Creepture

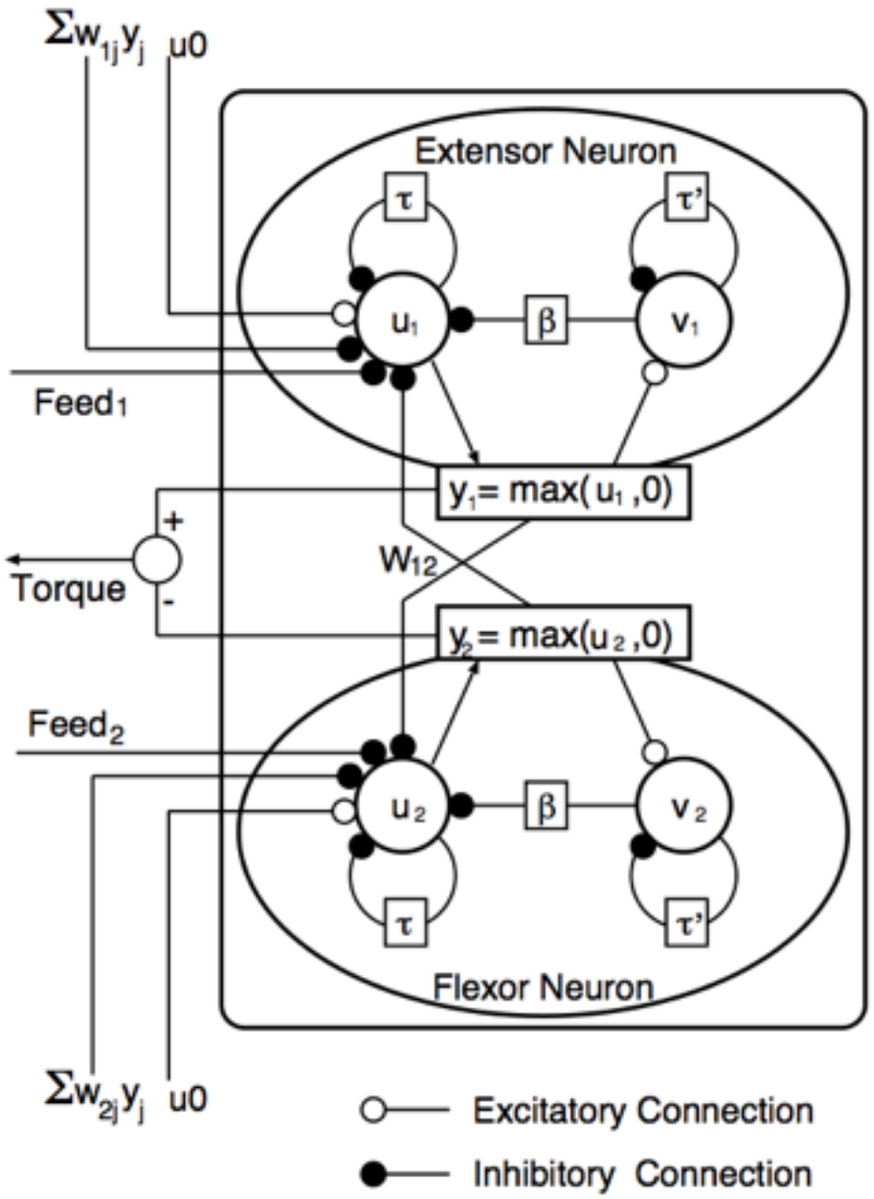
Optimizing Locomotion using a Genetic Algorithm

Background

- How does locomotion work in nature?
- Wouldn’t it just be easier to hard-code locomotive patterns?
- Recreation of an experiment performed in *Automatic Locomotion Design and Experiments for a Modular Robotic System* Kamimura et all 2005.

