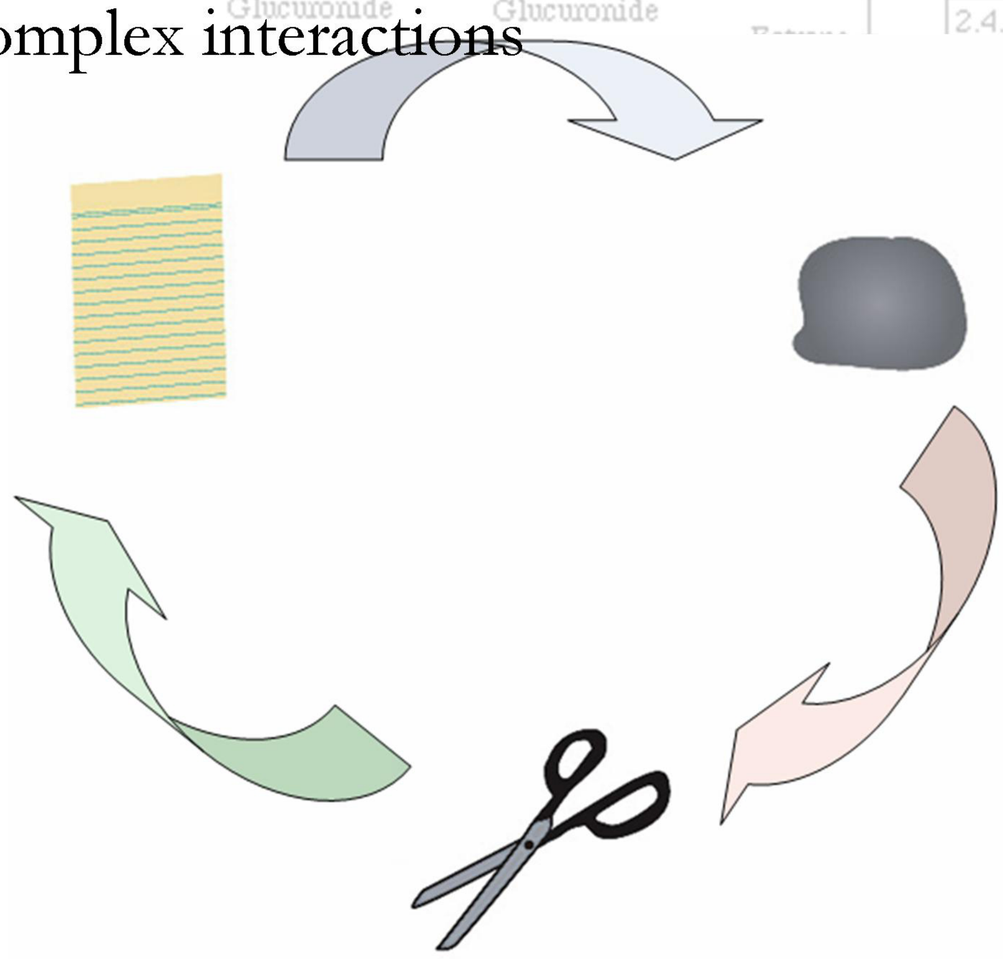
Ipro 302

Synthetic Biology
Engineering a Novel Organism

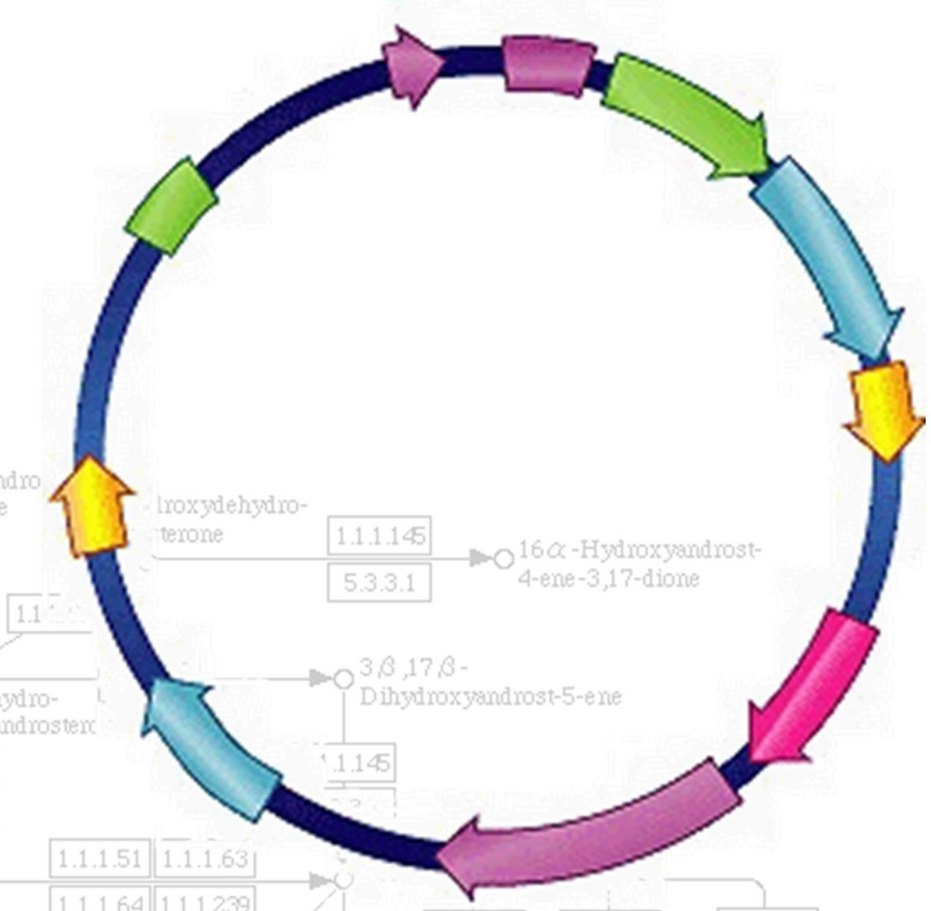
- Living things are constructed by proteins scripted out by the genes in our DNA.
- A living organism can have anywhere from 50-100,000 genes
- Numerous genomic maps have been constructed
- However this is just simple code which forms really complex interactions
- We are trying create a simpler system of 12 genes

Designing the Circuit



- The circuit is a cyclic three gene oscillating system
- Each gene turns the following one off
- On/off oscillation
- This creates polysystronic eukaryotic repressillator system
