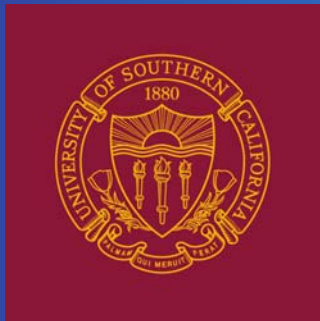


# Gate Network Dynamics

Amanda Fournier<sup>1</sup>, Daniel P. Lathrop<sup>2</sup>, John  
Rodgers<sup>2</sup>



<sup>1</sup>University of Southern California

<sup>2</sup>University of Maryland



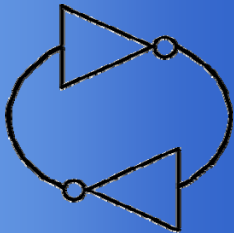
# Motivation

- Past theoretical work, incl. J.E.S. Socolar's
- Logic gates are widely used in computing
- They're also used to simulate biological processes

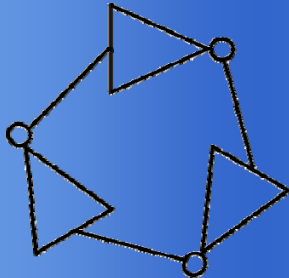
# Circuits used



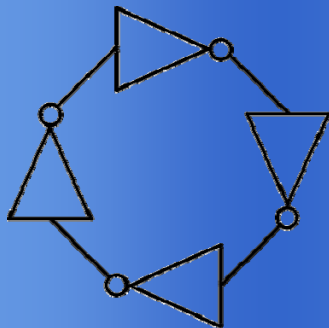