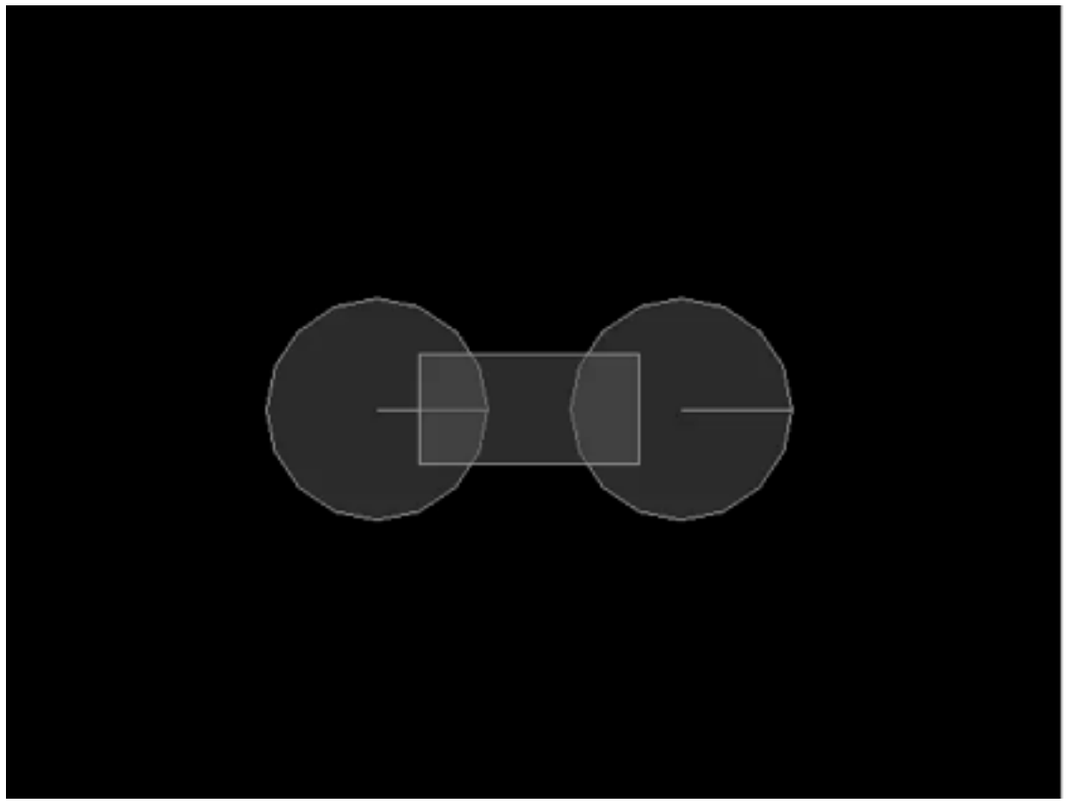
Central Pattern Generator

- Also known as a neural oscillator.
- Allows the main control unit to create oscillatory behavior without providing oscillator input.
- By connecting multiple CPGs together in a network, complex motions can be observed.



Creepture

- To the right is a single segment.
- Segments will be fused together.
- Each segment has 2 CPGs associated with it.



GA Design

- Simulation using Box2D physics engine.
- Results of simulation feedback into GA for determining fitness.
- Snapshots of individuals are saved from the GA to be played back graphically using Box2D's Testbed environment.

Representation

- Adjacency Matrix for weights between each CPG which can take on integer values -1, 0, 1.

- Initial values for the four inner neurons for each CPG which can take on double values from -1.0 to 1.0.

- Fixed length chromosome for each run. Length of chromosome depends on number of segments.

Operators

Fitness = a*distance - b*energy / segments

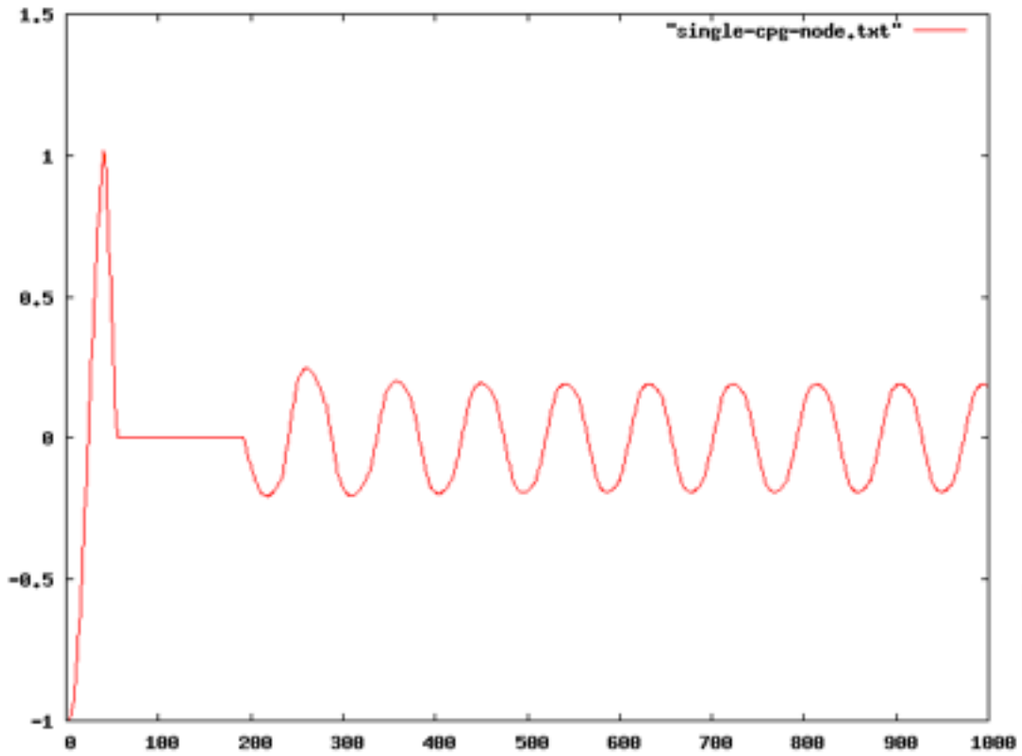
Mutation: weights and initial values will have separate rates. Both will be fairly small ~5%.

