RECONSTRUCTION OF CHAOTIC ATTRACTOR THROUGH FREESCALE DIGITAL SIGNAL PROCESOR

Ing. Jiří HNÍZDIL, Doctoral Degree Programme (2)
Dept. of Power Electrical and Electronic Engineering, FEEC, BUT
E-mail: xhnizd00@stud.feec.vutbr.cz

Ing. Jan NOVOTNÝ, Doctoral Degree Programme (1)
Dept. of Power Electrical and Electronic Engineering, FEEC, BUT
E-mail: xnovot40@stud.feec.vutbr.cz

Supervised by: Dr. Josef Koláčný

ABSTRACT

This article deals with reconstructing chaotic attractor trought Freescale digital signal procesor 56800 family. System is designed for use in the mechatronics aplications for simulating dynamic's states of prothetic's knuckle. Conception of project fully supplants chaotic analog circuits.

1 INTRODUCTION

Every system in the nature has an attractor. Attractor is a steady state of any state variables in the space. It can be for example steady velocity of motor shaft, steady trajectory of the Moon around the Earth and so on.

We known this types of atractors:

- Attractor is a fixed points

- Attractor is a periodic points

- Attractor is a kvaziperiodic points

- Chaotic attractor

- Strange attractor

Visualization of atractors creates different diagrams for example visualization of chaotics attractor give pictures called as a fractals. Fractals can be used in computer graphics as a textures, in the nature – for example structure of fem list. We implement fractal geometry into digital signal procesor.

For more informations about attractors see some books which are listed on the end of this paper in referrences chapter.

2   MAIN PART

Chaotic system can be represented trought two different electrical circuits:

2.1   CIRCUITS WITH ANALOG DEVICES

In this case, circuit is created trought analog operation amplifier with nonlinear components in the feed forward loop. Classic schematic circuit which represents chaotic behavior is shown bellow on the figure no.1
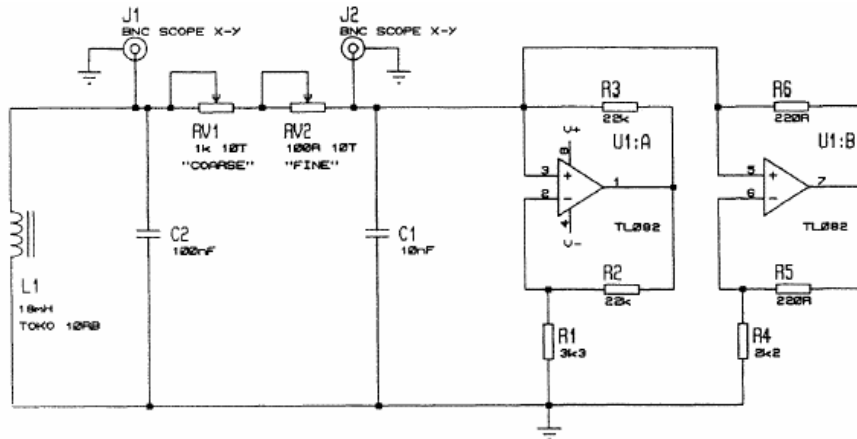

Fig. 1:   *Circuit diagram of analog chaotic system*

Epitome of analog chaotic integrated device is for example Yamakawa's Lab & FLSI Chaos chip.

2.2   CIRCUITS WITH DIGITAL DEVICES

In this case, chaotic behavior is represented by means of mathematical algoritm stored in the microprocessor. This algoritm generates numbers and these numbers are conversated by digital analog converter. Circuit diagram is shown bellow on the figure no.2
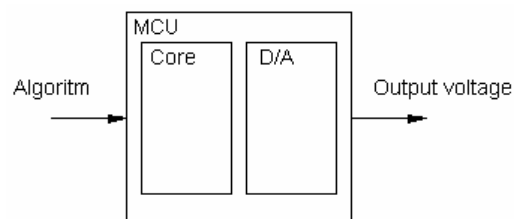

Fig. 2:   *Digital representation of chaos system*

3   DESIGN

Freescale digital signal processor 56800 was used to develope system with chaotics

attractor. Math representation of chaotic attractor was stored in the DSP system memory, where run into iteration cycle.

