

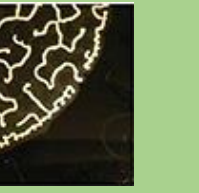


# Stress concentration in the local load sharing fiber bundle model

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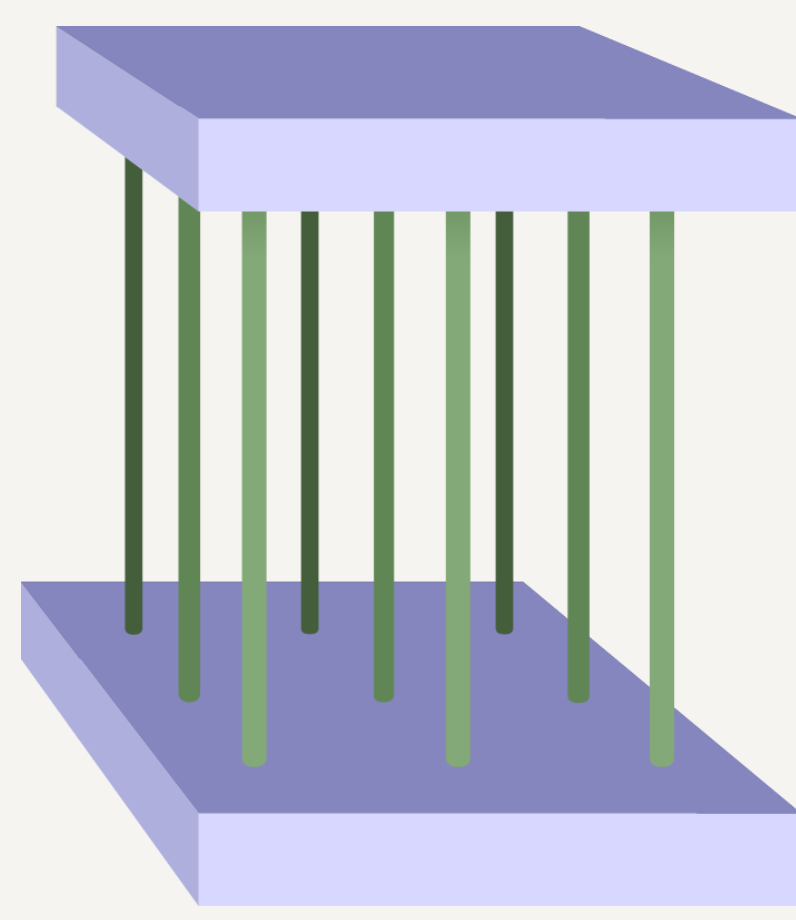
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## A. INTRODUCTION

A fiber bundle is a system of Hookian springs that pull on two plates. Each fiber has a random threshold value between  $t$  and 1 that determines at what point the fiber breaks.



### Equal Load Sharing

There are different variations on the fiber bundle model. One of the simpler models is the Equal Load Sharing (ELS). When a fiber breaks, its force is distributed **equally** onto all other fibers.

The grid shows the **relative force** on the fibers. Note that the sum of all the fibers is always equal to the number of cells in the grid.

$L = 3$

X	$9/8$	$9/8$
$9/8$	$9/8$	$9/8$
$9/8$	$9/8$	$9/8$

### Local Load Sharing

In Local Load Sharing (LLS) broken fibers form a **cluster**, and the load of the broken fibers is shared with fibers that boarder the cluster. We call these fibers the **outline** of a cluster.

The left grid shows a bundle with one broken fiber, and right grid shows how the bundle changes when a second fiber breaks.

