ABSTRACT

Microcystin-LR (MCLR, one of the most toxic and commonly found product of cyanobacteria in fresh water resources, threatens human health and the livestock. WHO has set a standard limit of $1 {μg}/{l}$ for the concentration of MCLR in drinking water. The lab based, specialized water quality monitoring tests for this purpose are not only expensive, but also slow and require sample preparation and transportation from distant sites. Therefore, there is a need for a hand held, field deployable and low cost biosensor to make frequent water quality monitoring easier.

Many field deployable biosensors with applications in environmental monitoring and healthcare where concentrations of interest are on the order of $μg/L$ and less, face challenges in achieving high dynamic range and lower detection resolution due to the resultant small fractional change in the transducer characteristics. Additionally, non-faradaic label free biosensors for MCLR type applications face difficulty in real-time data analysis due to signal drift, non-specific binding of non-target particles and last but not least noise coming from both transducer and read out electronics.

This dissertation is mainly focused on utilizing electronic circuit methods to fill the gap of reading small responses from the bio transducer with sufficient accuracy and sensitivity. Differential bridge based transduction as sensitivity booster and careful design of amplification unit and real-time signal processing capable of extracting signal information buried in noise are part of the presented work that achieves 8 bit resolution within a $1\%$ full scale transducer fractional capacitive change.