- Results will be visually displayed with color

Constructing the Circuit



- The system was designed from basic genes, and it is without a natural counterpart
- The genes used for the circuit will come from several different purchased plasmids (circular pieces of DNA)
- The specific genes that are needed from each purchased plasmid will be individually amplified using PCR
- These will then be coupled together using fusion PCR
- The 3 main pieces are the Lac gene, the Cumate gene, and the Tet gene

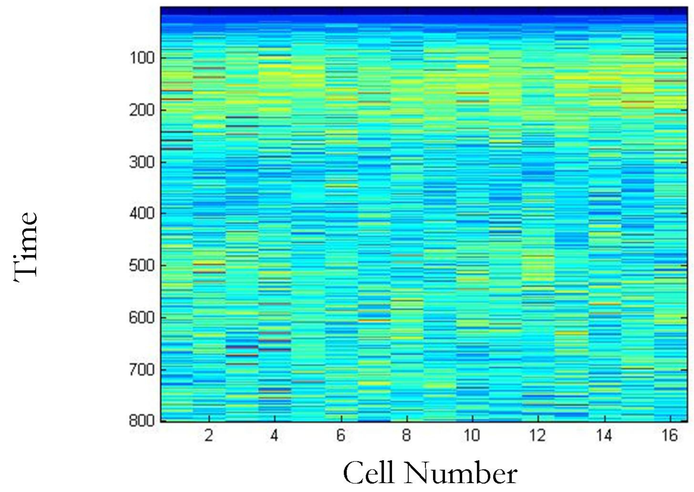
Math Modeling

Problems

Nature is messy – the genes don't turn 'on' or 'off' as neatly as switches and randomness always plays a factor.

