functional MRI results. Our findings suggest that more complex driving tasks (non-distracted) deactivate the frontal regions of the brain while distractions during driving significantly activate those regions, which is in agreement with the functional MRI results."

Upon completion of this study, Nosrati and her fellow team members recently published their findings in the journal, Biomedical Optics Express, in a paper called, "Event-related changes of the prefrontal cortex oxygen delivery and metabolism during driving measured by hyperspectral fNIRS."

In summarizing the significance of the team's exploration, Nosrati says the proposed Ryerson hyperspectral NIRS system has a unique ability in real time monitoring of cerebral oxygen metabolism in practical situations – which is very useful for bedside measurement of brain activity. "Currently there is no available technique that provides such useful information."

While this latest Ryerson study involved 16 human participants (aged 22 to 32), Nosrati's team previously employed its proposed hyperspectral NIRS system on 14 pigs to monitor cerebral metabolism during cardiac arrest and CPR.

Nosrati, who is now pursuing her PhD at Ryerson, has enjoyed the opportunities Ryerson affords for collaboration with researchers at leading Toronto institutions including Sunnybrook Hospital and St. Michael's Hospital. She says, "The supportive and friendly environment of Ryerson is the first thing that comes to my mind whenever someone asks me about Ryerson."

Nosrati’s research was supported by an NSERC grant and an Ontario Graduate Scholarship.