

List of simulations

Here are described the simulations whose visualizations can be found on:
<http://cui.unige.ch/~thorimby/coral/>. All the file names are on the form *SimulationID - nameOfTheDocument*.

The table below summarizes the main parameters for each simulation:

Simulations					
Sim ID	Reynolds number	Threshold	Particle probability	Seed Type	Content
A	10^3	4	$2 \cdot 10^{-3}$	3 spheres	Fractal Dim Plot
B	10^3	4	$2 \cdot 10^{-3}$	1 cross	Fractal Dim Plot
C	10^3	4	$2 \cdot 10^{-3}$	1 sphere	Video/pic
D	10^3	4	$2 \cdot 10^{-3}$	Array of spheres	Video
E	10^3	4	$2 \cdot 10^{-3}$	2 spheres	Video
F	10^3	8	$2 \cdot 10^{-3}$	3 crosses (superimposed)	Video/pics
G	10^1	4	$1 \cdot 10^{-3}$	1 cross	Pictures
H	10^1	40	$1 \cdot 10^{-3}$	3 spheres	Fractal Dim Plot

'Threshold' correspond to the number of particles to reach in order to transform a cell from next-to-coral to coral, while 'Particle probability' is the particle injection probability per cell.

Notice that I couldn't really manage to obtain a convincing 'fractal' appearance for any coral, probably for two main reasons:

1. The resolution is not large enough (obviously, we need a difference of at least 1 (but 2 or 3 would be really better) orders of magnitude for the space scale, between the biggest scale (coral's size) and the smallest one (cell size), which is not really the case here, with $\Delta X \approx 0.01$ m and coral size ≈ 0.1 m.
2. A finer tuning of the parameters of the flow and of the coral growth, as well as a proper geometrical setup could certainly improve the appearance of the coral, although many seed have been tested (multiple crosses superimposed, spheres, array of spheres, ..).

Fractal dimension

I used the Minkowski-Bouligand (or box-counting) method for determining the fractal dimension. For *A* (Fig. 1) and *B* (Fig. 3), the considered geometry was the contour of a 2D slice, so the 'real' dimension is 1, and the fractal dimension is clearly larger (around 1.5 for *A* and 1.25 for *B*). Pictures of the considered shapes for *A* (Fig. 2) and *B* (Fig. 4) are also provided. For *H* (Fig. 5), the considered geometry was the surface contour of the volume of the fractal, so the 'real' dimension is 2, and the fractal dimension is not much higher.

The noise on $D(\epsilon)$ plots can be explained by the fact that we analyze numerical data ; depending on the distribution of the boxes, D can take different values for a single value of ϵ . When the number of boxes used is low (*i.e* when ϵ is large, since the number of boxes goes like $1/\epsilon$), a slight change in their repartition on the domain to analyze can result in a significant change on estimated D . Hopefully this noise clearly reduces when a large amount of boxes is used.

Pictures

Note that videos are provided on <http://cui.unige.ch/~thorimby/coral/>. Note that in the pictures below, the iteration is given and not the real time, since this does not correspond to any physical system (coral don't grow in 30 seconds).

