

Results:

Experimental setup:

Using a function generator to provide V_2 , set to 142 kHz sinusoid wave.

Using an oscilloscope to monitor the bifurcation point and measure the voltages of V_1 and V_2 .

Repeat the measurements 5 times.

Use formula: $\delta = \frac{V_2 - V_1}{V_3 - V_2}$ [1] to calculate the Feigenbaum constant.

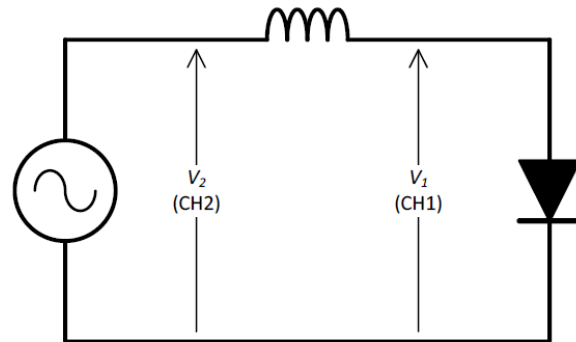


Figure 1: circuit diagram for Chaotic Oscillator, reproduced from University of Southampton, X3 laboratory experiment [2]

No.	1->2 V_{1osc}/V	1->2 V_{1func}/V	2->4 V_{2osc}/V	2->4 V_{2func}/V	4->8 V_{3osc}/V	4->8 V_{3func}/V	Result
1	1.68	1.48	2.16	1.97	2.28	2.1	4
2	1.64	1.48	2.12	1.97	2.28	2.1	3
3	1.68	1.48	2.16	1.97	2.24	2.1	6
4	1.64	1.48	2.16	1.97	2.24	2.1	6.5
5	1.68	1.48	2.16	1.97	2.28	2.1	4
Standard value							4.669

V_{nosc} : Peak-to-peak voltage measured by oscilloscope

Table 2: measurements and results

V_{nfunc} : Peak-to-peak voltage set by function generator

Result: The Feigenbaum constant calculated using voltage measured by oscilloscope

Standard value: The Feigenbaum constant given by Wikipedia.org. [1]

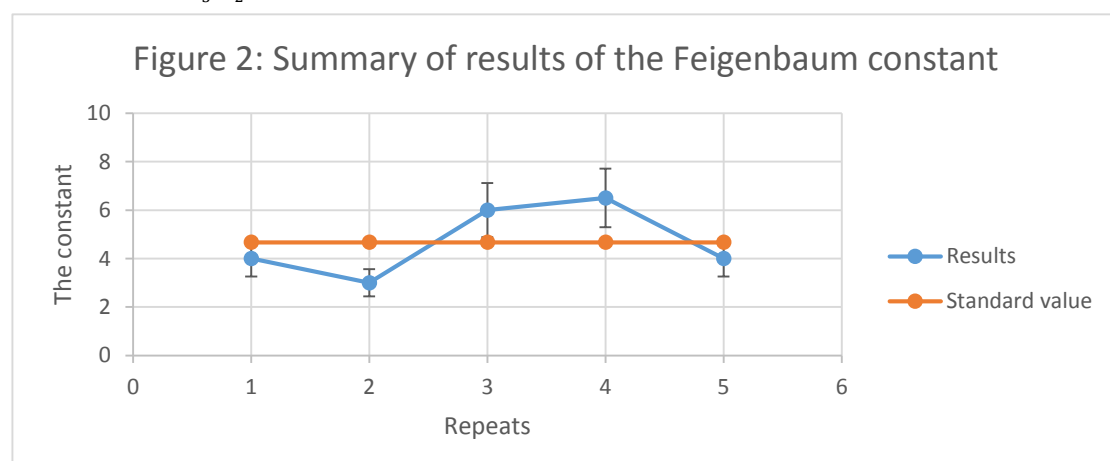
Error calculation:

Error rate of oscilloscope: $\pm (3\% \times \text{reading} + 0.1 \text{ div} + 1 \text{ mV})$ [3]

Precision of function generator pk-pk voltage: 0.01V for V_1 and V_2 , 0.1V for V_3 .

So total error of V_1 is 3.74%, V_2 is 3.55%, V_3 is 7.81%.

By formula $\delta = \frac{V_2 - V_1}{V_3 - V_2}$ [1], error percentage of results by adding errors together is 18.65%.



[1]: http://en.wikipedia.org/wiki/Feigenbaum_constants

[2]: <https://secure.ecs.soton.ac.uk/notes/ellabs/1/x3/x3.pdf>

[3]: https://secure.ecs.soton.ac.uk/notes/ellabs/databook/equip/TDS2000_User_Manual.pdf

Discussion:

The 5 results got from the experiment are: 4, 3, 6, 6.5 and 4.

Calculate the mean result: 4.7

Standard result got from Wikipedia.org is 4.669 [1].

Some possible error sources:

1. Instruments, totally 18.65%
2. Percentage error of varies of results, $(6.5 - 3) / 2 / 4.7 * 100\% = 37.2\%$
3. Human error

Apply error percentage of 18.65%, the actual result range can be from 3.82 to 5.58.

The standard result 4.669 [1] is in the range, so the mean result 4.7 is acceptable.

But, the error percentage of the result is quite big, so the result is not accurate and reliable at all.

[1]: http://en.wikipedia.org/wiki/Feigenbaum_constants