Abstract

Fluorescence Recovery After Photobleaching (FRAP) is a well established technique in molecular biology to investigate the biophysical properties of proteins in living cells. The reaction-diffusion equations that describe the protein dynamics during a FRAP experiment can be solved analytically only for idealized experimental geometries. The specific aims of this thesis were to solve these equations for realistic geometries. For these purposes a graphical user interface for the exact definition of the experiment was developed in MATLAB®. The differential equations were solved with an implementation of the finite element method (FEM) which was chosen because of its flexibility. It can be shown that a high accuracy of the numeric results can be obtained with selective refinement of the finite elements. Simulations with different experimental geometries and different bleaching patterns showed that changes in the experimental setup influence the results significantly. Ignoring these influences when working with experimental data would lead to a misinterpretation and a wrong estimation of the underlying parameters.

Keywords:
FRAP; Protein dynamics; Reaction-diffusion equation; Mathematical modeling; Simulation