Model description

Inputs :

- $I_{lux,in}(t)$: LuxI concentration from incoming medium
- $I_{las,in}(t)$: LasI concentration from incoming medium

States :

- I_{lux} : LuxI concentration
- I_{las} : LasI concentration
- X_{lux} : LuxR/LuxI complex concentration
- X_{las} : LasR/LasI complex concentration
- C : CI concentration
- L : lacI concentration
- L_m : $LacI_{min}$ concentration
- T : tetR concentration
- G : GFP concentration
- R : RFP concentration

ODEs :

$$\frac{dX_{lux}}{dt} = \rho_{lux} \cdot {R_{lux}}^2 \cdot {I_{lux}}^2 - \gamma_{X_{lux}} \cdot X_{lux}$$

$$\frac{dX_{las}}{dt} = \rho_{las} \cdot {R_{las}}^2 \cdot {I_{las}}^2 - \gamma_{X_{las}} \cdot X_{las}$$

$$\frac{dC}{dt} = \alpha_c \cdot \frac{{X_{lux}}^{n_1}}{{\theta_{X_{lux}}}^{n_1} + {X_{lux}}^{n_1}} - \gamma_C \cdot C$$

$$\frac{dL}{dt} = \alpha_L \cdot \frac{1}{1 + (C/\beta_C)^{n_3}} + \alpha_{L_{m,1}} \cdot \frac{{X_{lux}}^{n_1}}{{\theta_{X_{lux}}}^{n_1} + {X_{lux}}^{n_1}} + \alpha_{L_{m,2}} \cdot \frac{{X_{las}}^{n_2}}{{\theta_{X_{las}}}^{n_2} + {X_{las}}^{n_2}} - \gamma_L \cdot L$$

$$\frac{dT}{dt} = \alpha_T \cdot \frac{1}{1 + (L/\beta_L)^{n_4}} - \gamma_T \cdot T$$

$$\frac{dG}{dt} = \alpha_G \cdot \frac{1}{1 + (L/\beta_L)^{n_4}} - \gamma_G \cdot G$$

$$\frac{dR}{dt} = \alpha_R \cdot \frac{1}{1 + (T/\beta_T)^{n_5}} - \gamma_R \cdot R$$

$$\frac{dI_{lux}}{dt} = I_{lux,in}(t) + \alpha_{I_{lux}} \cdot \frac{1}{1 + (T/\beta_T)^{n_5}} - \gamma_{I_{lux}} \cdot I_{lux}$$

$$\frac{dI_{las}}{dt} = I_{las,in}(t) + \alpha_{I_{las}} \cdot \frac{1}{1 + (L/\beta_L)^{n_4}} - \gamma_{I_{las}} \cdot I_{las}$$

Parameters :

Name	Description	Value	Comments/Reference
R_{lux}	LuxR concentration	0.5 µM	Basu et al., 2005
R_{las}	LasR concentration	0.5 µM	Idem lux if same promoter?
$\theta_{X_{lux}}$	LuxR/AHL activation coefficient (Plux)	0.01 µM	Basu et al., 2005
$\theta_{X_{las}}$	LasR/AHL activation coefficient (Plas)	0.01 µM	Idem lux ?
β_C	Repression coefficient (Pλ)	0.008 µM	Basu et al., 2005
β_L	Repression coefficient (Plac)	0.8 µM	Basu et al., 2005
β_T	Repression coefficient (Ptet)	??	tetR ??
ρ_{lux}	LuxR/AHL dimerization	0.5 $\mu M^{-3} min^{-1}$	Basu et al., 2005
ρ_{las}	LasR/AHL dimerization	0.5 $\mu M^{-3} min^{-1}$	Idem lux ?
α_L	LacI synthesis rate (Pλ)	1 µM min^{-1}	Idem Basu or depends on promoter ?
$\alpha_{L_{m,1}}$	$lacI_{min}$ synthesis rate (Plux)	1 µM min^{-1}	Basu et al., 2005
$\alpha_{L_{m,2}}$	$lacI_{min}$ synthesis rate (Plas)	??	Las promoter ??
α_T	TetR synthesis rate (Plac)	2 µM min^{-1} ??	same promoter as GFP, but same synthesis rate ?
$\alpha_{G,1}$	GFP synthesis rate ($Plac_{min}$)	2 µM min^{-1}	Basu et al., 2005
$\alpha_{G,2}$	GFP synthesis rate (Plac)	2 µM min^{-1}	Basu et al., 2005
α_R	RFP synthesis rate (Ptet)	??	Tet promoter ??
$\alpha_{I_{lux}}$	LuxI synthesis rate (Ptet)	??	Tet promoter ??
$\alpha_{I_{las},1}$	LasI synthesis rate ($Plac_{min}$)	2 µM min^{-1}	Idem $\alpha_{G,1}$?
$\alpha_{I_{las},2}$	LasI synthesis rate (Plac)	2 µM min^{-1}	Idem $\alpha_{G,2}$?
$\gamma_{X_{lux}}$	Lux complex degradation rate	0.0231 min^{-1}	Basu et al., 2005
$\gamma_{X_{las}}$	Las complex degradation rate	0.0231 min^{-1}	Idem lux ?
γ_C	CI degradation rate	0.0692 min^{-1}	Basu et al., 2005
γ_L	Lac degradation rate	0.0231 min^{-1}	Basu et al., 2005
γ_T	TetR degradation rate	??	tetR ??
γ_G	GFP degradation rate	0.0692 min^{-1}	Basu et al., 2005
γ_R	RFP degradation rate	??	RFP ??
$\gamma_{I_{lux}}$	LuxI degradation rate	0.001 min^{-1}	Basu et al., 2005
$\gamma_{I_{las}}$	LasI degradation rate	0.001 min^{-1}	Idem lux ?
n_1, n_2	Transcription factor cooperativity/multimerization	2	Basu et al., 2005
$n_3, \ldots, n_5$	Transcription factor cooperativity/multimerization	1	Basu et al., 2005