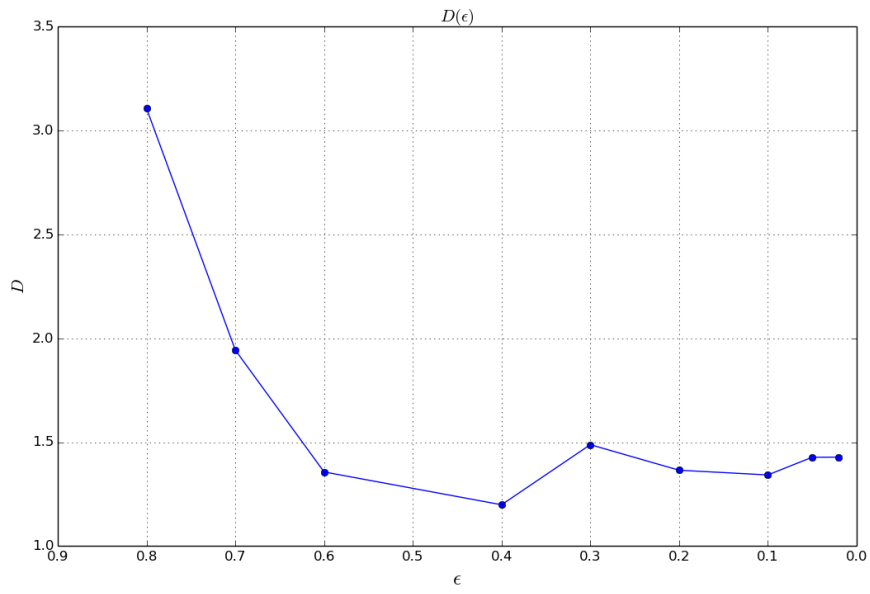


Figure 1: A fractal dimension.

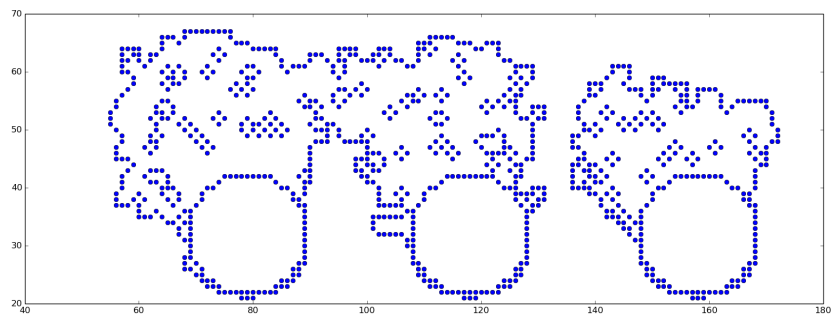


Figure 2: Shape used for A fractal dimension.

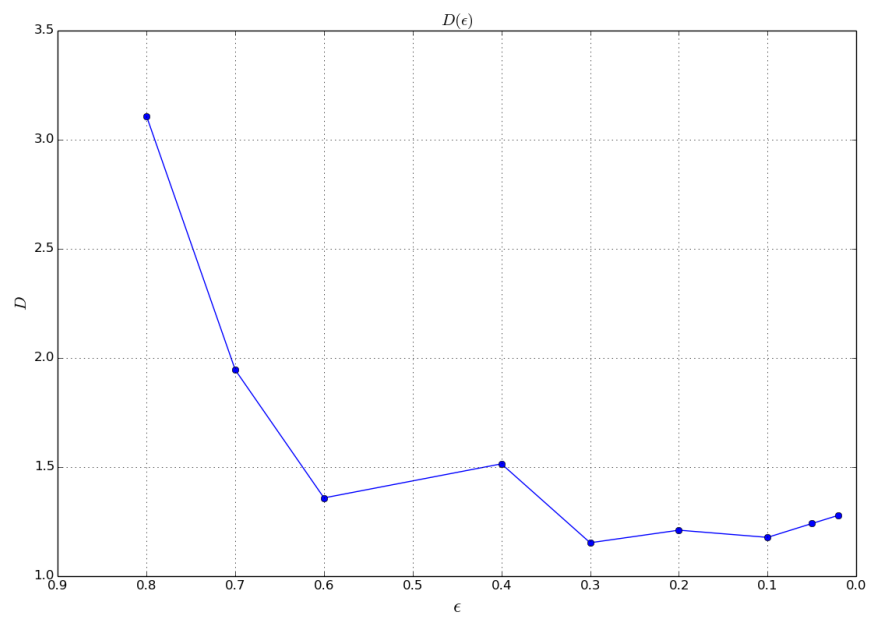


Figure 3: B fractal dimension.

