SynBioSS for computer-aided synthetic biology – A genetic comparator device

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Synthetic Biology Software Suite

http://synbioss.sourceforge.net

Hill AD, Tomshine JR, Sotiropoulos V, Weeding EM and Kaznessis YN
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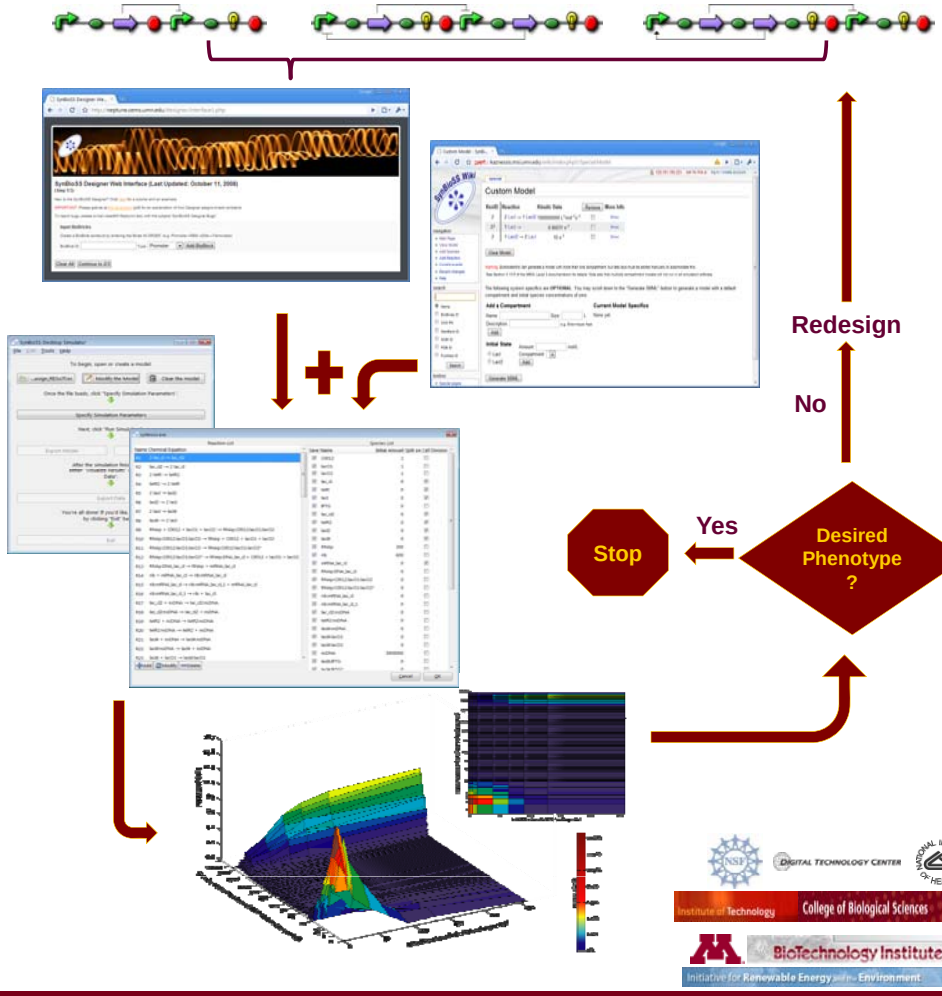
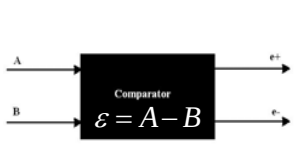
1) User can enter any BioBricks sequence in SynBioSS Designer, which will generate a set of reactions that model gene expression and regulation. 2) User can query SynBioSS Wiki for kinetic constants. 3) User can use SynBioSS DS to numerically simulate the dynamic behavior of the synthetic gene network.

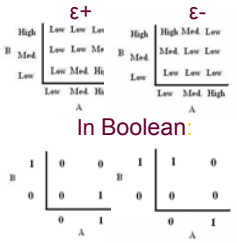


Genetic Comparator

Basic Function of Comparator

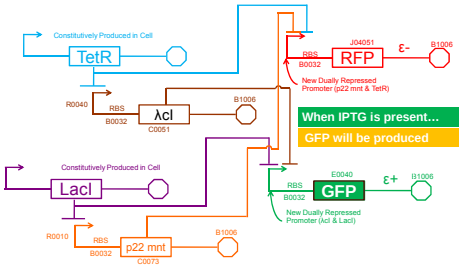


The comparator takes in two inputs, A and B, determines which one is larger and generates a particular output based on the relative input levels.



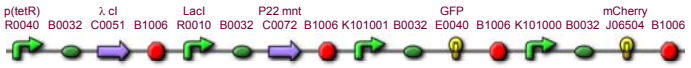
The Boolean graphs lead to the logic statements:
ε+ = A AND (NOT B)
ε- = B AND (NOT A)
In order to get this logic, the following schematic was designed with equivalent logic:
ε+ = B NOR (NOT A)
ε- = A NOR (NOT B)

Comparator Gene Network



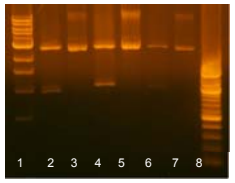
Parts Submitted to Registry

BBa_K101000 - Dual-Repressed Promoter for p22 mnt and TetR
BBa_K101001 - Dual-Repressed Promoter for LacI and LambdacI
BBa_K101002 - Dual-Repressed Promoter for p22 cII and TetR
BBa_K101003 - TetR promoter, RBS, Lambda cI gene, terminator
BBa_K101004 - LacI promoter, RBS, p22 mnt gene, terminator
BBa_K101005 - LacI/Lamsda cI promoter, RBS, GFP, terminator
BBa_K101006 - TetR/p2 mnt promoter, RBS, RFP, terminator
BBa_K101007 - TetR/p2 cII promoter, RBS, RFP, terminator
BBa_K101008 - Whole construct of comparator
BBa_K101009 - Dual-Repressed Promoter for p22 mnt and TetR with RBS
BBa_K101010 - Dual-Repressed Promoter for LacI and LambdacI with RBS
BBa_K101011 - Dual-Repressed Promoter for p22 cII and TetR with RBS

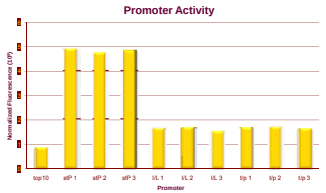


Experimental Results

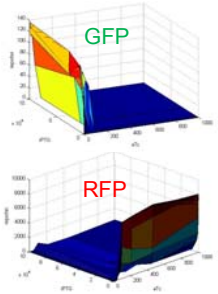
1. 1 kb ladder
2. Cut standard promoter
3. Uncut standard promoter
4. Cut Lac/Lamda promoter
5. Uncut Lac/Lamda promoter
6. 6 Cut Tet/p22mnt promoter
7. Uncut Tet/p22mnt promoter
8. 100 bp ladder



stP: standard promoter
l/L: Lac/Lamda promoter
t/p: Tet/p22mnt promoter



Network Simulations



Conditions used in model include:
1. 50 LacI and TetR molecules
2. Similar RBS strength on all genes
3. Varied both inducer concentrations from 0-1000 molecules/cell in 10 steps

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