REAL TIME MONITORING OF ELECTRIC FIELD VIA PHOTONIC SENSING FOR EFFECTIVE BRAIN-COMPUTER INTERFACE (BCI)

Ibrahim L. Olokodana[1], Saraju P. Mohanty[2], Elias Kougianos[3], Maurizio Manzo[4]
Smart Electronic Systems Laboratory,
Computer Science and Engineering,
University of North Texas,
Denton, TX 76207, USA.
Email: [1]ilo0008@unt.edu [2]saraju.mohanty@unt.edu [3]elias.kougianos@unt.edu [4]manzo.maurizio@unt.edu

Abstract: In Brain-Computer Interface (BCI) applications, it is important that the method of retrieving signals from the brain should not cause scalp irritation, is not excessively heavy, have long latency or any characteristics that further reduce the comfort level of the subject rather than improving it. Photonic sensing is an ideal candidate for satisfying these criteria while also creating a much more effective alternative to the traditional Electroencephalography (EEG). Figure 1 is a succinct schematic representation of the proposed Brain Computer Interface (BCI) system architecture based on photonic sensing.

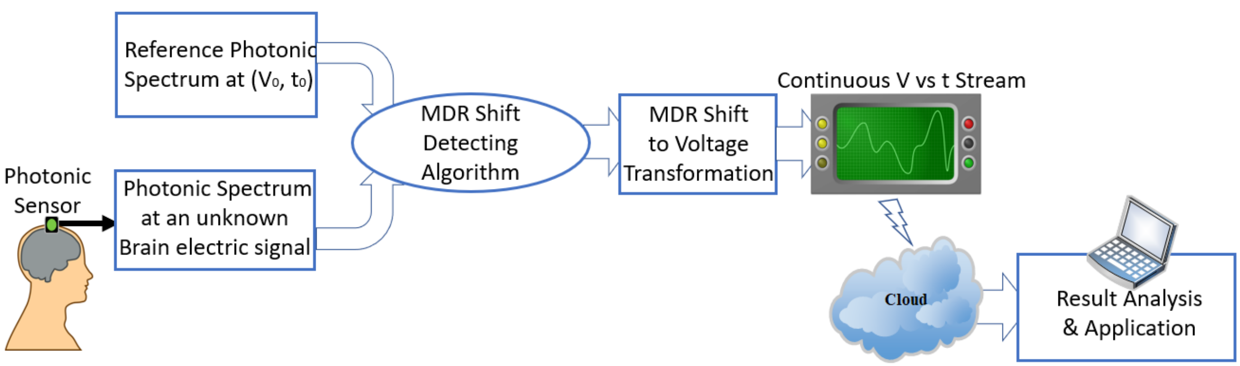

Figure 1: Proposed Photonic Brain-Computer Interface (BCI) Architecture

In this work, we developed a photonic sensor and a model for real-time monitoring of the electric field in a self-organizing manner using a photonic micro-resonator as the sensing element. The micro-resonator used for this work is a chemical combination of Norland Blocking Adhesive (NBA-107) and Di-4-ANEPPS ($C_{28}H_{36}N_2O_3S$) at a predetermined ratio. The applied principle is based on the Whispering Gallery Mode (WGM) or Morphology Dependent Resonance (MDR) but in a continuous, uninterrupted way that directly mimics the ceaseless release of electric pulses from different parts of the brain. Having a pre-existing, tested and reliable system of tracking and interpreting a continual flow of electric field, with marginal Mean Absolute Error (MAE) and a seamless integration to the cloud can lead to the development of an effective Brain Computer Interface (BCI) system.