ETHzürich

Emergent Gait Periodicity in Evolved Creatures

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institute of
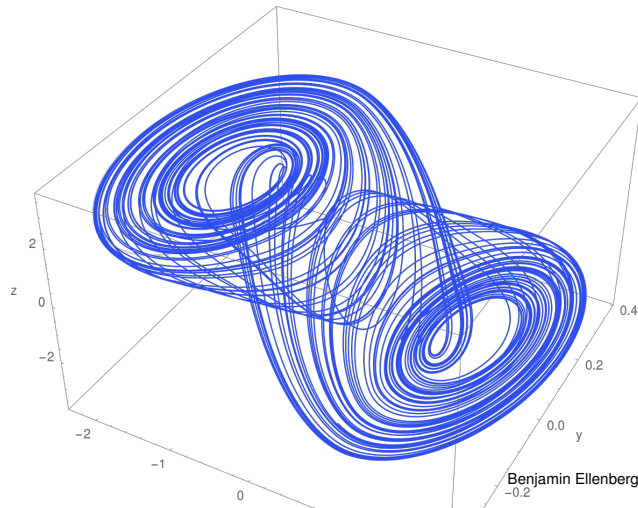neuroinformatics

Introduction

I introduce things.

2016-05-12

Emergent Gait Periodicity in Evolved Creatures

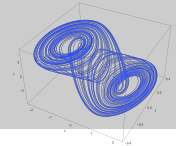└─ Introduction

Figure : The multiscroll attractor generated by the Chua circuit without any simple limiter applied.
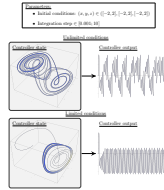
Introduction II

I introduce things.

Figure : The specification of the chaotic chua controller, its internal state and output signal. The internal state of the chaotic chua controller is three dimensional because the Chua circuit's equations are defined using three dimensions. The output signal is chosen to be the z dimension of the internal state and is therefore only one dimensional. The controller state and output are shown for the unlimited condition and an example of limited condition. The example limitation leads to a period two limit cycle. If the chaotic chua circuit controller is mutated during the mutation step of the simulator, the parameters are chosen from a uniform distribution out of the

Chaotic Systems

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[1]R. L. Devaney - An Introduction to chaotic dynamical systems (1989)

Chaotic Systems

1. **Chaotic system** is a **non-linear, dynamical system**
   exhibiting chaotic dynamics.

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Chaotic Systems

1. **Chaotic system** is a **non-linear, dynamical system** exhibiting chaotic dynamics.

2. Chaos means that even in a deterministic system, where the future behavior is fully determined by the initial state, a slightly varied initial state makes the system unpredictable.

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Chaotic Systems

1. **Chaotic system** is a **non-linear, dynamical system** exhibiting chaotic dynamics.

2. Chaos means that even in a deterministic system, where the future behavior is fully determined by the initial state, a slightly varied initial state makes the system unpredictable.

3. A chaotic system must..[1]
   - be sensitive to the initial conditions.
   - show topological mixing.
   - have dense periodic orbits.

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[1]R. L. Devaney - An Introduction to chaotic dynamical systems (1989)

Parameters:
- Amplitude $\in [0, 0.5]$
- Frequency $\in [0.5, 4]$
- X Offset $\in [0, 2\Pi]$
- Y Offset $\in [0, 1]$

Controller state

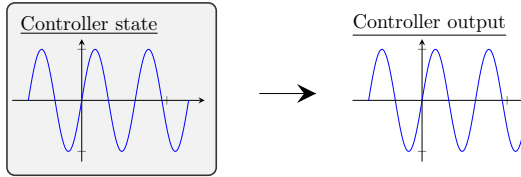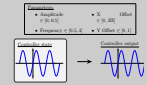Controller output

$\longrightarrow$

Figure : The specification of the sinusoid controller, its internal state and output signal. The internal state has the same dimensionality as the output. If the sinusoidal controller is mutated during the mutation step of the simulator, the parameters are chosen from a uniform distribution over the respective intervals.
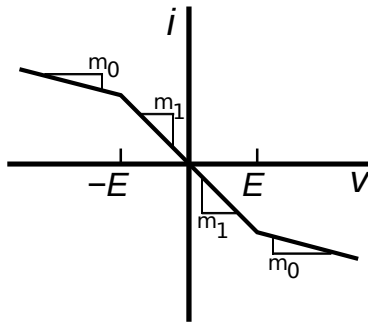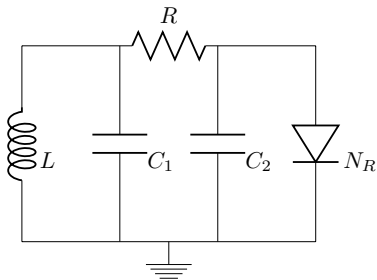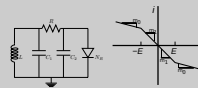
Figure : The Chua circuit with its special Chua diode. The Chua diode is a piecewise-linear resistor with the characteristics as shown in the right figure.

Mathematica Experiments

Some crazy things I did in Mathematica.

Minemonics: A 3D Virtual Creature Simulator

The simulator can do everything.

Simulator Experiments with the Model Leg

The Model Leg did everything, not me.

Simulator Experiments with the Model Leg

The Model Leg did everything, not me.

Discussion

Many things want to be discussed.

Conclusion

I conclude on what I did.

Outlook

What could be done next?

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Acknowledgements

I would like to thank my group!

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neuroinformatics

Backup Slides

Some things we could discuss if we had more time.