Development and comparison of the techniques for solving the inverse problem in photoacoustics

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In this work, theory- based simulation models are derived for the photoacoustic (PA) frequency response of both volume and surface optically absorbing samples in a minimum volume PA cell. In the derivation process, thermal memory influence of both the sample and the air of the gas column are accounted for, as well as the influence of the measurement chain.

Within the analysis of the TMS model, the influence of optical, thermal and elastic properties of the sample was investigated, and consequently, two methods are developed for TMS model parameter determination. The first one, a self consistent numerical procedure for solving the exponential problems of mathematical physics, based on regression, is also implemented on experimental measurements, done on macromolecule samples, and the results are presented and discussed. The second one, a well trained three-layer perceptron with back propagation, based upon theory of neural networks, is developed and presented as the proof of concept.

Finally, as part of the extended investigation, these two inverse problem solving concepts are applied, compared and discussed in the domain of polymer sample characterization, and then repeated and proven on semiconductor samples.

REFERENCES

[1] M. V. Nesic, "Developing the techniques for solving the inverse problem in photoacoustics – doctoral dissertation", School of Electrical Engineering, University of Belgrade, Belgrade (2018)