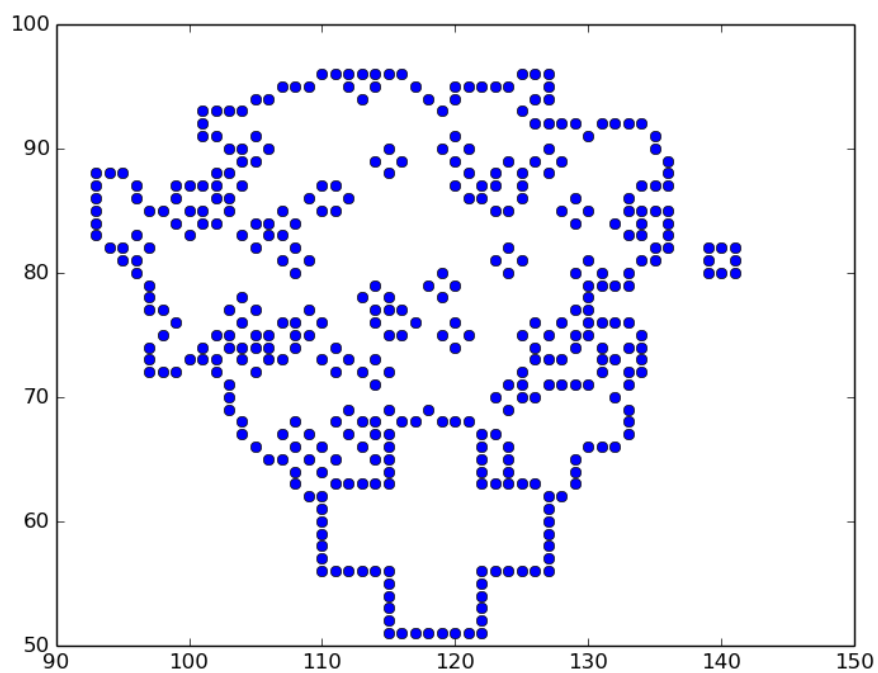


Figure 4: Shape used for B fractal dimension.

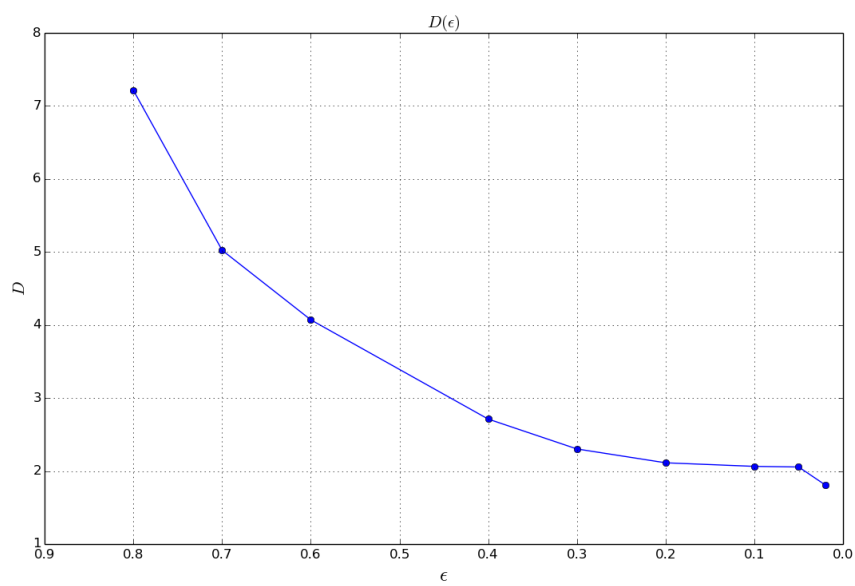


Figure 5: H fractal dimension.

