INVESTIGATE A CHAU CHAOS CIRCUIT (L,R DIODE IN SERIES) -COMPARE IT ALINEAR L, C,R RESONANT CIRCUIT

Supervisor: Steve Hall

Group Member: YifanWei, TianjianZhong, Lochlainn Hankin-Appleby (In no particular order)

UNIVERSITY OF LIVERPOOL

Introduction:

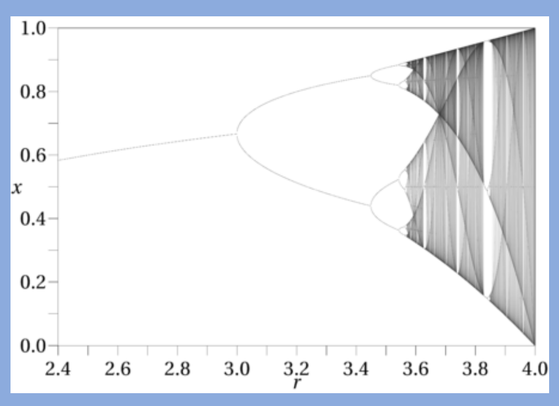
The goal of this project is to study chaos through circuits. Chaotic phenomenon refers to the seemingly random irregular motion occurring in a deterministic system, and it is irreversible and unpredictable. For the purpose of study the relation of non-linear component and chaos phenomenon, a simple RL-Diode circuit with a resistance, a diode and an inductor was built.

Methodology:

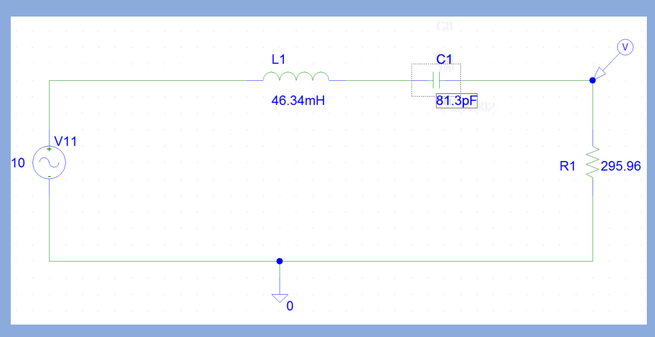
In mathematics, a period doubling bifurcation in a discrete dynamical system is a bifurcation in which a slight change in a parameter value in the system's equations leads to the system switching to a new behavior with twice the period of the original system. With the doubled period, it takes twice as many iterations as before for the numerical values visited by the system to repeat themselves.

A period doubling cascade is a sequence of doublings and further doublings of the repeating period, as the parameter is adjusted further and further.

Period doubling bifurcations can also occur in continuous dynamical systems, namely when a new limit cycle emerges from an existing limit cycle, and the period of the new limit cycle is twice that of the old one.

