1. Digital Display
2. Cell Immobilization
3. Time Delay
**PROCESS ANALYSIS**

**Input:** Binary-coded

**Computation system**

**Output:** decimal numbers

<table>
<thead>
<tr>
<th>Ara</th>
<th>aTc</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Ara: arabinose
aTc: anhydrotetracycline
OUTPUT: UNSTABLE GFP

GFP with LVA tag
OUTPUT: UNSTABLE GFP

S1: BL21
S2: P$_{BAD}$GLT(-)
S3: P$_{BAD}$GLT(+)0min
S4: P$_{BAD}$GLT(+)75min
S5: P$_{BAD}$GLT(+)360min
S6: P$_{BAD}$GLT(+)480min
OUTPUT: UNSTABLE GFP

[Graph showing fluorescence levels across samples with different conditions, e.g., BL21, PBADGLT(-), PBADGLT(+) 0min, PBADGLT(+) 75min, PBADGLT(+) 360min, PBADGLT(+) 480min.]
**PROCESS ANALYSIS**

**Input:** Binary-coded

- Ara 0
- aTc 0
- Ara 0
- aTc 1
- Ara 1
- aTc 0
- Ara 1
- aTc 1

**Computation system**

**Output:** decimal numbers

**Ara:** arabinose

**aTc:** anhydrotetracycline
Input: Binary-coded computation system
Output: decimal numbers

Ara: arabinose
aTc: anhydrotetracycline
COMPUTATION SYSTEM

BUFFERS

NOT

OR

NOR

$P_{BAD}$  
$gfp$-lva

$P_{BAD}$  
$cI$-lva  
$P_{cl}$  
$gfp$-lva

$P_{BAD}$  
$gfp$-lva  
$P_{tet}$  
$gfp$-lva

$P_{tet}$  
$cI$-lva  
$P_{BAD}$  
$cI$-lva  
$P_{cl}$  
$gfp$-lva

BUFFERS

NOT

OR

NOR
COMPUTATION SYSTEM

Cell (a, d)

$P_{tet}$ cl-lva $P_{cl}$ gfp-lva $P_{BAD}$ gfp-lva

Cell (c)

$P_{BAD}$ cl-lva $P_{cl}$ gfp-lva $P_{tet}$ gfp-lva

Cell (e)

$P_{tet}$ cl-lva $P_{cl}$ gfp-lva

Cell (f)

$P_{tet}$ cl-lva $P_{cl}$ gfp-lva $P_{BAD}$ cl-lva

Cell (g)

$P_{BAD}$ gfp-lva
# COMPUTATION SYSTEM

<table>
<thead>
<tr>
<th>Ara</th>
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<th>GFP</th>
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</thead>
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</tbody>
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Segment(e)  

\[ P_{tet} \quad cl-lva \quad P_{cl} \quad gfp-lva \]
COMPUTATION SYSTEM

<table>
<thead>
<tr>
<th>Ara</th>
<th>aTc</th>
<th>GFP</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Segment(e)

$P_{tet}$  $cl$-lva  $P_{cl}$  $gfp$-lva
COMPUTATION SYSTEM

<table>
<thead>
<tr>
<th>Ara</th>
<th>aTc</th>
<th>GFP</th>
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**COMPUTATION SYSTEM**

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</table>

**Segment(e)**

- $P_{tet}$
- $cl$-lva
- $P_{cl}$
- $gfp$-lva
**Process Analysis**

**Input:** Binary-coded

<table>
<thead>
<tr>
<th>Ara</th>
<th>αTc</th>
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<tbody>
<tr>
<td>0</td>
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</tbody>
</table>

Ara: arabinose
αTc: anhydrotetracycline

**Computation System**

**Output:** decimal numbers

1/3
OPTIMIZATION

Optimizing Concentration

BBa_K750000

BBa_K750114

$P_{BAD}$

gfp-lva

$P_{tet}$

gfp-lva
OPTIMIZATION: Ara

![Graph showing fluorescence over time with different arabinose concentrations.]

- **High peak value**
- **Less fluctuations**
OPTIMIZATION: aTc

- Higher
- Long duration

Graph showing fluorescence over time with different concentrations of aTc.
SINGLE-INPUT BCD

![Graph showing fluorescence over time for P_{BAD} induced by 1 mM Arabinose and P_{cl} GLT.]