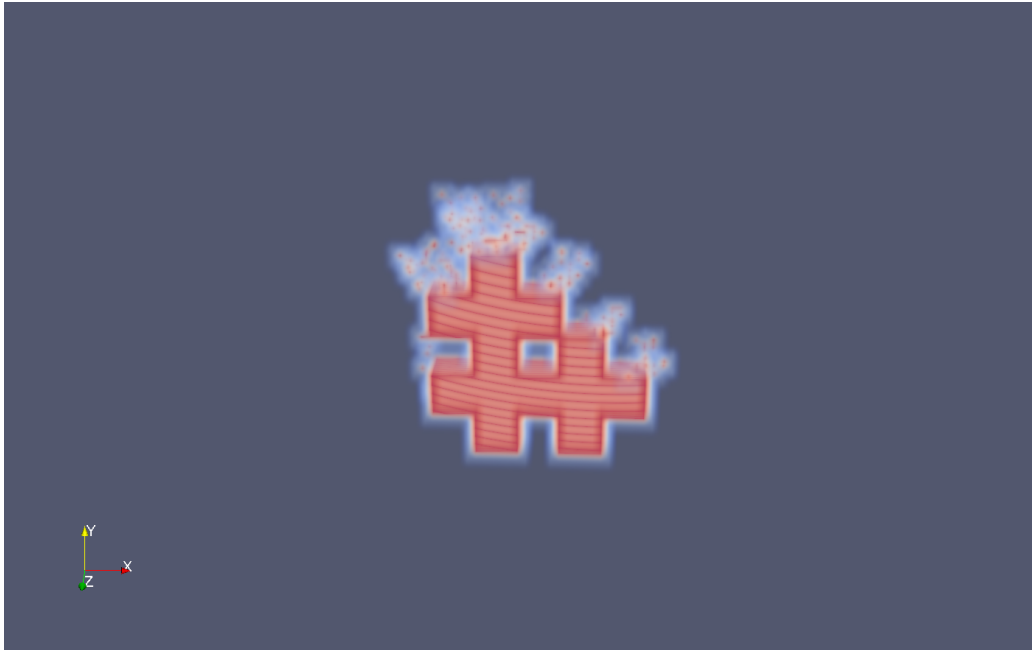


Figure 6: F at time $t = 50$

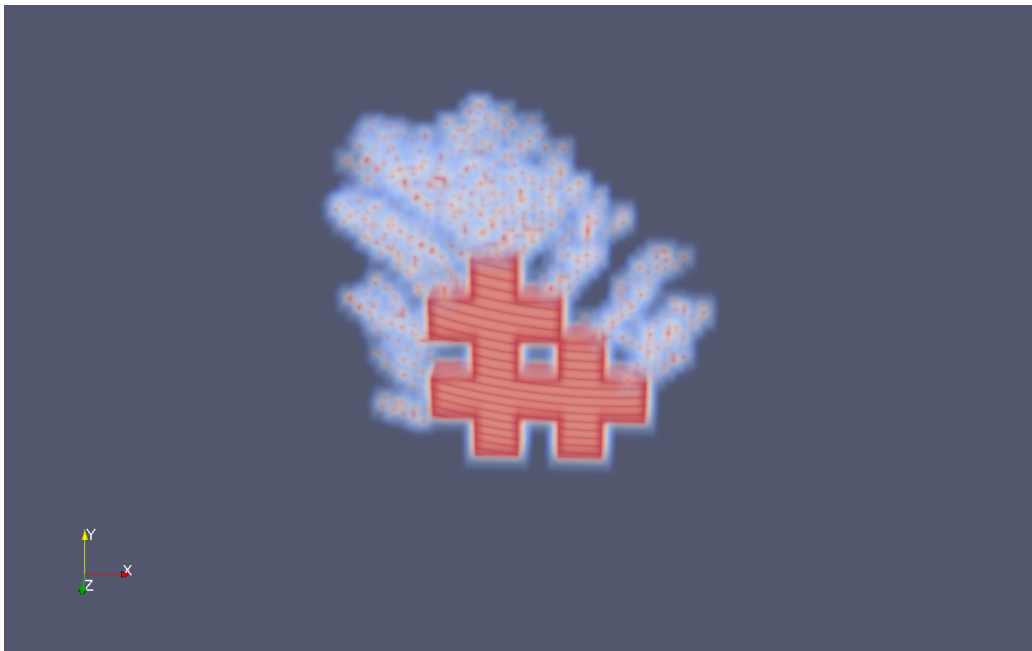


Figure 7: F at time $t = 80$

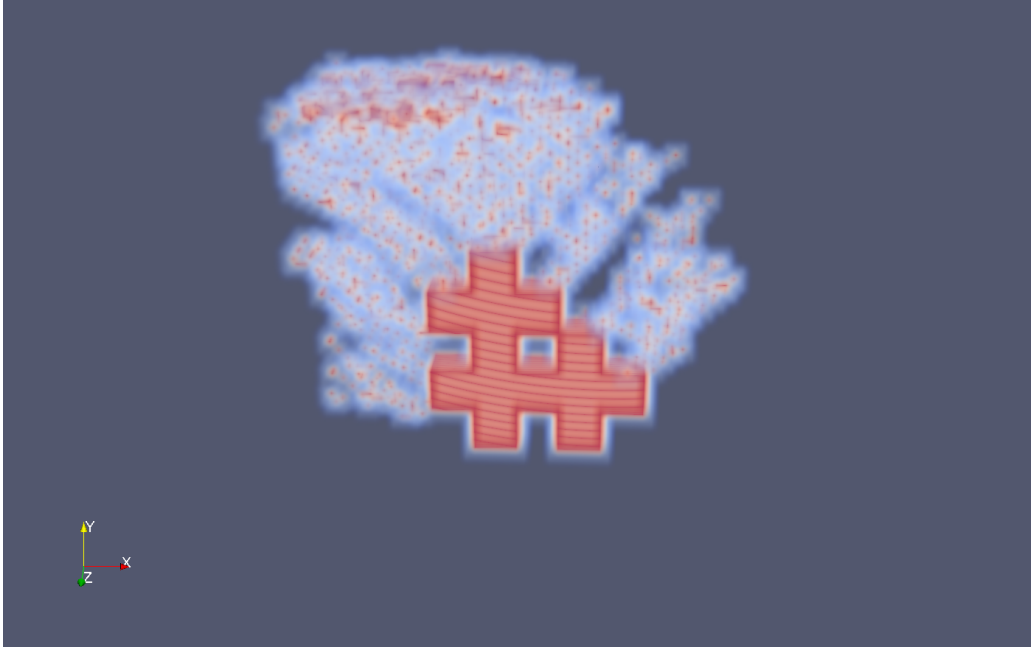