Crossover: N-Point crossover. Possible use of Unimodal Normal Distribution Crossover (UNDX)

Selection: Elites in the population will crossover with the weakest members and the rest of the population will use the roulette method.

Status

- CPGs emulated in software individually and in a network.
- Box2D has been integrated into development environment and simulation has been performed.
- Fusing the segments together still must be done.
- Development of the fitness function from simulation has begun.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-1
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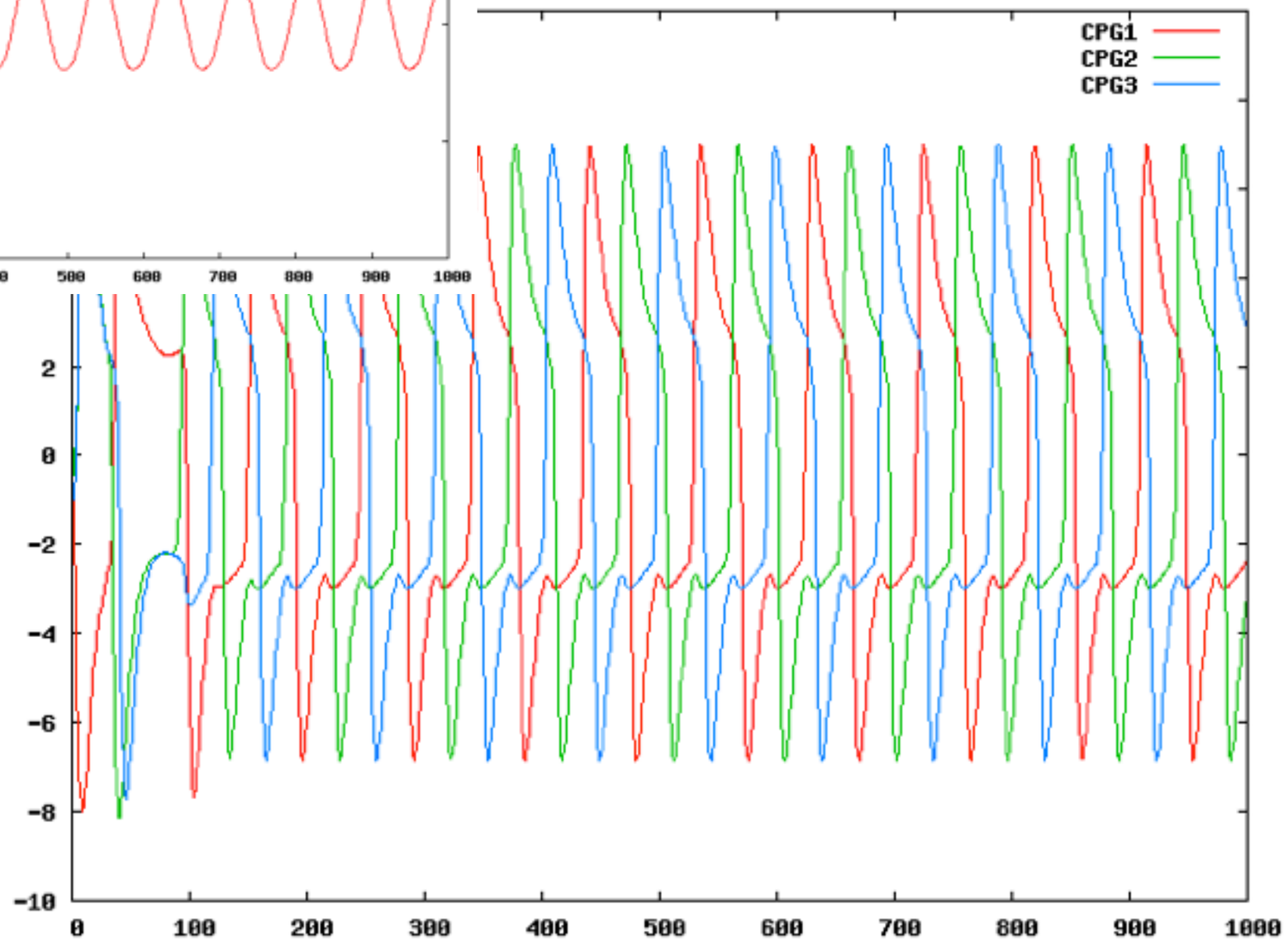
CPG1
CPG2
CPG3
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