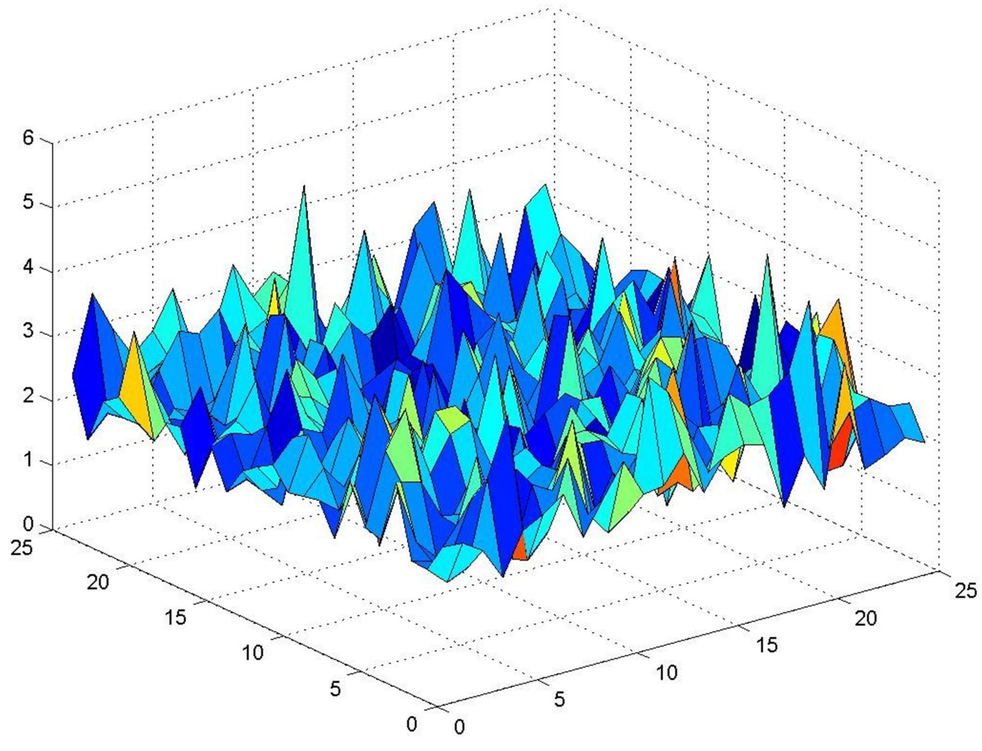
A fish is a huge multi cellular organism, made up of trillions of cells each with its own complete set of genes. We want them to all oscillate in phase.

Unsynchronized

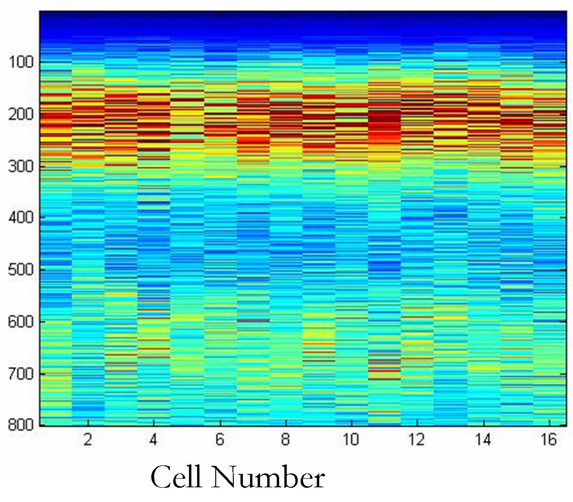


Solution

- Efficient computing, achieved by integrating C++ and MATLAB, provides the modeling capacity for multiple cells in a eukaryote.
- A graphical user interface was developed to make simulation and analysis user-friendly.
- Added features in the interface allow quick control of multiple simulation parameters.
- Development of different visual analysis tools for clear visual analysis of oscillator behavior.



