On estimation of phycobilisome diffusivity using noisy data from the FRAP experiments: An inverse ill-posed problem

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This study describes the method of diffusivity estimation (diffusion coefficient D) of a fluorescent particle in an Euclidean bounded domain based on spatio-temporal FRAP (Fluorescence Recovery After Photobleaching) images. The FRAP technique is routinary used for investigation of protein dynamics within the living cells. In our case we aim to study the mobility of photosynthetic complexes in a native intact membrane. The diffusion process is modelled by the Fickian diffusion PDE with the noisy initial condition and the time-varying (experimentally measured) Dirichlet or Neumann boundary condition. The single parameter estimation problem is then formulated as the optimization problem residing in the minimization of an objective function representing the disparity between the experimental and simulated data. Due to the ill-posedness of our inverse problem, regularization algorithms are implemented. On the synthetic example we illustrate the behaviour of the algorithm for various regularization parameters and perform the error analysis for different level of noise.

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