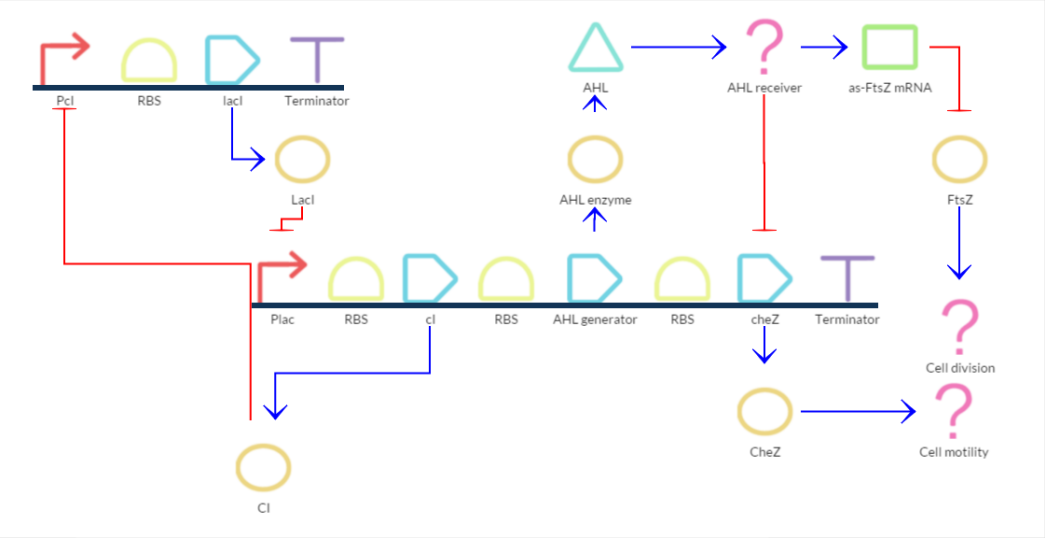
Auto differentiation system



Formulae for two certain parts

CI_1

$$\frac{d[\mathrm{CI}_1]}{dt} = \alpha_1 \chi_4 [\mathrm{cI}_1] - \mathrm{d}[\mathrm{CI}_1]$$

LacI

$$\frac{d[\mathrm{LacI}]}{dt} = \alpha_2 [\mathrm{lacI}^F] \chi_4 - d[\mathrm{LacI}]$$

$$[\mathrm{lacI}^F] = [\mathrm{lacI}] \frac{1}{1 + \left(\frac{[CI]}{\beta_{CI}} \right)^{\mu_{CI}}}$$

CI_2：

$$\frac{d[\mathrm{CI}_2]}{dt} = \alpha_1 \chi_5 [\mathrm{cI}_2{}^F] - \mathrm{d}[\mathrm{CI}_2]$$

$$[\mathrm{cI}_2^F] = [\mathrm{cI}_2] \frac{1}{1 + \left(\frac{[\mathrm{LacI}]}{\beta_{LacI}} \right)^{\mu_{LacI}}}$$

Note that CI=CI_1+CI_2

AHL enzyme

$$\frac{d[\mathrm{AHLenzyme}]}{dt} = \alpha_3 \chi_5 [\mathrm{AHLgenerator}] - \mathrm{d}[\mathrm{AHLenzyme}]$$

AHL1 and AHL enzyme

$$\frac{d[\mathrm{AHL}]}{dt} = \alpha_4 \frac{[\mathrm{AHLenzyme}]^n}{h_0^n + [\mathrm{AHLenzyme}]^n} - d[\mathrm{AHL}]$$

As-Ttsz mRNA

$$\frac{d[\text{as}-\text{TtszmRNA}]}{dt}=\alpha_5\chi_5\chi_7[\text{AHL}]-\text{d}[\text{as}-\text{TtszmRNA}]$$

Ftsz1 and as-Ttsz mRNA

$$\frac{d[\text{Ftsz}]}{dt}=\alpha_5\frac{1}{1+\left(\frac{[\text{as}-\text{TtszmRNA}]}{\beta_{as-TtszmRNA}}\right)^{\mu_{as-TtszmRNA}}}-d[\text{Ftsz}]$$

cheZ

$$\frac{d[\text{cheZ}]}{dt}=\alpha_6\chi_5[\text{chez}^F]$$

$$[\text{chez}^F]=[\text{chez}]\frac{1}{1+\chi_7\left(\frac{[\text{AHL}]}{\beta_{AHL}}\right)^{\mu_{AHL}}}$$

Eigen Functions:

Functions	Symbols	Notifications
χ_{light}	χ_1	$\chi_1=1$ when light exists $\chi_1=0$ otherwise
$\chi_{lightreceiver}$	χ_2	$\chi_2=1$ when light receiver exists $\chi_2=0$ otherwise
$\chi_{lightpromoter}$	χ_3	$\chi_3=1$ when light promoter exists $\chi_3=0$ otherwise
$\chi_{CIpromoter1}$	χ_4	$\chi_4=1$ when CI Promoter exists $\chi_4=0$ otherwise
$\chi_{LacIpromoter1}$	χ_5	$\chi_5=1$ when LacI Promoter exists $\chi_5=0$ otherwise
$\chi_{AHLgenerator}$	χ_6	$\chi_6=1$ when AHL generator exists $\chi_6=0$ otherwise

$\chi_{AHLreceiver}$	χ_7	$\chi_7 = 1$ when AHL receiver exists $\chi_7 = 0$ otherwise

Parameter Table

Symbols	Parameters	Values and Units
Alpha_1	Translation rate of CI protein	5.59um*min^-1
Alpha_2	Translation rate of LacI protein	9.12um*min^-1
Alpha_3	Translation rate of AHL enzyme	2.28um*min^-1
Alpha_4	Translation rate of AHL	0.60um*min^-1
Alpha_5	Translation rate of Ftsz	3.78um*min^-1
Alpha_6	Translation rate of CheZ protein	2.60um*min^-1
Beta_CI	CI repression coefficient	0.008um
Mju_CI	CI cooperativity coefficient	2
Beta_LacI	LacI repression coefficient	0.8um
Mju_LacI	LacI cooperativity coefficient	2
Beta_as_TtszmRNA	as-TtszmRNA repression coefficient	0.75um
Mju_as_TtszmRNA	as-TtszmRNA cooperativity coefficient	1
Beta_AHL	AHL repression coefficient	0.1um
Mju_AHL	AHL cooperativity coefficient	2
d	Degradation rate	0.034min^-1
h_0	Constant	1.8
n	Hill constant	2

Reference: http://2012.igem.org/Team:SEU_O_China