**S**: size of the cluster. **L**: size of the system.

$L = 4 \quad s = 1$

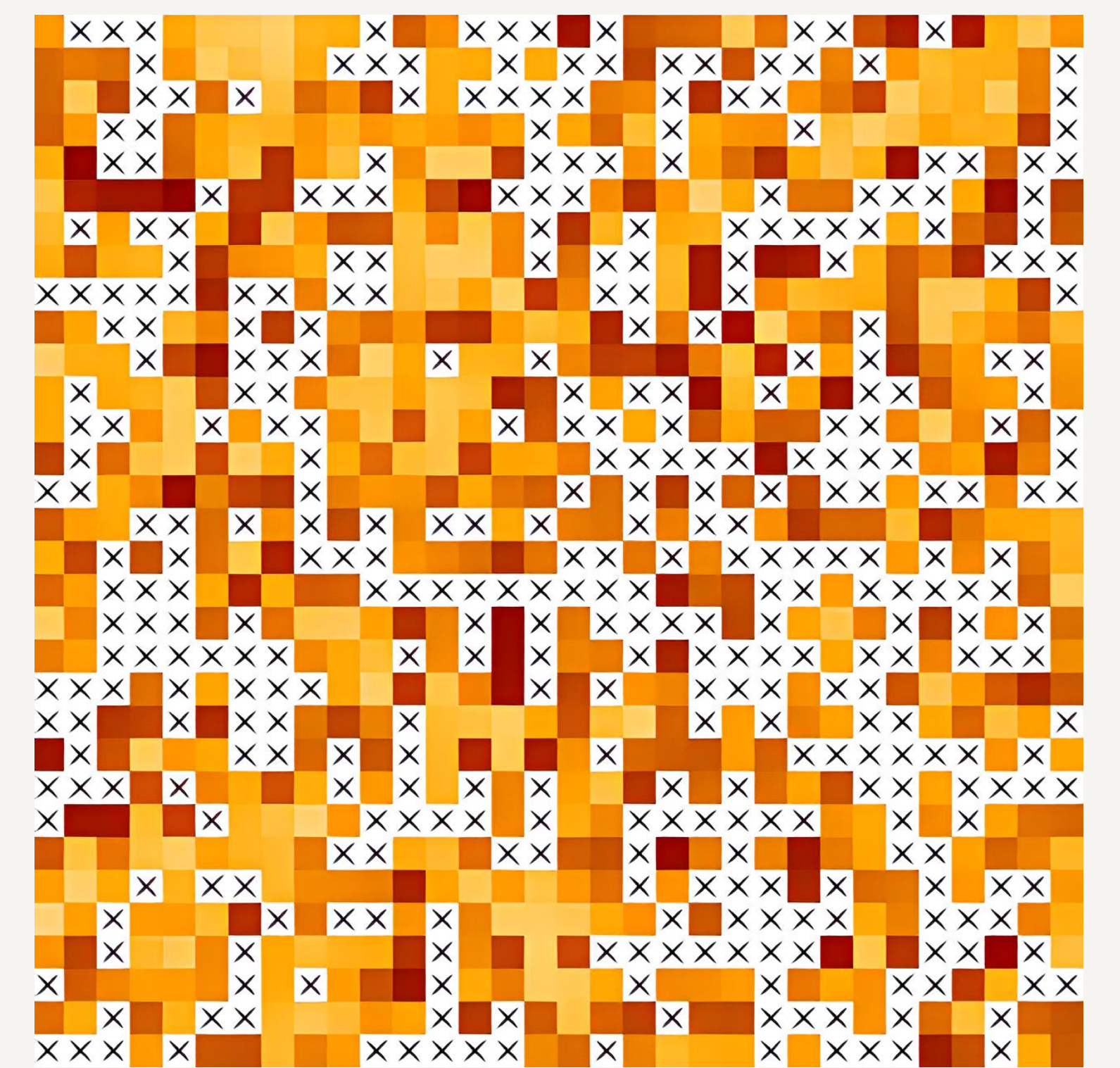
1	$5/4$	1	1
$5/4$	X	$5/4$	1
1	$5/4$	1	1
1	1	1	1

$L = 4 \quad s = 2$

1	$8/6$	$8/6$	1
$8/6$	X	X	$8/6$
1	$8/6$	$8/6$	1
1	1	1	1

The LLS is often *more* realistic than the ELS, but to say that either is *realistic* at all might be a stretch. One issue with the LLS we can qualitatively observe is that the way the systems breaks is fractal.

## A: Standard (UNR)



## B. STRESS CONCENTRATION DETERMINED BY NEIGHBOURHOODS

In the standard LLS, load is **uniformly distributed** on the outline of the cluster. We can shift this distribution depending on the number of neighbours.