1-NOT



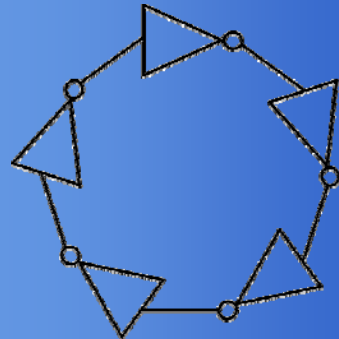
2-NOT



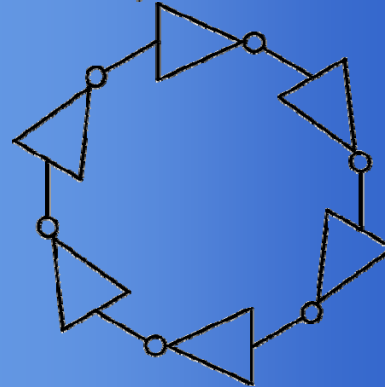
3-NOT



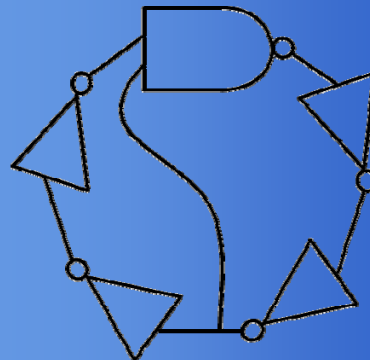
4-NOT



5-NOT



6-NOT



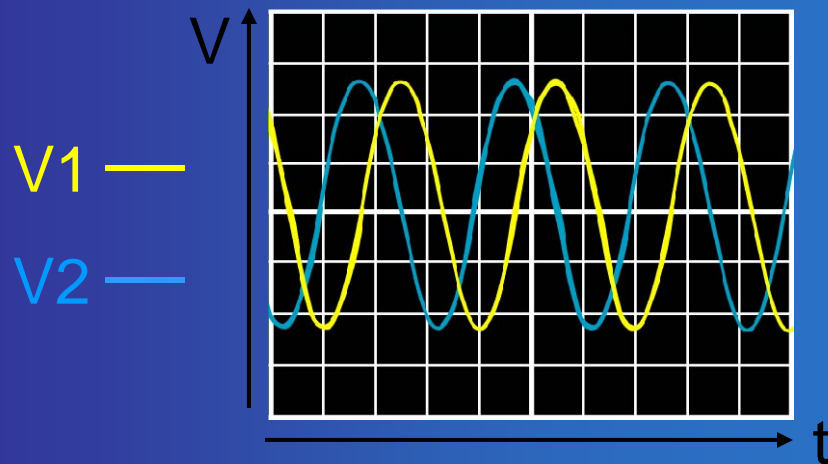
2-NOT NAND 2-NOT

# Parameters

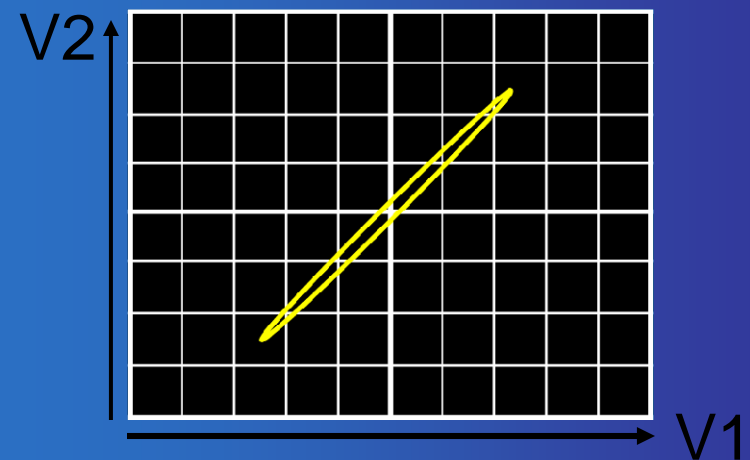
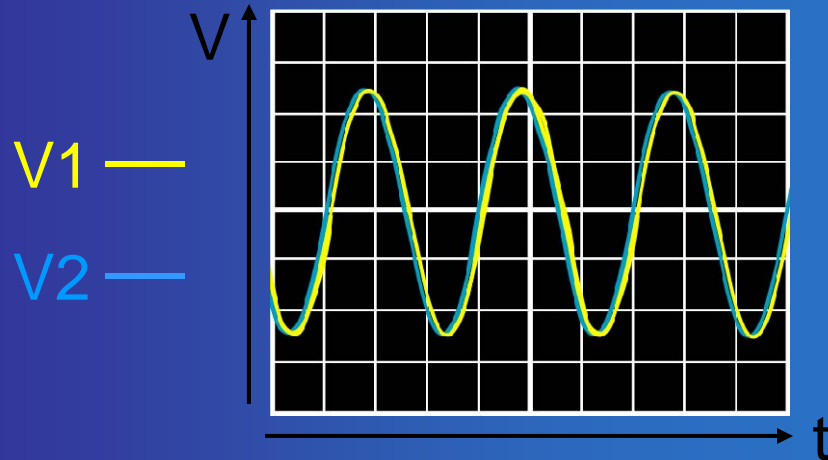
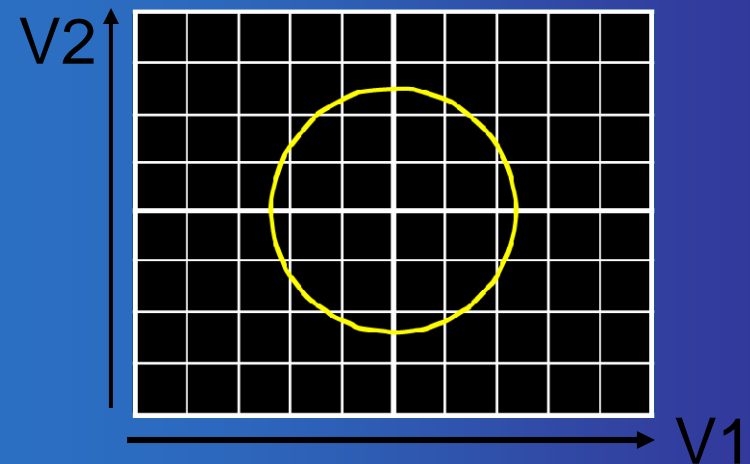
- Voltage
- Circuit layout
- Temperature
- Amount of free wire
- Capacitive filtering of power supply
- Radio driving
- Arrangement of wires and nearby objects

