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From Data Processing to Experimental Design and Back Again: A Parameter Identification Problem Based on FRAP Images

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Abstract : FRAP (Fluorescence Recovery After Photobleaching) is a widely used measurement technique to determine the mobility of fluorescent molecules within living cells. While the experimental setup and protocol for FRAP experiments are usually fixed, data processing part is still under development. In this paper, we formulate and solve the problem of data selection which enhances the processing of FRAP images. We introduce the concept of the irrelevant data set, i.e., the data which are almost not reducing the confidence interval of the estimated parameters and thus could be neglected. Based on sensitivity analysis, we both solve the problem of the optimal data space selection and we find specific conditions for optimizing an important experimental design factor, e.g., the radius of bleach spot. Finally, a theorem announcing less precision of the integrated data approach compared to the full data case is proven; i.e., we claim that the data set represented by the FRAP recovery curve lead to a larger confidence interval compared to the spatio-temporal (full) data.

Keywords : FRAP, inverse problem, parameter identification, sensitivity analysis, optimal experimental design
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