Programmable cells: Interfacing natural and engineered gene networks

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Presentation

• Introduction to Cell Programming
• Cell Control and Transition States
• Discussion of Four Strains
  – A1
  – A2
  – B1
  – B2
• Conclusions
• Future Applications
Introduction to Cell Programming

- Biosensor detects signal and sends input
- Regulatory network follows rules to make input into output
- Output delivers response

Components

- **Sensors**
  - SOS pathway detects DNA strand damage
  - AHL plasmid pAHLα is quorum sensing

- **Network**
  - Toggle switch to regulate CI and lacI network

- **Outputs**
  - GFP expression
  - Biofilm production
Cell Control and Transitions

• Integration of cl and lacI system

Figure from Programmable cells: Interfacing natural and engineered gene networks by Kobayashi et al

Strain A1

- Sensor: SOS pathway
- Regulator: toggle switch pTSMa
- Output: GFP plasmid
- DNA damage activates RecA, increasing lacI and GFP

Strain A2

- Sensor: SOS pathway
- Regulator: toggle switch pTSMa
- Output: biofilm plasmid pBFR
- DNA damage activates RecA increasing lacI and pBFR

Figure from Programmable cells: Interfacing natural and engineered gene networks by Kobayashi et al.

Strain B1

- Sensor: AHL inducible pAHLa
- Regulator: toggle switch pTSMb1
- Output: GFP
- GFP expression with low LacR and high CI

Slide B2

- Sensor: AHL plasmid pAHLb
- Regulator: toggle switch pTSMb2
- Output: GFP plasmid pCIRb
- Lux R activation and lacI expression when cell density increases

Figure from Programmable cells: Interfacing natural and engineered gene networks by Kobayashi et al.
Conclusions

• Programmable cells can be constructed by coupling sensors to cell regulatory mechanisms

• Binary response, around threshold get some bimodal response due to differences in individual cells

• Memory capable- changes are stored and passed on to future generations
Future Applications

• Evaluate further interactions of programming and basal cell functions
• Look at directed evolution for optimizing system instead of individual responses
• Examine more complex networks for counting and integration
Questions?