# Phase portraits

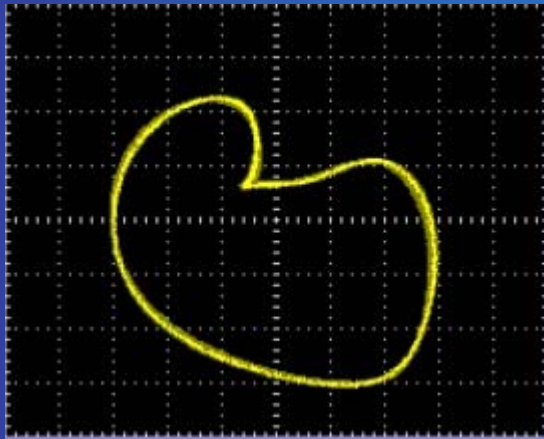
V vs. t graph



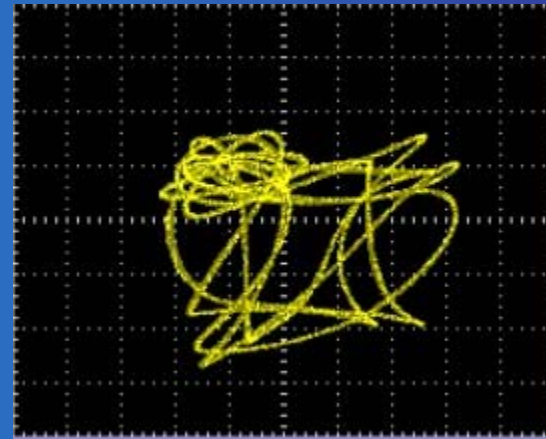
V1 vs. V2 graph



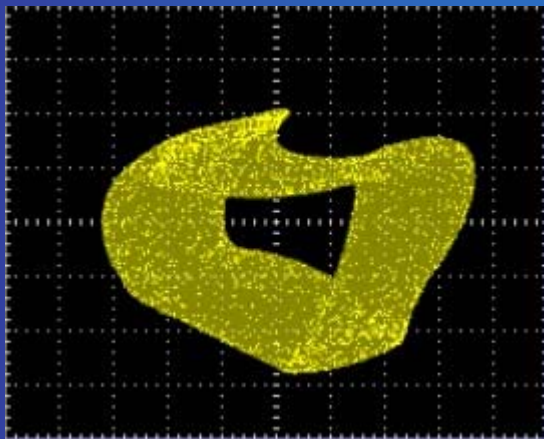
# Classes of Behavior



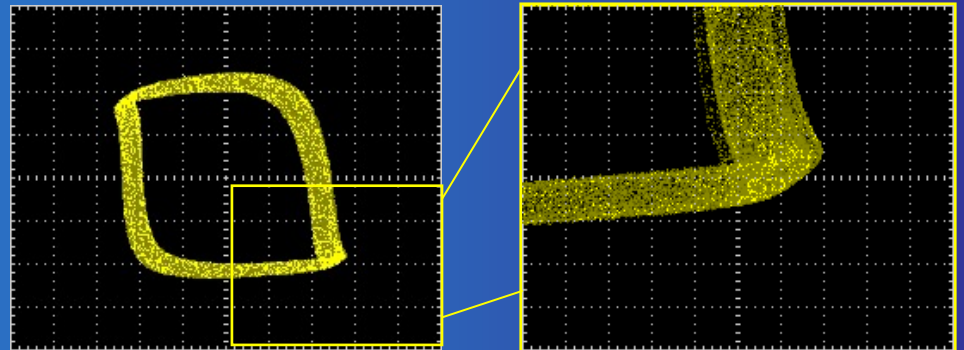
Periodic



Multiply Periodic

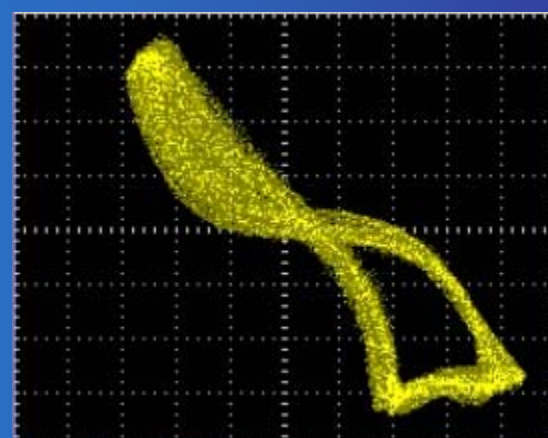
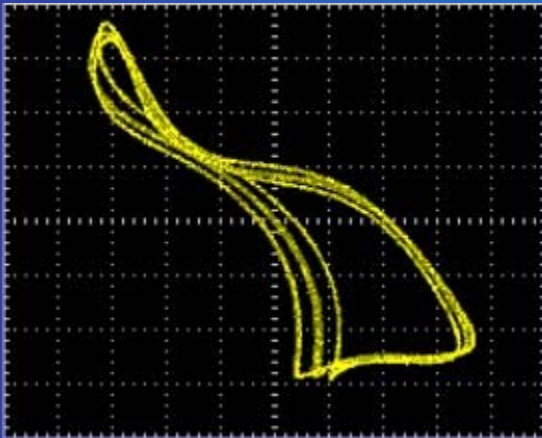
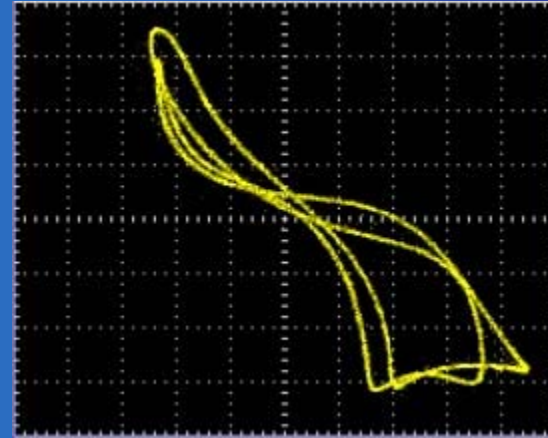
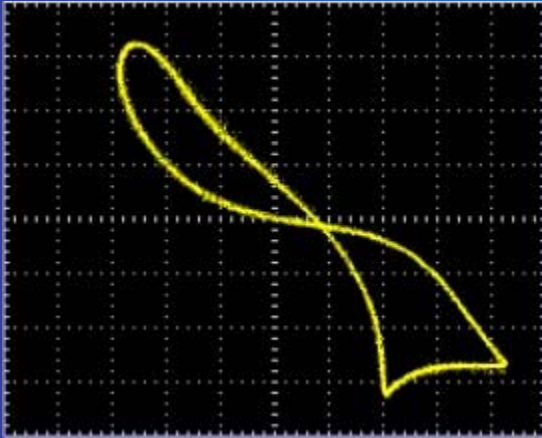


2-tori



Chaotic

# Environmental sensitivity



# Possible future research

- With radio driving: Measure synchronization of circuit oscillations to external forcing, measure resonant frequency vs. natural frequency, etc.
- Quantify and better understand sensitivity and responses to environment
- Study transitions between states