Synchronized

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   #else
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   #endif
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   #ifdef __cplusplus
      fputs("C++ ", mpLogFile);
   #else
      fputs("C ", mpLogFile);
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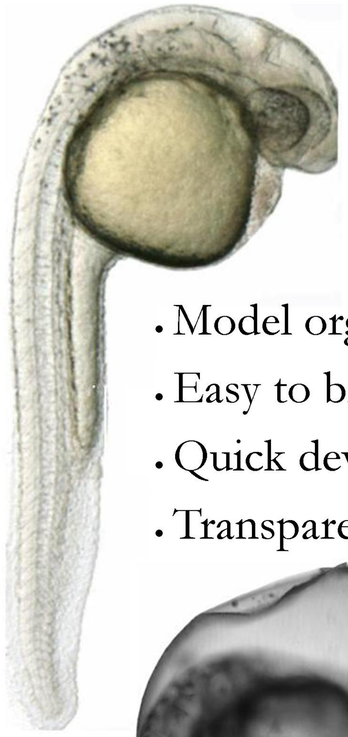
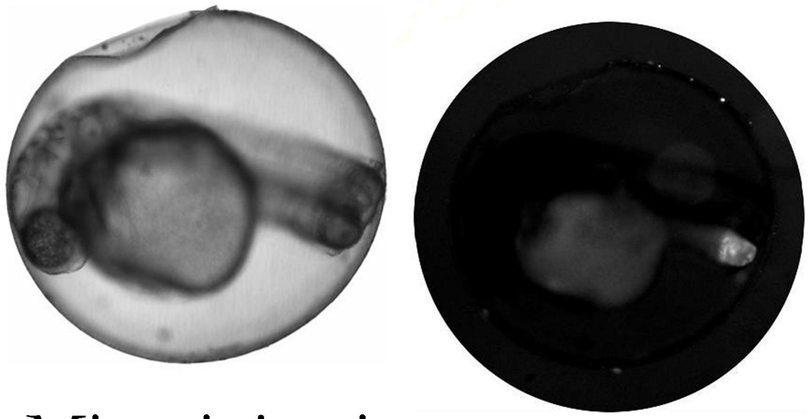
Future focus will concentrate toward quantitative analysis of the oscillator behavior using these efficient tools



Zebrafish

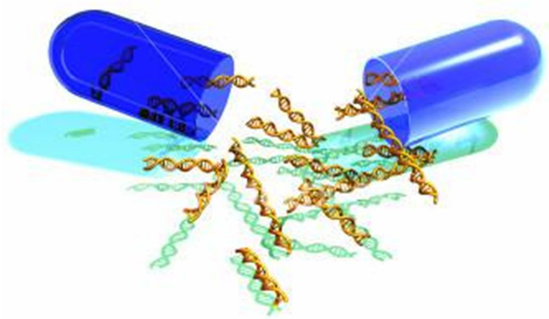
Danio rerio

- Model organism for genetic experiments
- Easy to breed, and maintain
- Quick developmental cycle
- Transparent embryonic growth



Microinjection

- Microinjection is used as a means of implementing DNA
- Small glass needle pierces the embryo and inserts DNA
- Using low pressure, DNA is pushed into the embryo
- Embryos are highly resilient and regenerate the membrane
- Main problem is low percentage of DNA incorporation into genome
- Many trials must be attempted



Future and Design

Limitless possibilities are available with this technolo

- Improve life quality
- Cure diseases
- Create novel materials
- Bioremediation
- Designer life forms

Ethics

- Current regulations on the research and application of genetic engineering need to be improved to become more uniform between companies and more effective at preventing misuse
- The public needs to be made more knowledgeable of what this technology is doing and how its use is being controlled, and moreover why it is necessary at all
- The question of how far science is willing to go in modifying the human genome, either to prevent disease or to improve function, needs to be addressed