

## S1 Text. Simulation methods and codes

### Efficient switches in biology and computer science

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#### I. METHODOLOGY

The data to generate all time-course diagrams have been obtained by using Visual GEC software (<http://lepton.research.microsoft.com/webgec/>). The ODEs have been solved using a Runge-Kutta Method (RK547M), included in the software.

Graphics have been created by using ggplot2 package, from R.

All wiring diagrams of figures 3-7 and below are condensed versions. Each node (molecule) of each network represents the three states of the molecule: inactive form, non-decided form and active form. Thus, each node is showing up by three traces in simulation plots.

#### II. LBS CODE FOR THE MODELS

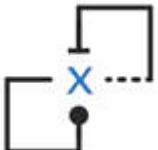
AM	Figure 3		directive sample 5 100 directive simulation deterministic  rate k = 1;  init x 1.001   init xb 1   init xi 1    x + xi ->{k} xi + xb   xi + x ->{k} x + xb   xb + x ->{k} x + x   xb + xi ->{k} xi + xi
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	Figure 5A		<pre> directive sample 5 100 directive simulation deterministic  rate k = 1;  init x 2.001   init xb 0   init xi 2    M + A -&gt;{k} M + U   A + x -&gt;{k} M + U   U + x -&gt;{k} M + M   U + A -&gt;{k} A + A </pre>
MI	Figure 5B		<pre> directive sample 10.0 100 directive simulation deterministic  rate k = 1;  init z0 2.001   init z1 0   init z2 2   init y0 2   init y1 0   init y2 2.001    z2 + z0 -&gt;{k} z0 + z1   z1 + z0 -&gt;{k} z0 + z0   y0 + z0 -&gt;{k} z0 + y1   y1 + z0 -&gt;{k} z0 + y2    y2 + y0 -&gt;{k} y0 + y1   y1 + y0 -&gt;{k} y0 + y0   z0 + y0 -&gt;{k} y0 + z1   z1 + y0 -&gt;{k} y0 + z2 </pre>
SI	Figure 5C		<pre> directive sample 10.0 100 directive simulation deterministic  rate k = 1;  init z0 2.001   init z1 0   init z2 2   init y0 2   init y1 0   init y2 2.001   </pre>

			$z_0 + y_0 \rightarrow \{k\} y_0 + z_1  $ $z_1 + y_0 \rightarrow \{k\} y_0 + z_2  $ $z_2 + y_2 \rightarrow \{k\} y_2 + z_1  $ $z_1 + y_2 \rightarrow \{k\} y_2 + z_0  $ $y_0 + z_0 \rightarrow \{k\} z_0 + y_1  $ $y_1 + z_0 \rightarrow \{k\} z_0 + y_2  $ $y_2 + z_2 \rightarrow \{k\} z_2 + y_1  $ $y_1 + z_2 \rightarrow \{k\} z_2 + y_0  $
CC	Figure 3		directive sample 40 100 directive simulation deterministic  rate k = 1;  init CDK 1.001   init CDC25 1.001   init WEE1 1   init CDKb 1   init CDC25b 1   init WEE1b 1   init CDKi 1   init CDC25i 1   init WEE1i 1.001   init a 1   init i 1    CDC25i + CDK ->{k} CDK + CDC25b   CDC25b + CDK ->{k} CDK + CDC25   WEE1 + CDK ->{k} CDK + WEE1b   WEE1b + CDK ->{k} CDK + WEE1i    CDKi + CDC25 ->{k} CDC25 + CDKb   CDKb + CDC25 ->{k} CDC25 + CDK    CDK + WEE1 ->{k} WEE1 + CDKb   CDKb + WEE1 ->{k} WEE1 + CDKi    CDC25 + i ->{k} i + CDC25b   CDC25b + i ->{k} i + CDC25i   WEE1i + a ->{k} a + WEE1b   WEE1b + a ->{k} a + WEE1

