Smart microsensors for Total Aquatic Process Monitoring and Control

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Abstract

The rising global demand for environmental sustainability and enhanced industrial productivity has intensified the need for advanced instrumentation in aquatic process control. Current probes for continuous monitoring face significant limitations: they are expensive, require frequent maintenance and calibration, and are limited to measuring only a few specific parameters (pH, conductivity, dissolved oxygen, redox potential, and temperature). Critical parameters such as nitrogen derivatives (ammonium, nitrites, nitrates), phosphates, and microorganisms are still analyzed in laboratories, which is time-consuming and labor-intensive.

In this context, we propose the development of a smart multi-sensor system fabricated with cost-effective microelectronic technology [1] combined with powerful data fusion tools like neural networks [2,3] to achieve a predictive system for on-line water quality monitoring. This system contains multi-sensor electrochemical sensors manufactured with microelectronic technology, being therefore robust, miniaturizable and scalable in its production. They detect directly indicators like pH, conductivity, temperature, chlorine, and ions (nitrate, phosphate, ammonium). Sensors are combined with local neuromorphic intelligence that, in addition to its predictive capabilities, allows to correct sensor drift, aging and interferences produced during their operation. They allow also to measure new parameters not detected by sensors using neural network algorithms. These corrections minimize and even avoid need for calibration during long-term periods of continuous monitoring.

In this work we present the results of a probe containing a smart multisensor system developed in the frame of the IAQUA project funded by the AGAUR (Generalitat de Catalunya) and in collaboration with IRTA-La Rapita partner. This probe is deployed in an aquaculture site to assess fish conditions and improve decision making.

References

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