Used math model is created by these equations:

For x axis:

$$x_n = \sin(y_{n-1} - b) + c\sin(x_{n-1} - b)$$

For y axis:

$$y_n = \sin(y_{n-1} - a) + c\sin(y_{n-1} - b)$$

Where

a,b	Initial conditions
x_n, y_n	present iteration step x and y axes position
x_{n-1}, y_{n-1}	previous iteration step x and y axes positon

Outputs from digital to analog converters was connected to aritma 2d plotting system with prothetic knuckle. Frescale evolution board with dsp and aritma 2d ploting system are shown bellow on the figure no.3

Fig. 3:   *Evolution dsp board with 2d ploting system and scope*

Used math algoritm is very sensitive on the initial conditions change. Some records of chaotic attractor are shown on the figures bellow in the result chapter. Type of reconstructed chaotic attractor is called as King's dream fractal.
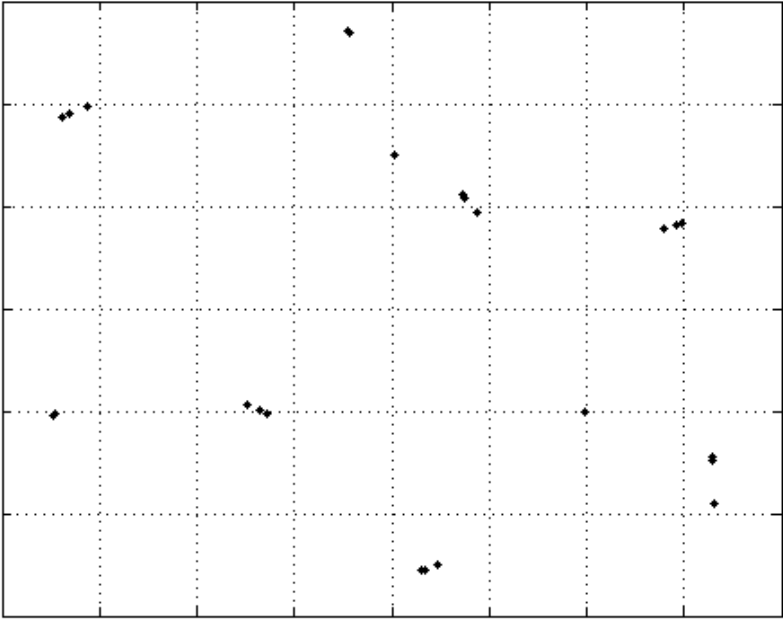
4 RESULTS

Fig. 4: *Chaotic system with different initial variables set no. 1*
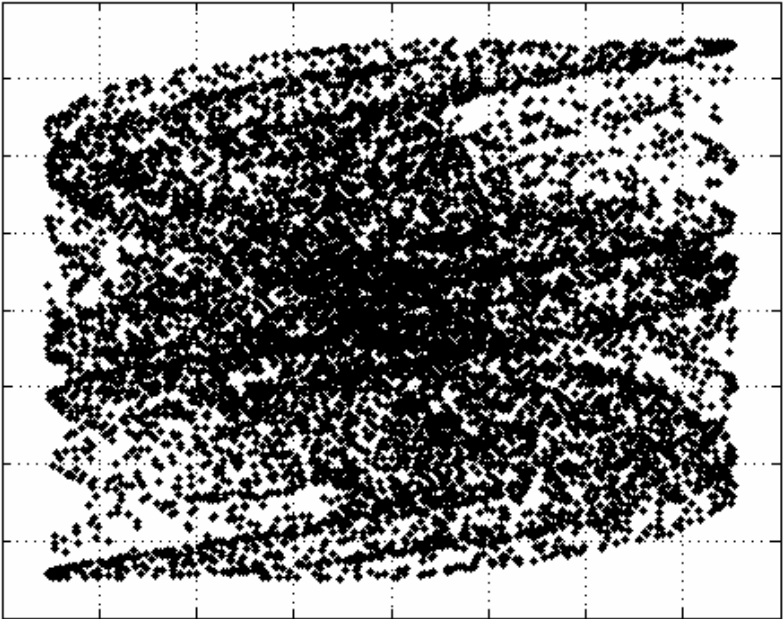

Fig. 5: *Chaotic system with different initial variables set no. 2*

Fig. 6: *Chaotic system with different initial variables set no. 3*

5   CONCLUSION

We created machatronic's aplication with digital signal procesor which one can be used for simulating dynamics states of prothetics knuckle. All of results are listed in the paper.

REFERENCES

[1] Chaos in Wonderland: Visual Adventures in a Fractal World, Palgrave Macmillan; Reprint edition (November 1, 1995), ISBN: 031212774X

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[4] http://ej.iop.org/links/q98, 2005