

# Alice in Stretch & SqueezeLand: 9 Nerves

August 12, 2012

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# Chapter Abstract

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Sensory neuron data from dogfish, catfish, and rats appear to show signs of chaotic behavior.

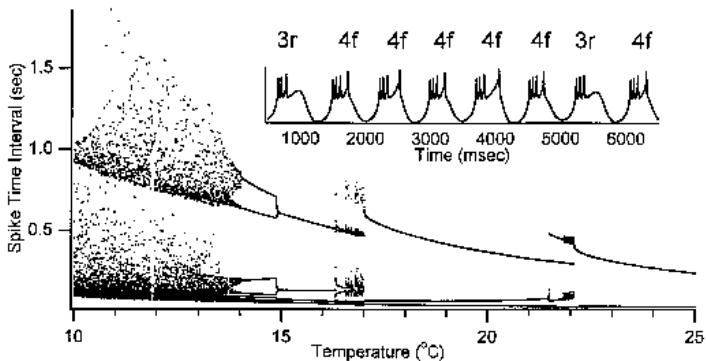
A five-parameter HH model was built to describe these data.

The model is effectively three dimensional.

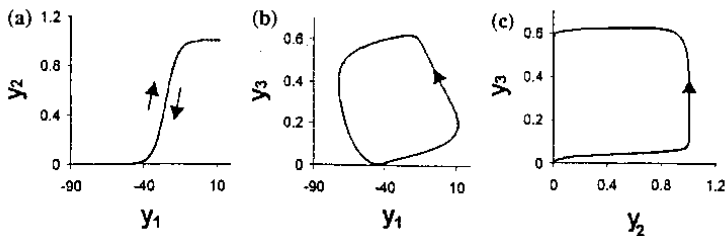
A topological analysis was carried out, revealing a 'gateau-roulé' mechanism (same as Nd doped fiber laser).

A simple 2-parameter mechanism describes perestroikas produced by temperature changes.

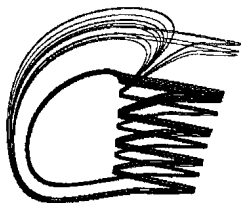
## Is This Predictable or Not?



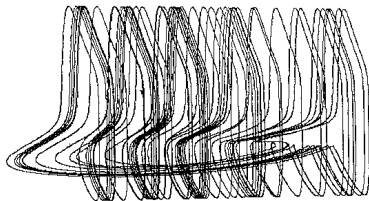
## Some Variables are Strongly Correlated



## The Attractor can be Projected in Many Ways



$y_4$ - $y_5$  Plane

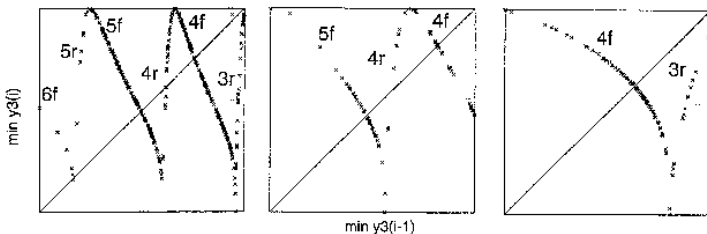


$\frac{dy_4}{dt}$ - $y_5$  Plane

# First Return Maps at Different Temperatures

## The Return Map

### “Drifts” with Temperature



$T = 12^\circ \text{C}$

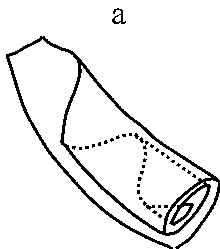
$T = 13.5^\circ \text{C}$

$T = 16.5^\circ \text{C}$

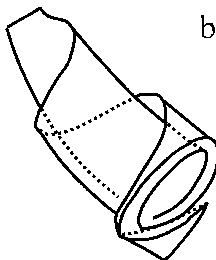
# Scroll Templates

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Outside to Inside



Inside to Outside



Branch	Array	0	1	2	3	4	5	6	7	8	9
0	1N-0	0	0	0	0	0	0	0	0	0	0
1	-N+0	0	1	2	2	2	2	2	2	2	2
2	1N-1	0	2	2	2	2	2	2	2	2	2
3	-N+1	0	2	2	3	4	4	4	4	4	4
4	1N-2	0	2	2	4	4	4	4	4	4	4
5	-N-2	0	2	2	4	4	5	6	6	6	6
6	-N-3	0	2	2	4	4	6	6	6	6	6
7	-N-3	0	2	2	4	4	6	6	7	8	8
8	-N-4	0	2	2	4	4	6	6	8	8	8
9	-N+4	0	2	2	4	4	6	6	8	8	9

Branch	Array	0	1	2	3	4	5	6	7	8	9
0	0	0	0	2	2	4	4	6	6	8	8
1	-1	0	1	2	2	4	4	6	6	8	8
2	+1	2	2	2	2	4	4	6	6	8	8
3	-2	2	2	2	3	4	4	6	6	8	8
4	+2	4	4	4	4	4	4	6	6	8	8
5	-3	4	4	4	4	4	4	6	6	8	8
6	+3	6	6	6	6	6	6	6	6	8	8
7	-4	6	6	6	6	6	6	6	6	7	8
8	14	8	8	8	8	8	8	8	8	8	8
9	-5	8	8	8	8	8	8	8	8	8	9

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# Some Periodic Orbits

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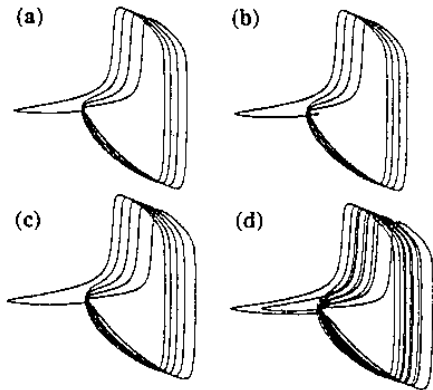
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(a):  $4f$

(b):  $4r$

(c):  $5f$

(d):  $(4f, 5f)$



# Steps in Constructing Scroll Template

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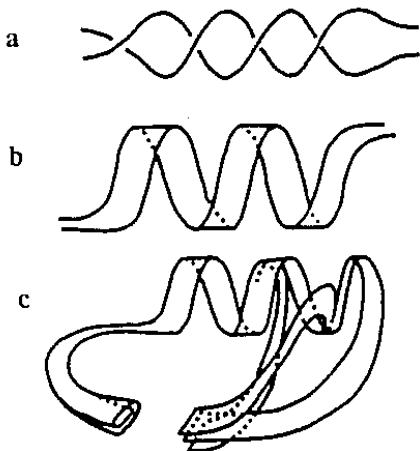
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Twist

Relax

Return

# A Simple Two-Parameter Model of Chaotic Nerves

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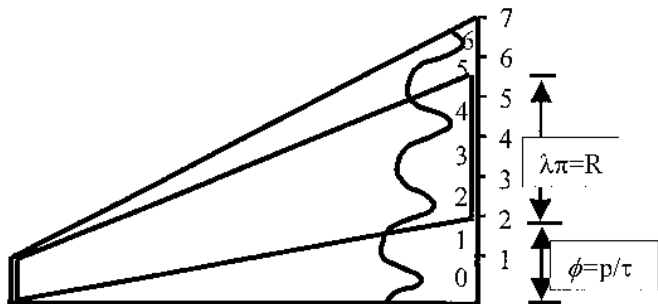
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$\Phi = \text{Drift}$

$\lambda = \text{Stretch}$