Figure 8: F at time $t = 100$

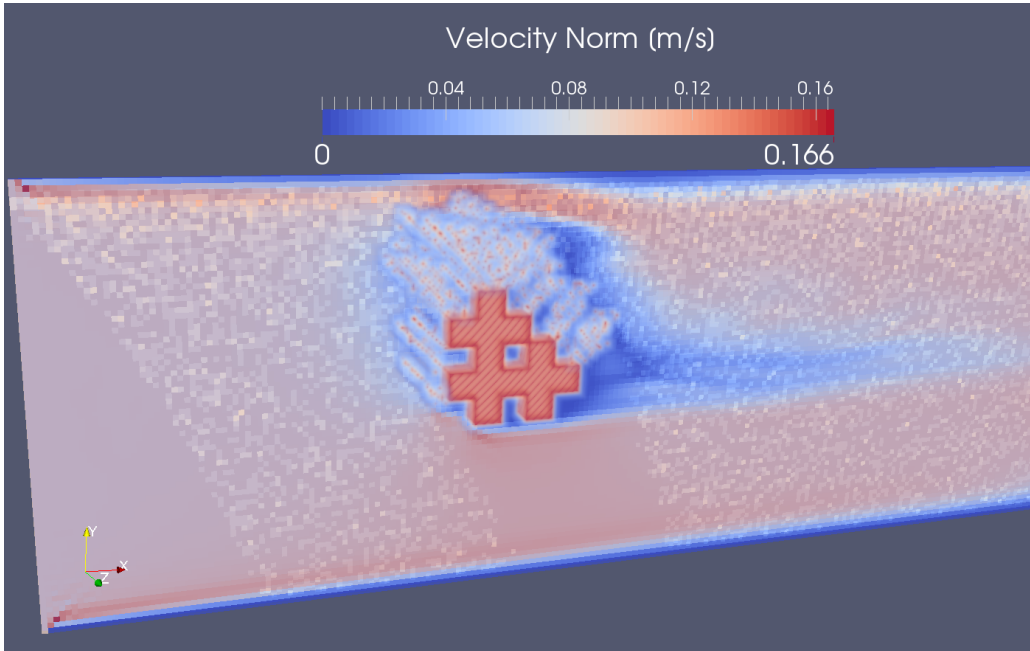


Figure 9: Velocity norm of F at time $t = 80$. Particle density is also plotted.