			<pre> directive sample 20 100 directive simulation deterministic  rate k = 1;  init CDK 1.001   init cdc25 1.001   init wee1 1   init PP1PP2A 1   init CDKb 1   init cdc25b 1   init wee1b 1   init PP1PP2Ab 1   init wee1i 1.001   init cdc25i 1   init CDKi 1   init PP1PP2Ai 1.001    cdc25i + CDK -&gt;{k} cdc25b + CDK  cdc25b + CDK -&gt;{k} cdc25 + CDK  PP1PP2A + CDK -&gt;{k} PP1PP2Ab + CDK  PP1PP2Ab + CDK -&gt;{k} PP1PP2Ai + CDK  wee1 + CDK -&gt;{k} wee1b + CDK  wee1b + CDK -&gt;{k} wee1i + CDK  CDK + wee1 -&gt;{k} CDKb + wee1  CDKb + wee1 -&gt;{k} CDKi + wee1  CDKi + cdc25 -&gt;{k} CDKb + cdc25  CDKb + cdc25 -&gt;{k} CDK + cdc25    PP1PP2Ai + PP1PP2A -&gt;{k} PP1PP2Ab + PP1PP2A  PP1PP2Ab + PP1PP2A -&gt;{k} PP1PP2A + PP1PP2A  wee1i + PP1PP2A -&gt;{k} wee1b + PP1PP2A  wee1b + PP1PP2A -&gt;{k} wee1 + PP1PP2A  cdc25 + PP1PP2A -&gt;{k} cdc25b + PP1PP2A  cdc25b + PP1PP2A -&gt;{k} cdc25i + PP1PP2A </pre>
GW	Figure 3		<pre> graph TD     PP2A[PP2A/PP1] --&gt; Wee1     PP2A --&gt; Gwl     Gwl --&gt; Cdc25     Gwl --&gt; Gwl     Cdc25 --&gt; Cdc25 </pre>

Extended GW	Figure 4AC. No oscillations	<pre> graph TD     checkpoint --&gt; Cdc20     Cdc20 --&gt; Wee1     Wee1 --&gt; Cdk     Cdk --&gt; Cdc25     Cdc25 --&gt; PP1[PP1/PP2A]     PP1 --&gt; Cdc20     Cdk --&gt; Wee1     </pre>	<pre> directive sample 20 1000 directive simulation deterministic  rate k = 1; rate k2 = 1; rate re = 1; rate k0 = 1;  init ch 3   init cs 3    init cdc20 3   init cdc20i 4   init cdc20b 2    init cdk1 3   init cdk1b 3   init cdk1i 3    init cdc25 3   init cdc25i 3   init cdc25b 3    init wee1 3   init wee1i 3   init wee1b 3    init PP1PP2A 3   </pre>
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			<pre> init PP1PP2Ab 3   init PP1PP2Ai 3    wee1i + PP1PP2A -&gt;{k} wee1b + PP1PP2A  wee1b + PP1PP2A -&gt;{k} wee1 + PP1PP2A  wee1 + cdk1 -&gt;{k0} wee1b + cdk1  wee1b + cdk1 -&gt;{k0} wee1 + cdk1    cdc25i + cdk1 -&gt;{k0} cdc25b + cdk1  cdc25b + cdk1 -&gt;{k0} cdc25 + cdk1  cdc25 + PP1PP2A -&gt;{k} cdc25b + PP1PP2A  cdc25b + PP1PP2A -&gt;{k} cdc25i + PP1PP2A    PP1PP2A + cdk1 -&gt;{k} PP1PP2Ab + cdk1  PP1PP2Ab + cdk1 -&gt;{k} PP1PP2Ai + cdk1  PP1PP2Ai + PP1PP2A -&gt;{k} PP1PP2Ab + PP1PP2A  PP1PP2Ab + PP1PP2A -&gt;{k} PP1PP2A + PP1PP2A    cdk1i + cdc25 -&gt;{k0} cdk1b + cdc25  cdk1b + cdc25 -&gt;{k0} cdk1 + cdc25  cdk1i + cs -&gt;{k0} cdk1b + cs   cdk1b + cs -&gt;{k0} cdk1 + cs   cdk1 + wee1 -&gt;{k0} cdk1b + wee1  cdk1b + wee1 -&gt;{k0} cdk1i + wee1  cdk1 + cdc20 -&gt;{re} cdk1b + cdc20  cdk1b + cdc20 -&gt;{re} cdk1i + cdc20    cdc20i + cdk1 -&gt;{re} cdc20b + cdk1  cdc20b + cdk1 -&gt;{re} cdc20 + cdk1  cdc20 + ch -&gt;{re} cdc20b + ch  cdc20b + ch -&gt;{re} cdc20i + ch  cdc20i + cdc20 -&gt;{k0} cdc20b + cdc20  cdc20b + cdc20 -&gt;{k0} cdc20 + cdc20  cdc20 + cdc20i -&gt;{re} cdc20b + cdc20i   cdc20b + cdc20i -&gt;{re} cdc20i + cdc20i </pre>
Exte nde d GW	Figure 4BD. Oscillation s	<pre> checkpoint Cdc20 PP1/PP2A Wee1 Cdk1 Cdc25 cyc synthesis </pre>	<pre> directive sample 20 1000 directive simulation deterministic  rate k = 1; rate k2 = 1; rate re = 1; rate k0 = 1;  init ch 3   init cs 3    init cdc20 3   init cdc20i 4   init cdc20b 2    init cdk1 3   </pre>

