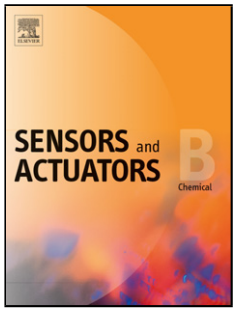

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PII: S0925-4005(18)30004-2
DOI: https://doi.org/doi:10.1016/j.snb.2018.01.004
Reference: SNB 23901

To appear in: *Sensors and Actuators B*

Received date: 24-6-2017
Revised date: 14-12-2017
Accepted date: 2-1-2018

Please cite this article as: Sidahmed Abayzeed, Richard J Smith, Chung W. See, Michael G. Somekh, Analysis of noise in differential and ratiometric biosensing systems, *<![CDATA[Sensors & Actuators: B. Chemical]]>* (2018), https://doi.org/10.1016/j.snb.2018.01.004

Analysis of noise in differential and ratiometric biosensing systems

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Abstract

This paper presents formulations to evaluate noise in differential and ratiometric measurements that are often performed in biosensing. These measurements are performed to improve signal to noise ratio of the sensing systems for sensitive detection of dynamic biological processes. The use of these formulations is discussed in the context of the differential intensity surface plasmon resonance (SPR) system that is widely used to characterise molecular interactions on a confined axial scale. Previous studies provide qualitative descriptions of the noise performance of such systems but lack rigorous characterisation. Here we present analytical expressions for quantitative evaluation of the noise in differential and ratiometric measurements by applying the rules of arithmetic operations on random variables. Such formulations provide the means for evaluating the signal to noise ratio of such systems. We present how correlated noise can be removed by performing differential or ratiometric processing. Applying these formulations, we also show how the sensitivity of the differential intensity SPR system changes during the experiment.

1. Introduction

Differential or ratiometric processing is often employed to enhance the signal to noise ratio or the sensitivity of biosensing systems. It is driven by the

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