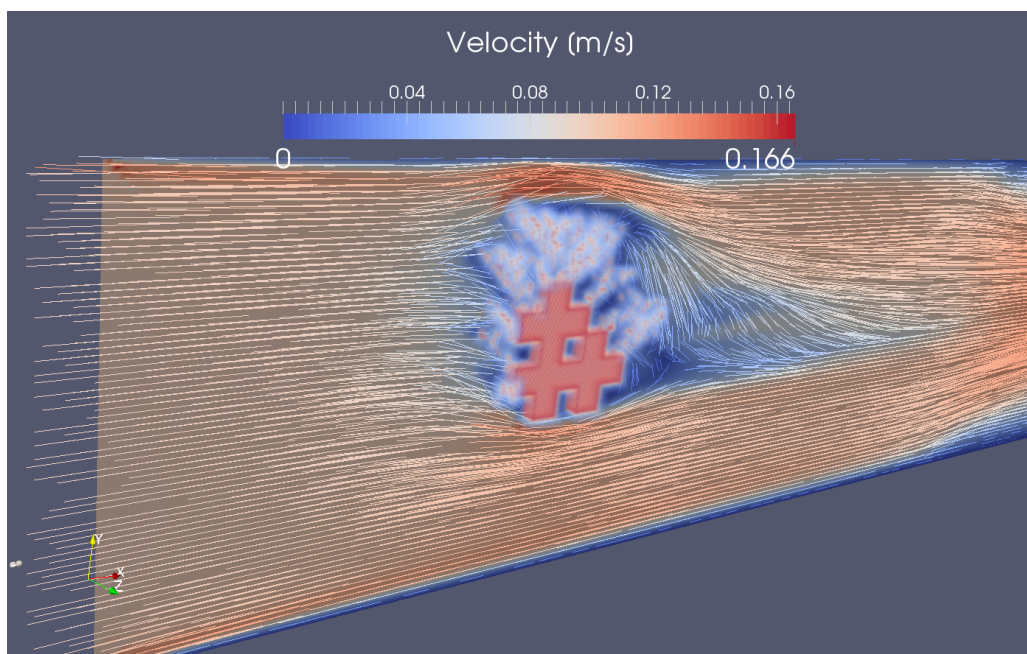


Figure 10: Velocity norm of F at time $t = 80$



Figure 11: G at time $t = 50$

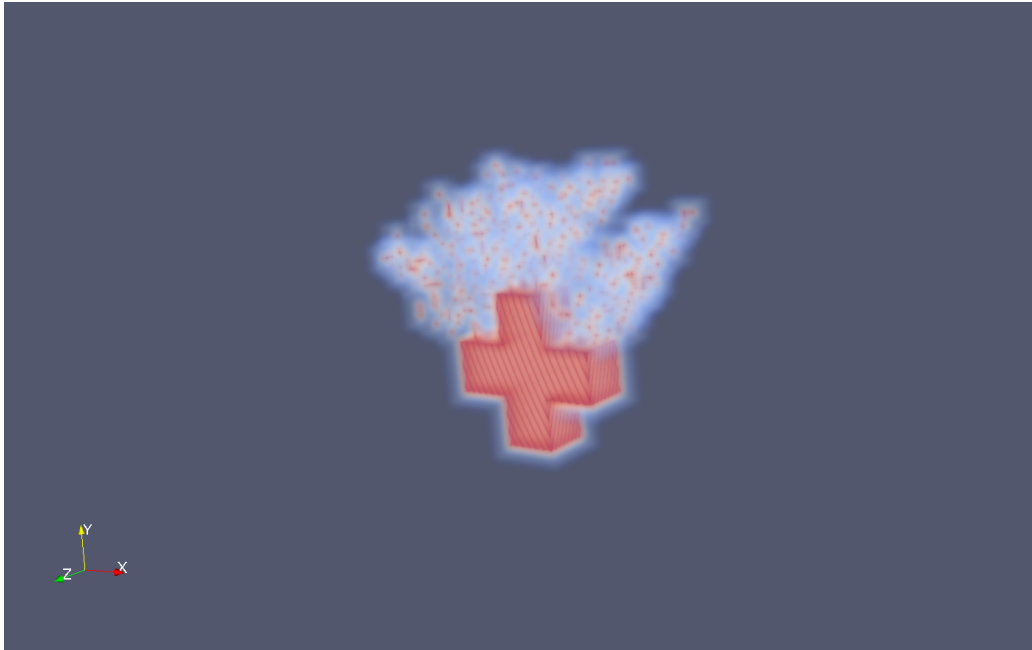