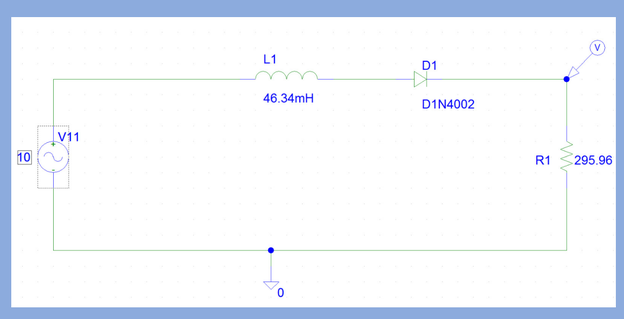


Bifurcation diagram for the logistic map



Final RLC circuit considering real component values

Resonence of RLD circuit



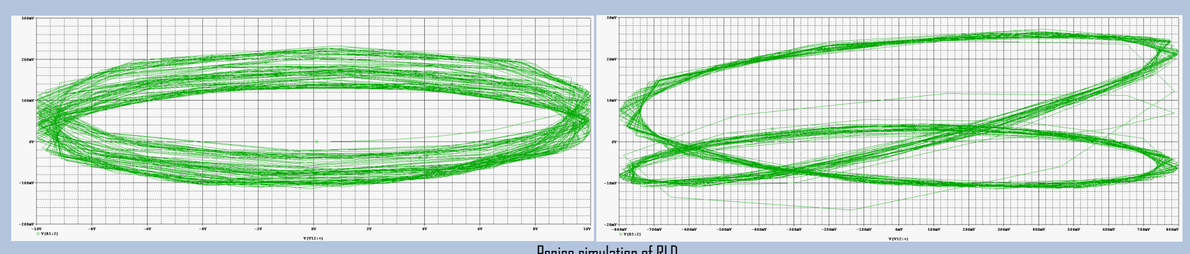
Final RLD circuit considering real component values

According to the principle of chaos circuit, chaos can be simulated by chaotic circuits, and there are three necessary conditions for chaotic circuits that can generate chaos: at least one of a nonlinear element and a linear resistor, and the energy storage element has not less than three. In this project, a linear resistance, a diode and an inductor be used in circuit as shown figure 1 and the values be recorded in table 1, and the normal chaos will be simulated by using this circuit. Additionally, the expected resonance frequency could be calculated as simulation = 81.37KHz.

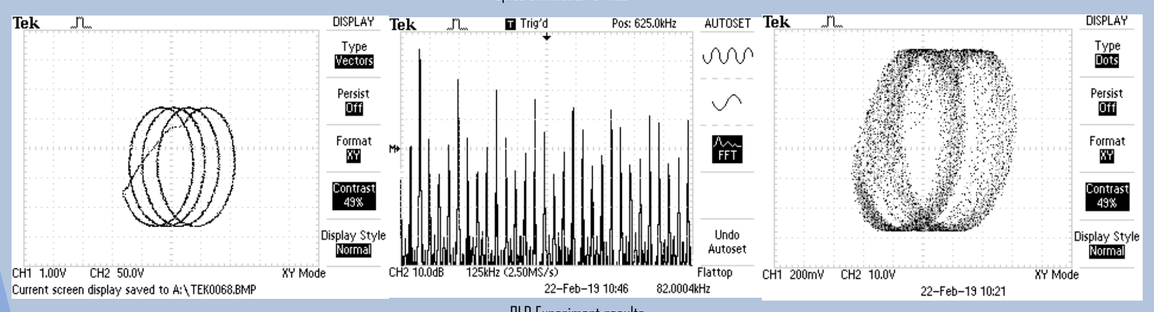
Experiment result:

RLD circuit

The RLD circuit shows chaos in both pspice simulation and experiment. Increasing the amplitude, the output signal shows more than one rings even infinite rings which is totally chaos. The FFT graph also shows many different frequencies generate by the circuit.



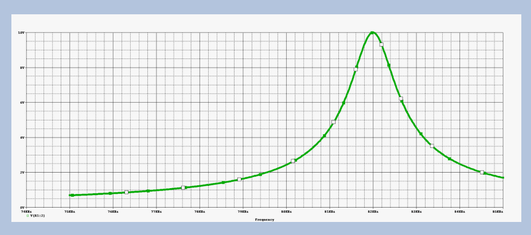
Pspice simulation of RLD



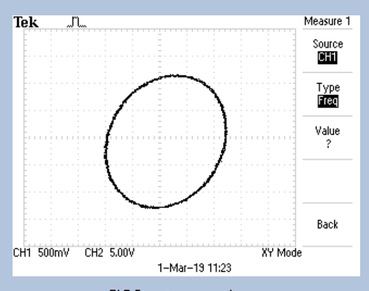
RLD Experiment results

RLC circuit

The simulation shows the resonant frequency is 82kHz, the X-Y graph in oscilloscope os always a ring which show the circuit is liner.



RLC resonance frequency



RLC Experiment results

Conclusion:

The chasing chaos experiment successfully verified the theory of chaos.

During the experiment, the RLD circuit with a non-liner component diode could cause chaos in several amplitudes which cannot be generate from liner RLC circuit.

However, the simulation results are different from the real experiment which may cause by unconsidered capacitor or inductance of the diode or the system error of measuring instruments.

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