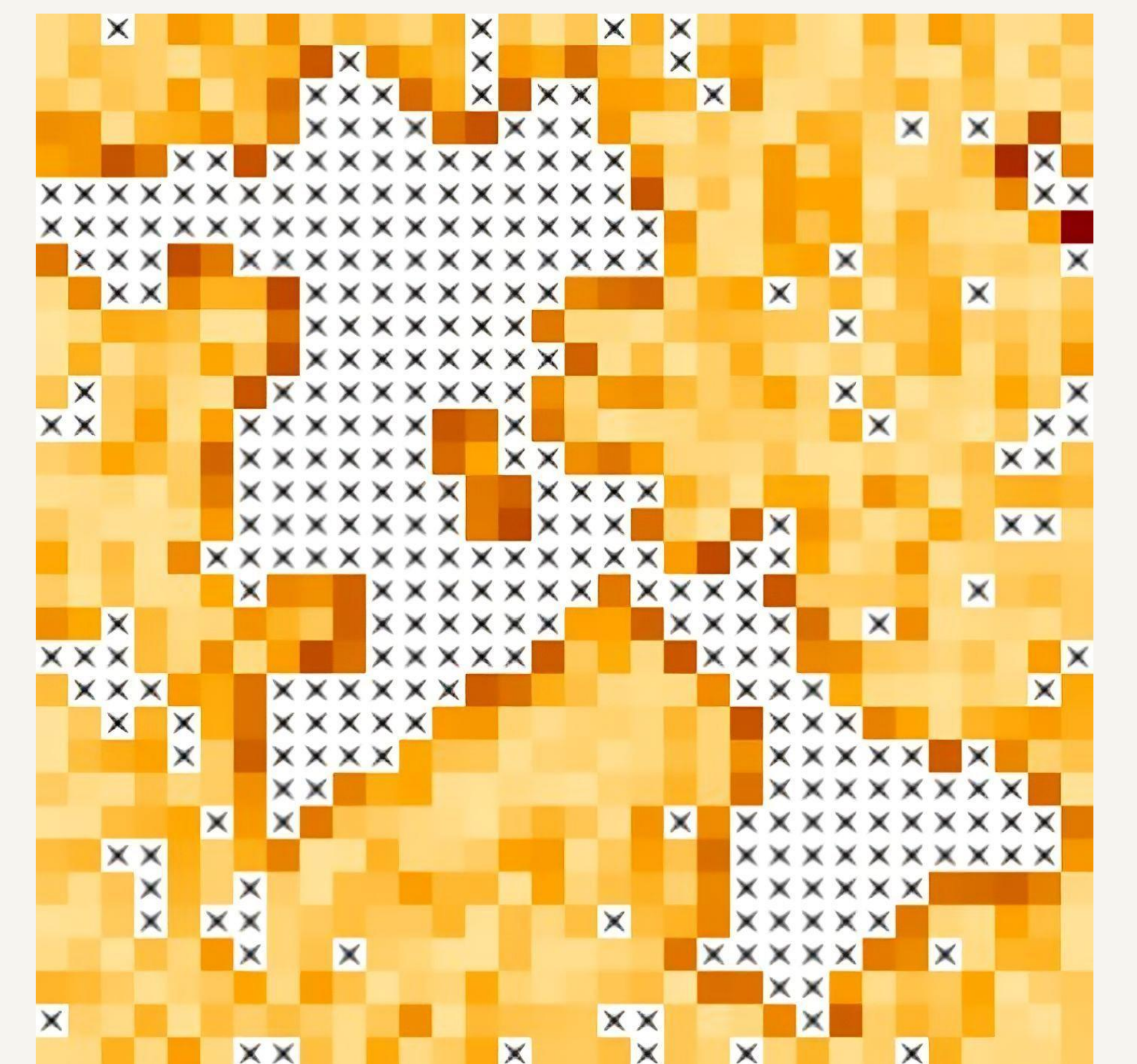


The standard LLS uses as uniformly distributed neighbourhood rule (**UNR**), and that we introduce a stress enhancing neighbourhood rule (**SNR**).

