Données d'imagerie en microscopie: quelques exemples et besoins en visualisation

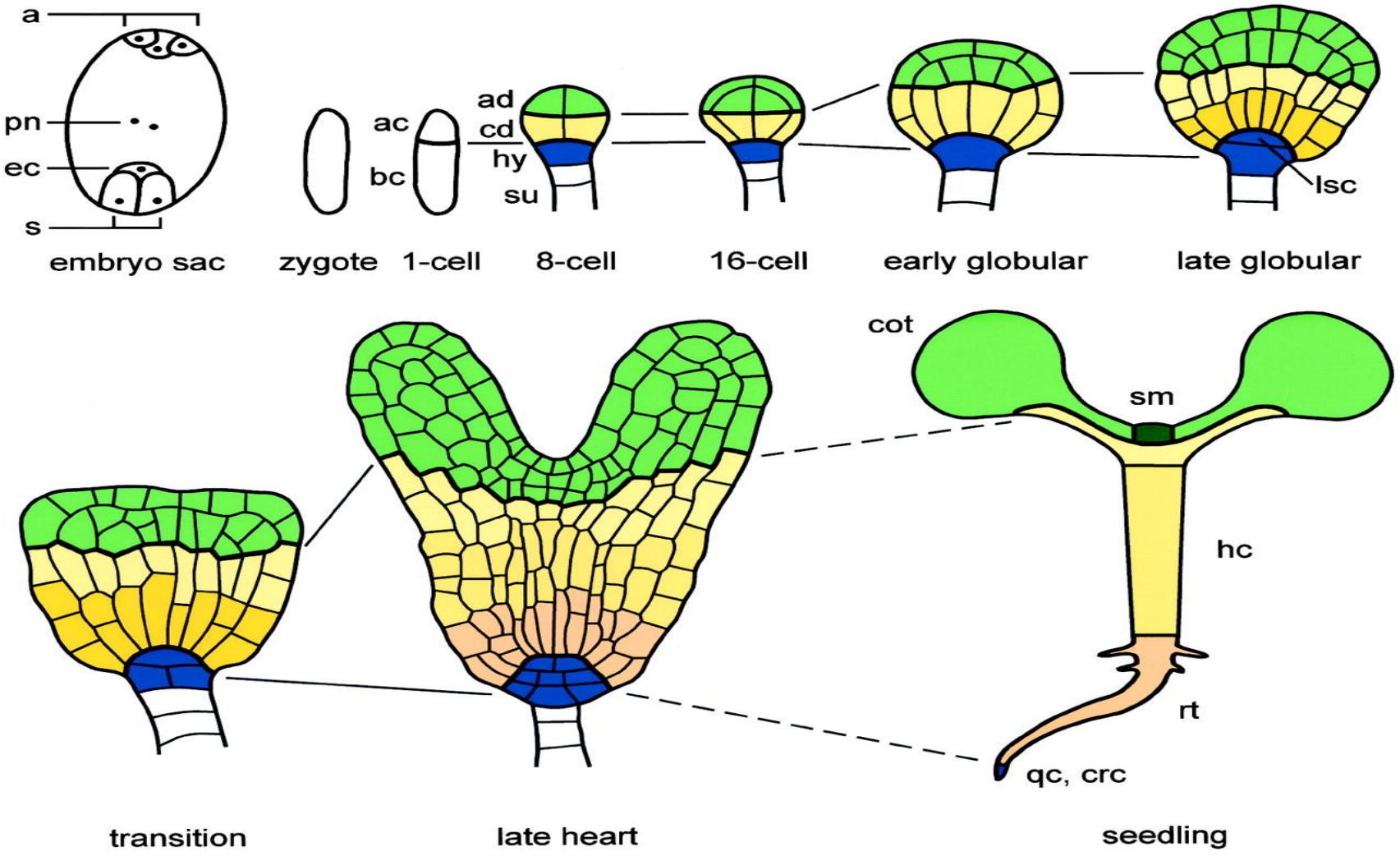
A. Trubuil
INRA/MaIAGE

1. Besoin d'IHM pour le lignage cellulaire

2. Besoin de navigation pour des observations 2D +T ou 3D+T

✓ Movies have been removed from the pdf file due to file size limitations

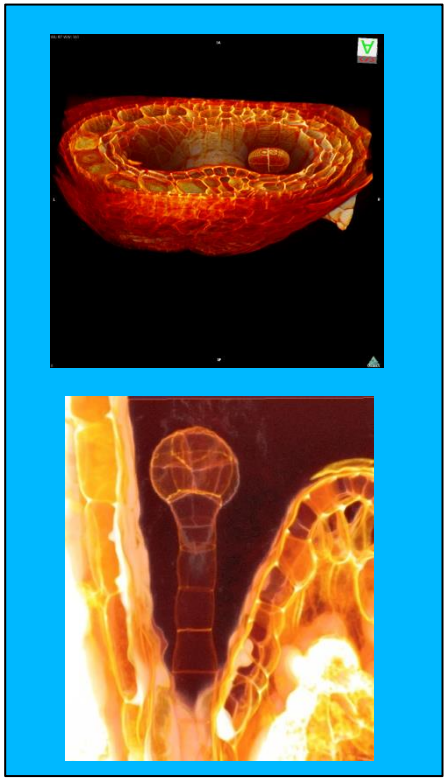
From a single cell to an embryo



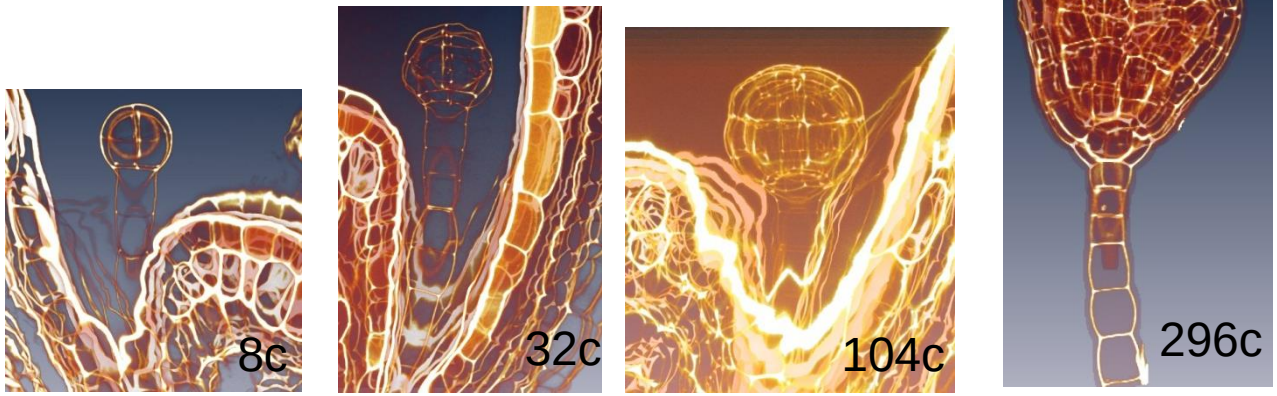
Laux T., et al., Plant Cell ,**16**,190 – 202 (2004)