Figure 12: G at time $t = 80$

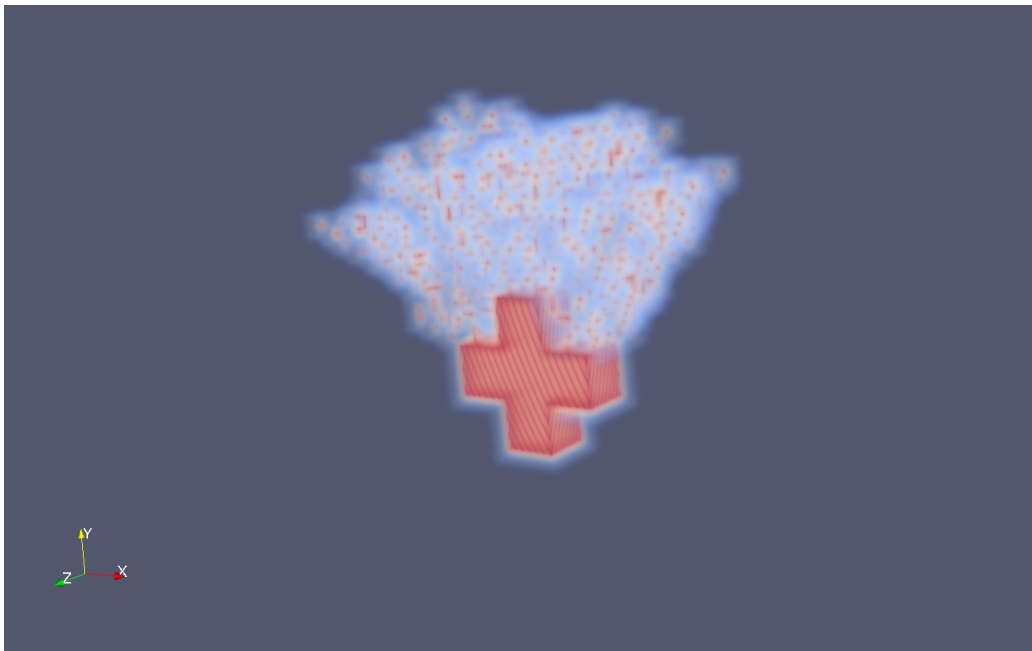


Figure 13: G at time $t = 100$

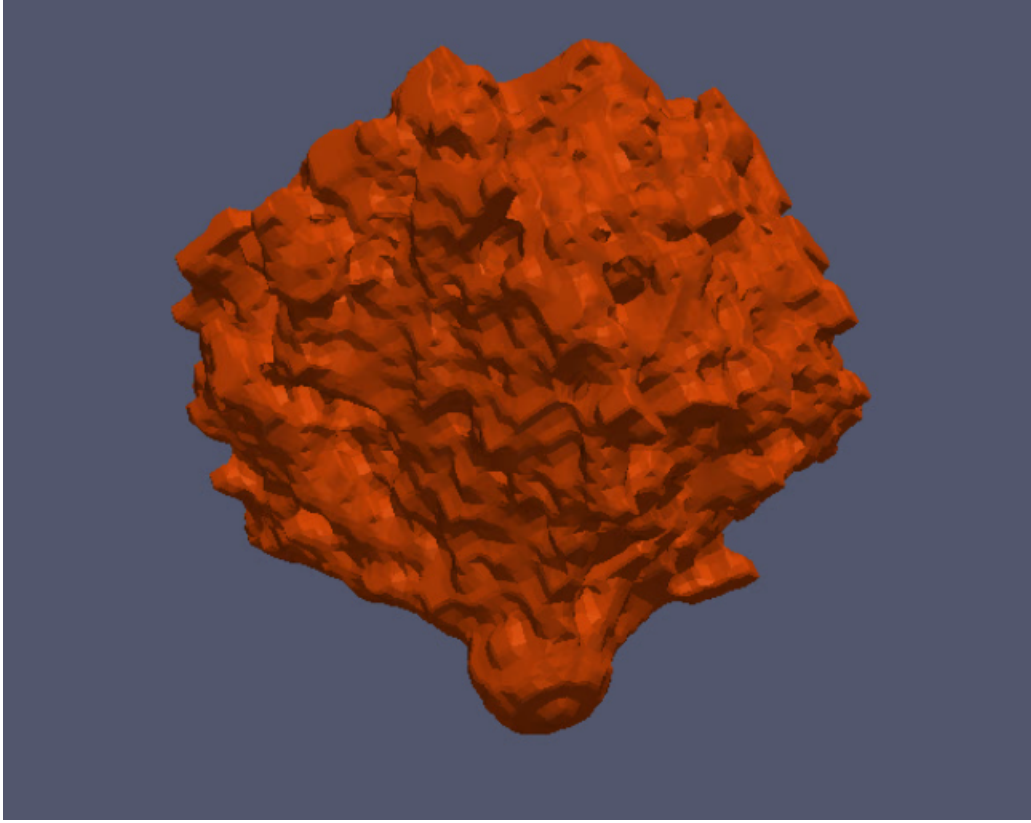