### Summary

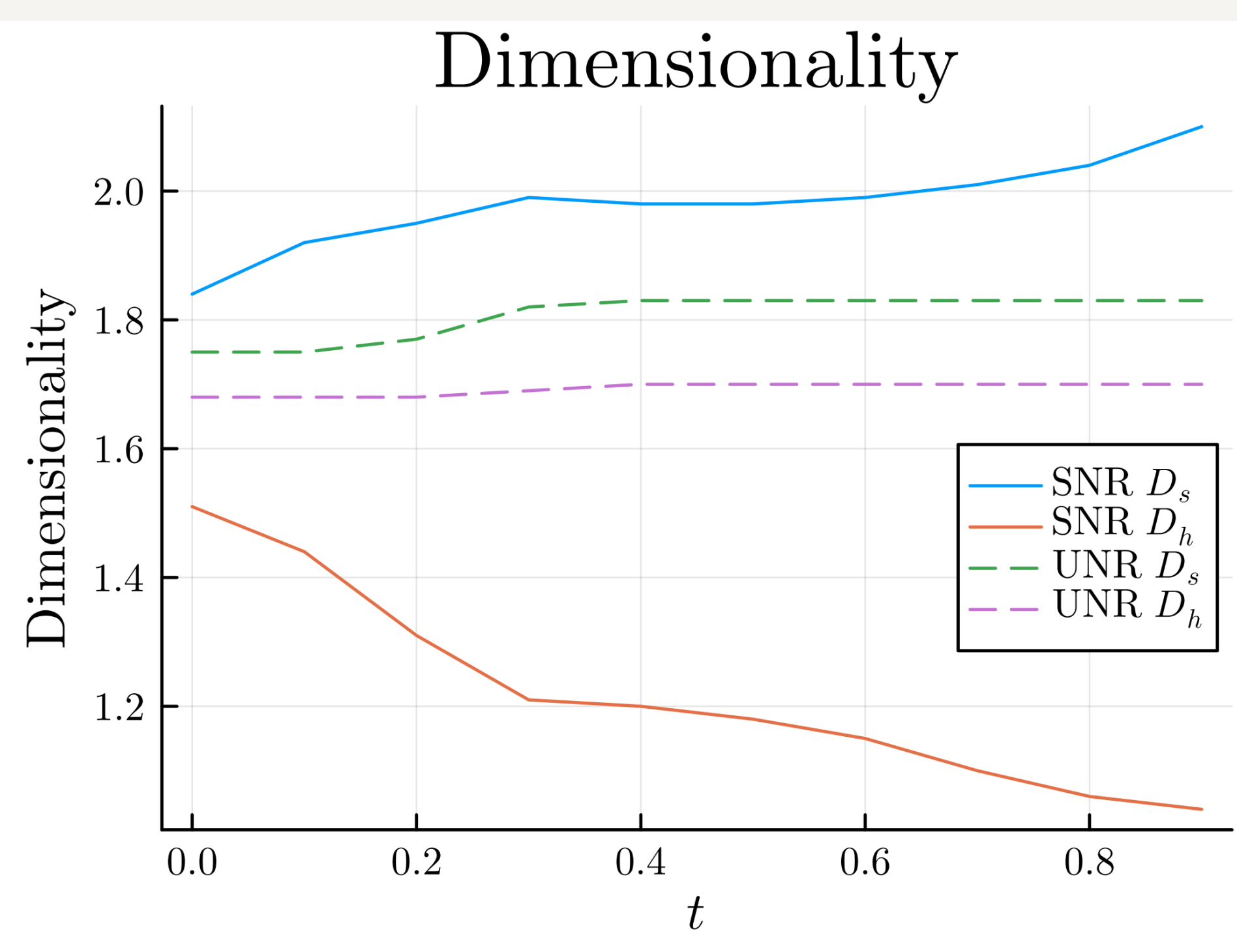
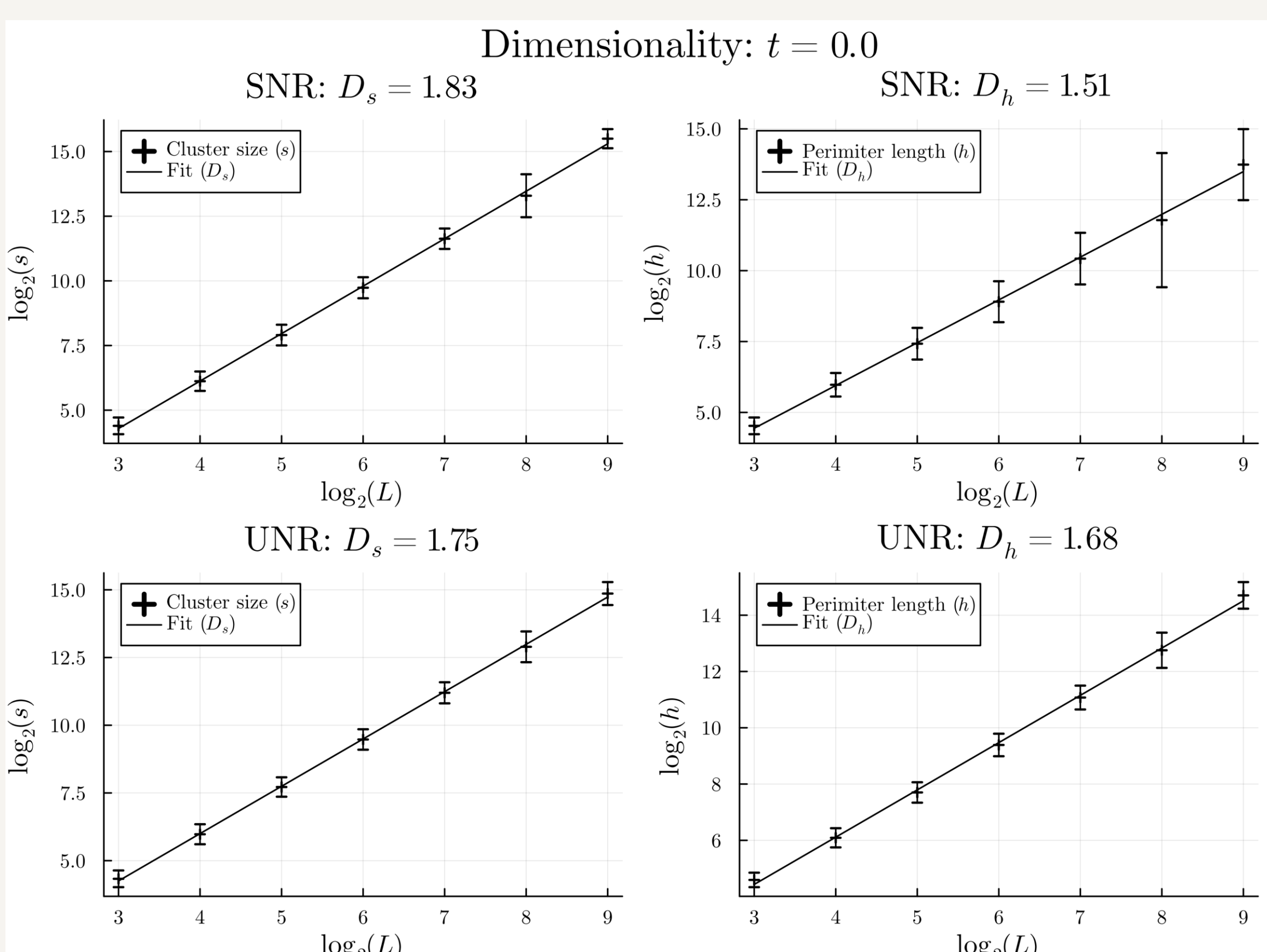
Introducing a neighbourhood dependance makes the bundle break in a less fractal way. Compare the situations depicted in figures A and B.