		<pre> init cdk1b 3   init cdk1i 3    init cdc25 3   init cdc25i 3   init cdc25b 3    init wee1 3   init wee1i 3   init wee1b 3    init PP1PP2A 3   init PP1PP2Ab 3   init PP1PP2Ai 3    wee1i + PP1PP2A -&gt;{k} wee1b + PP1PP2A  wee1b + PP1PP2A -&gt;{k} wee1 + PP1PP2A  wee1 + cdk1 -&gt;{k0} wee1b + cdk1  wee1b + cdk1 -&gt;{k0} wee1i + cdk1    cdc25i + cdk1 -&gt;{k0} cdc25b + cdk1  cdc25b + cdk1 -&gt;{k0} cdc25 + cdk1  cdc25 + PP1PP2A -&gt;{k} cdc25b + PP1PP2A  cdc25b + PP1PP2A -&gt;{k} cdc25i + PP1PP2A    PP1PP2A + cdk1 -&gt;{k} PP1PP2Ab + cdk1  PP1PP2Ab + cdk1 -&gt;{k} PP1PP2Ai + cdk1  PP1PP2Ai + cdc20 -&gt;{k0} PP1PP2Ab + cdc20  PP1PP2Ab + cdc20 -&gt;{k0} PP1PP2A + cdc20    cdk1i + cdc25 -&gt;{k0} cdk1b + cdc25  cdk1b + cdc25 -&gt;{k0} cdk1 + cdc25  cdk1i + cs -&gt;{k0} cdk1b + cs   cdk1b + cs -&gt;{k0} cdk1 + cs   cdk1 + wee1 -&gt;{k0} cdk1b + wee1  cdk1b + wee1 -&gt;{k0} cdk1i + wee1  cdk1 + cdc20 -&gt;{re} cdk1b + cdc20  cdk1b + cdc20 -&gt;{re} cdk1i + cdc20    cdc20i + cdk1 -&gt;{re} cdc20b + cdk1  cdc20b + cdk1 -&gt;{re} cdc20 + cdk1  cdc20 + ch -&gt;{re} cdc20b + ch  cdc20b + ch -&gt;{re} cdc20i + ch  cdc20i + cdc20 -&gt;{k0} cdc20b + cdc20  cdc20b + cdc20 -&gt;{k0} cdc20 + cdc20  cdc20 + cdc20i -&gt;{re} cdc20b + cdc20i   cdc20b + cdc20i -&gt;{re} cdc20i + cdc20i </pre>
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