Dear Editors,

we wish to submit the new manuscript entitled: “Dual oxygen and temperature luminescence learning sensor with parallel inference”, for consideration to be published in the journal Optica. We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

In this paper, we propose an entirely new approach to luminescence sensing, which is based on multi-task learning neural network and allows the parallel inference of multiple quantities using one single indicator and one single measuring channel.

The classical approach to luminescence sensing is to use an approximate mathematical model describing the functional dependence of the measured quantities and to apply non-linear fitting algorithms. This task can be difficult in case of cross interferences and limits the accuracy of the sensor.

In this work, we propose a method to extract multiple parameters from a single set of optical measurements, without the need for an a priori mathematical model. To estimate the performance of a sensor based on neural networks, we introduce a new metric, which indicates the maximal error in the prediction of a sensor based on neural networks.

The approach is demonstrated by a sensor that learns to determine oxygen concentration and temperature with unprecedented accuracy.

The proposed approach is not limited to oxygen and temperature sensing but can be applied to the luminescence of multiple luminophores, whenever the underlying mathematical model is not known or too complex to derive the desired quantities from a single measurement.

All authors listed have contributed sufficiently to the project to be included as authors, and all those who are qualified to be authors are listed in the author byline. To the best of our knowledge, no conflict of interest, financial or other, exists.

Sincerely,

Prof. Dr. Francesca Venturini

Institute of Applied Mathematics and Physics

Zurich University of Applied Sciences

Technikumstrasse 9, 8401 Winterthur, Switzerland

Michael Baumgartner

Institute of Applied Mathematics and Physics

Zurich University of Applied Sciences

Technikumstrasse 9, 8401 Winterthur, Switzerland

Umberto Michelucci

TOELT LLC

Birchlenstr. 25, 8600 Dübendorf, Switzerland