Figure 14: C grown.

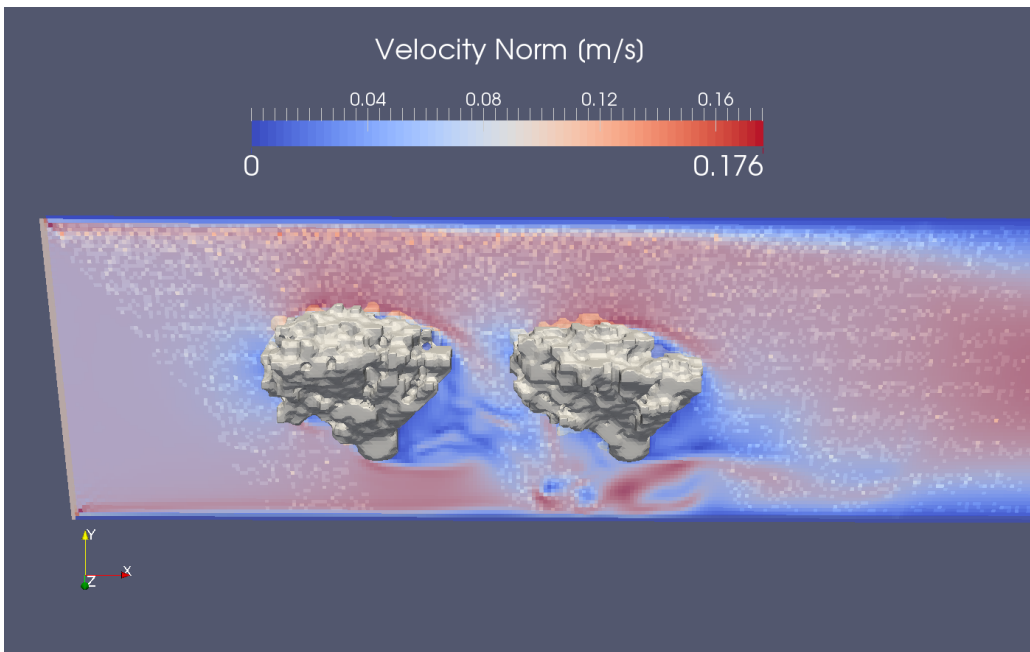


Figure 15: E : a seed induces perturbations for the other one.