- P_{BAD} gfp-lva
- P_{cl} gfp-lva
MODELING

\[
\begin{align*}
\frac{dOD(t)}{dt} &= k_{\text{grow}} \times OD(t) \times [1 - OD(t)] \quad \text{(1)} \\
\frac{dflu(t)}{dt} &= k_{\text{flu}} \times OD(t) \times \text{arc}(t) - k_{\text{dec}} \times OD(t) \times flu(t) \quad \text{(2)} \\
\frac{darc(t)}{dt} &= -k_{\text{arc}} \times OD(t) \quad \text{(3)}
\end{align*}
\]

Equation (1): the course of growth of *E. coli*.
Equation (2): the course of producing and decomposing GFP.
Equation (3): arabinose utilized for inducing.
MODELING: $P_{BAD\text{GLT}}$

### Best value for parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Value Arc 0.1</th>
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<tr>
<td>kgrow</td>
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<tr>
<td>kflu</td>
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<tr>
<td>kdec</td>
<td>0.031</td>
</tr>
<tr>
<td>karc</td>
<td>0.009</td>
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<tr>
<td>Arc₀</td>
<td>1.0</td>
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</table>
MODELING: $P_{ci}$GLT

**Best value for parameters**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
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<tbody>
<tr>
<td>kgrow</td>
<td>0.021</td>
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<td>kflu</td>
<td>150</td>
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<tr>
<td>kdec</td>
<td>0.02</td>
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</table>

$P_{ci}$  
gfp-lva
PROBLEMS: NO FUNCTION

\[ P_{cI} \text{ gfp-lva} \quad P_{BAD} \text{ gfp-lva} \]

Graph showing fluorescence over time with and without induction by 1 mM ara.
PROBLEMS: NO FUNCTION

Part: BBa_K145280
Designed by iGEM08_KULeuven
FURTHER RESEARCH

Mathematical model
Compatibility and robustness
FURTHER RESEARCH

GO!
Mathematical model
Compatibility and robustness
DIGITAL DISPLAY

CELL IMMOBILIZATION

TIME DELAY
METHODS OF IMMobilization

Bead

Capsule

Micro-Capsule
## COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>Bead</th>
<th>Capsule</th>
<th>Micro-Capsule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Ca-alginate</td>
<td>Ca-alginate</td>
<td>NaCS-PDMDAAC</td>
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<tr>
<td>Preparation</td>
<td>Very Easy</td>
<td>Easy</td>
<td>Difficult</td>
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</table>

**PDMDAAC:** Poly dimethyl diallyl ammonium chloride
## COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>Bead</th>
<th>Capsule</th>
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<tbody>
<tr>
<td><strong>Average Size/mm</strong></td>
<td>2.40</td>
<td>2.68</td>
</tr>
<tr>
<td><strong>Core</strong></td>
<td>Solid</td>
<td>Liquid</td>
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</table>
## COMPARISON

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<tr>
<td><strong>Compressive Strength/N</strong></td>
<td>1.29</td>
<td>2.52</td>
</tr>
<tr>
<td><strong>Immobilizing Capability</strong></td>
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COMPARISON

Average Size/mm
- Bead: 2.40
- Capsule: 2.68

Core
- Solid
- Liquid

Compressive Strength/N
- Bead: 1.29
- Capsules: 2.52
# COMPARISON

<table>
<thead>
<tr>
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<td>1.29</td>
<td>2.52</td>
</tr>
<tr>
<td>Immobilizing Capability</td>
<td>Fair</td>
<td>Good</td>
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### FLUORESCENCE ANALYSIS

<table>
<thead>
<tr>
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<th>Induction time</th>
<th>3 h</th>
<th>10 h</th>
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<tr>
<td>Intensity</td>
<td></td>
<td>2800</td>
<td>710</td>
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<tr>
<td>Time of peak / h</td>
<td></td>
<td>3.5</td>
<td>3.5</td>
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</table>

**Graphs:**
- **3000**: Absence of arabinose vs. Induced by 5 mM arabinose.
- **800**: Absence of arabinose vs. Induced by 5 mM arabinose.
Limited inner space
Seven-Segment Display Device
FUTURE PLAN

