20.109
Synthetic Biology Module
Lecture #2

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System design and implementation

**high-level objective** → **system architecture** → **modules** → **biochemical reactions**

\[
\begin{align*}
\frac{dU}{dt} &= \alpha_u I_u - \gamma_u U + D_u \nabla^2 U \\
\frac{dV}{dt} &= \alpha_v I_v - \gamma_v V + D_v \nabla^2 V \\
\frac{dI_u}{dt} &= \alpha_{iv} F_1(X_1, C) - \gamma_{iv} I_u \\
\frac{dI_v}{dt} &= \alpha_{iv} F_1(X_1, C) - \gamma_{iv} I_v \\
\frac{dC}{dt} &= \alpha_c F_2(X_2, L) - \gamma_c C
\end{align*}
\]
Genetic Edge Detection Algorithm

• Pseudocode:

  IF NOT (light)
    produce signal
  IF signal AND NOT (NOT light)
    produce pigment

• Produce signal – generate diffusible communication signal

• Produce pigment – produce black pigment

A synthetic genetic edge detection program. Tabor JJ, Salis HM, Simpson ZB, Chevalier AA, Levskaya A, Marcotte EM, Voigt CA, Ellington AD. Cell. 2009 Jun 26;137(7):1273. Figure 1B, 1C
Abstract operation of the system
Detailed operation of the system
Transfer Function for Dark Sensor
• For $5:
  What was the incorrect slide from last lecture?
III. Inverter

- But with R0065, B-gal should be expressed only where AHL AND NOT (NOT light)
Edge detection with idealized (Top) versus broken (bottom) pLux/cl

pLux/cl transfer function

B-gal behavior?

“Ideal”

“Broken”

Mask
Edge detection with idealized (Top) versus broken (bottom) pLux/cl

pLux/cl

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