Stochasticity in signal transduction pathways

Vidal Rodriguez, J.

Citation for published version (APA):
# Contents

1 Introduction ........................................ 1
   1.1 The Computer in Systems Biology ................. 2
       1.1.1 The Research Cycle .......................... 3
   1.2 Models: Purpose and Focus ......................... 5
       1.2.1 Macro, Meso and Microscopic Scales .......... 6
       1.2.2 Regimes .................................. 6
   1.3 Stochastic Phenomena in Bacteria ................ 8
   1.4 Computer Methods for Stochastic Chemical Reactions 10
   1.5 Signalling Systems in Bacteria .................... 13
       1.5.1 Two-Components Signalling Systems .......... 15
   1.6 Objectives of this Thesis ........................ 17
   1.7 Overview of this Thesis .......................... 18

2 Gillespie Multiparticle Method .......................... 21
   2.1 Background ................................... 21
   2.2 Description of GMP ............................. 22
       2.2.1 The Operator-Split Reaction-Diffusion ...... 22
       2.2.2 The Diffusion Process ....................... 24
       2.2.3 The Reaction Process ....................... 25
       2.2.4 Choosing a Lattice Discretisation Size ...... 26
   2.3 Enhancements for Low Numbers of Particles ......... 26
       2.3.1 Qualitative Computational Cost Comparison .. 28
   2.4 Detailed Analysis of the GMP Reaction Mechanism ... 30
       2.4.1 The Reversible Diffusion-Limited Reaction of a Pair of Molecules .... 30
       2.4.2 Effects of the Operator-split on the Distribution ... 32
   2.5 Discussion .................................... 34
   2.6 Conclusions ................................... 35

3 Noise and Spatial Comparisons .......................... 37
   3.1 Noise in Gene Expression ......................... 38
       3.1.1 The Model ................................ 39
       3.1.2 Comparison of Noise ....................... 40
       3.1.3 Reversible Pair ........................... 42
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>References</td>
<td>111</td>
</tr>
<tr>
<td>Index</td>
<td>119</td>
</tr>
</tbody>
</table>