- Bio-sensor
- E-ink -> Bio-ink
FOR MORE FUNCTIONS
1. Digital Display

2. Cell Immobilization

3. Time Delay
CONSTRUCTION

TD0.6

TD1.0

TD0.01

\[
\begin{align*}
&T_{BAD}^{0.6} \quad \text{RBS}_{0.6} \\
&T_{BAD}^{1.0} \quad P_{BAD}^{1.0} \quad \text{luxR} \\
&T_{BAD}^{0.01} \quad \text{RBS}_{0.01}
\end{align*}
\]

\[\text{luxpR} \quad \text{gfp}\]
ANALYSIS

TD1.0

TD0.6

TD0.01
HUMAN PRACTICE

Lab-Open Day

Visiting

Theme Exhibition
LAB-OPEN DAY

2012 · 07 · 17

20 students from

• Jiyan High School
• Pinghe First High School
VISITING TO OTHER CHINESE iGEM TEAMS

- Peking University
- Tianjin University
- University of Science & Technology of China
- Xiamen University
- Sun Yat-sen University
- Hong Kong University of Science & Technology
VISITING TO OTHER CHINESE iGEM TEAMS

Promote Understanding
Strengthen Relationship
THEME EXHIBITION

Lab-Open Day

Visiting

Theme Exhibition
Theme Exhibition

- **Genesis of Synthetic Biology**
- Aug. 23\(^{rd}\) to 27\(^{th}\)
- Campus Student Center
- Audiences include:
  - Teachers
  - Student Fellows
  - Local citizens
  - Domestic and Foreign Tourists
The Theme Exhibition

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- Audiences include:
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  - Student Fellows
  - Local citizens
  - Domestic and Foreign Tourists
主题展览

解释

面板

观众
THEME EXHIBITION

Ichnography Plan for Exhibition Hall
MESSAGE AND FEEDBACK

Good Job! It impresses me upon my arrival of XMU.

Great exhibition! Synthetic biology is so interesting! I love it, aha!

We learn a lot from the exhibition. Nice work!

Synthetic Biology Benefit Human Beings!

Endeavor Creation

Come on!
Influence of 2011 iGEM-XMU

The Textbook

Refined and Incorporated into Fundamental Laboratory Course
Influence of 2011 iGEM-XMUC

Refined and Incorporated into Fundamental Laboratory Course

Operation

The Textbook
Team

Instructors:
Prof. Baishan Fang, Associated Prof. I-Son Ng, Dr. Zhaoshou Wang
REFERENCES


<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
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<th>Length</th>
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<tr>
<td>BBA_k750000</td>
<td>Signaling</td>
<td>pBADGLT: unstable gfp expression device activated by arabinose</td>
<td>Sifan Wang, Yizhen Yan, Jianzhao Chi, Qingshu Wu</td>
<td>1052</td>
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<tr>
<td>BBA_k750009</td>
<td>Signaling</td>
<td>TIME DELAY1.0:Luxi(RBS0.0)→LuxR→LuxPR→GFP</td>
<td>Sifan Wang, Ruosang Qiu, Xinyi Yao, Qingshu Wu</td>
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<tr>
<td>BBA_k750111</td>
<td>Signaling</td>
<td>PflglT:GFP(lva) expression system controlled by (anhydro)tetacyclin</td>
<td>Sifan Wang, Yizhen Yan, Rong Fan, Muqin Yu</td>
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<td>BBA_k750001</td>
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<td>LuxI expression device activated by arabinose (Regulated by RBS of 1.0 strength)</td>
<td>Sifan Wang, Ruosang Qiu, Xinyi Yao, Qingshu Wu</td>
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<tr>
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<td>TIME DELAY0.3:Luxi(RBS0.3)→LuxR→LuxPR→GFP</td>
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<tr>
<td>BBA_k750102</td>
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<td>PflglT: atc sensor(J23119 promoter) with cl system</td>
<td>Sifan Wang, Yizhen Yan, Jianzhao Chi, Qingshu Wu</td>
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<td>BBA_k750103</td>
<td>Signaling</td>
<td>PflglT:GFP(lva) repression system activated by cl protein</td>
<td>Sifan Wang, Yizhen Yan, Jianzhao Chi, Qingshu Wu</td>
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<td>BBA_k750006</td>
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<td>cl→GFP(lva)→arabinose</td>
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<td>BBA_k750114</td>
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<td>PflglT-PflglT: atc→cl→GFP(lva)</td>
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<td>Sifan Wang, Yizhen Yan, Ruosang Qiu, Youbin Mo</td>
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Acknowledgement

The State Council Information Office of P.R.China (国务院新闻办)

Xiamen Municipal Government Information Office (厦门市人民政府新闻办)

Xiamen University Academic Administration (厦大教务处)
Thanks for your attention!

XMU-CHINA