## B: SNR



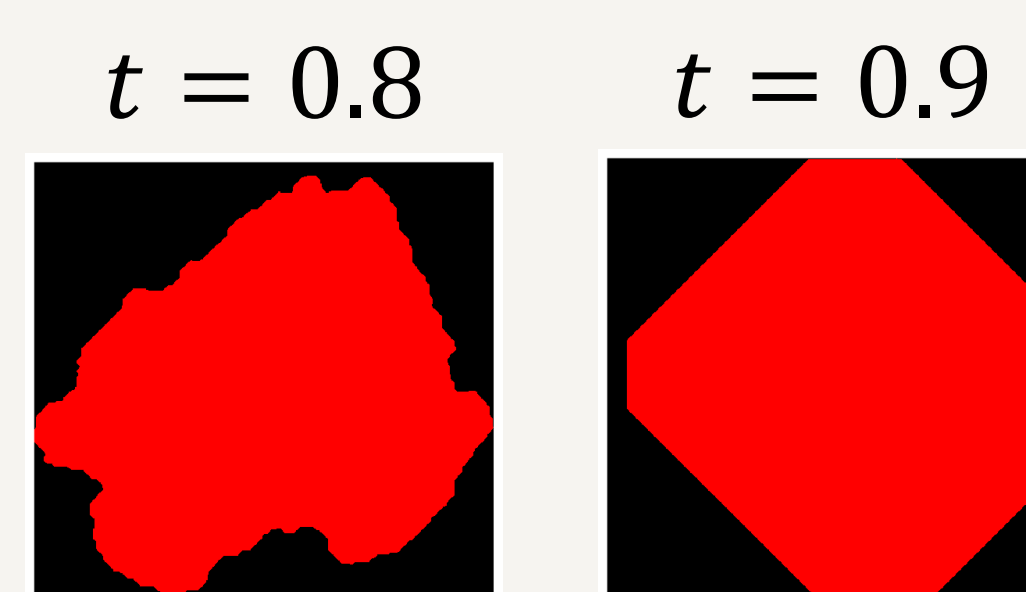
## C. DIMENSIONALITY

We can quantitatively analyse the effect of this change by looking at the dimensionality of the clusters. We do this by plotting the size of the largest cluster  $s$  by the size of the system  $L$  in a log plot, and the slope of the line is the dimensionality of the cluster. We do the same for the outline.



Repeating this process for several values of  $t$  gives us somewhat strange and unexpected results that require further investigation. These results are based on 200 samples for all sizes of  $L$ .

This shows what happens when  $t$  becomes large for **SNR** systems.



The images below show each cluster in a random color except the largest cluster in red. Note that the **UNR** is not drawn with a darker red.

$L = 1024 \quad t = 0.2$   
**SNR** **UNR**