How this shape evolution could be explained?

Q1: what is the sequence of events?



time lapse



Several embryos at different stages of development

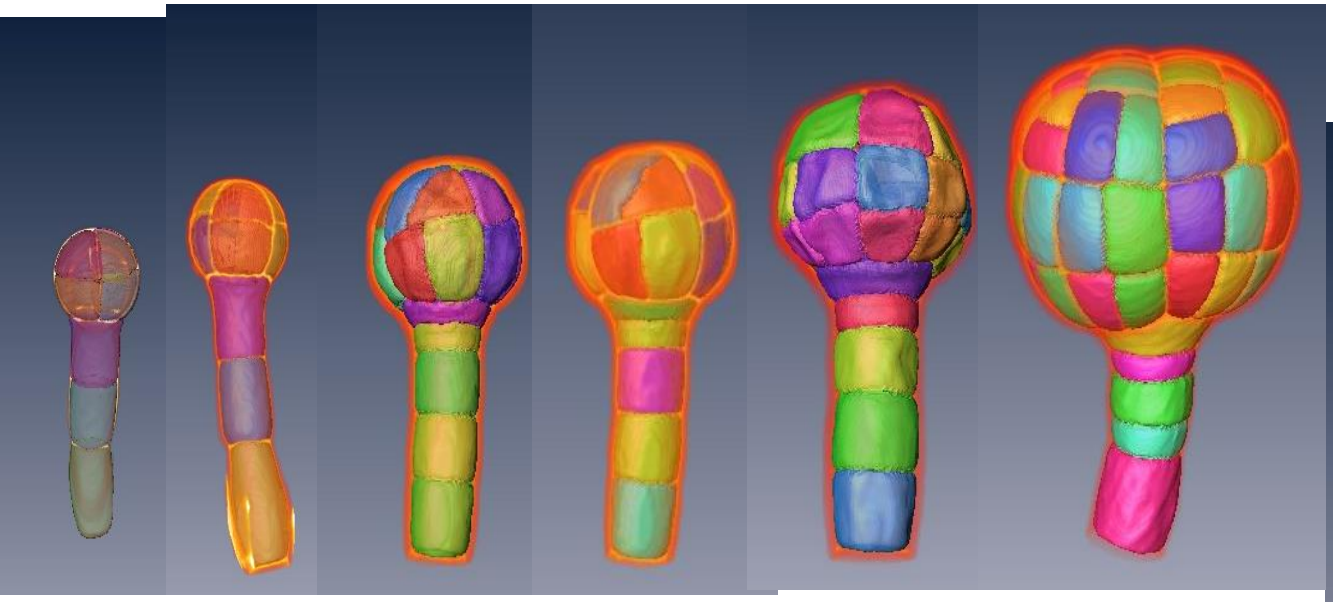
→ Characterize events: cells, walls, [stiffness],…

1. 3D segmentation (number of cells, volumes,…)
2. Reconstruction of the dynamics
3. Mechanical properties ?

Q1: 3D segmentation

- Embryo not alone
- Observation of a continuous process (walls under construction)
- 3D
- Complexity (from 1-300 cells)
- Artifact due to experiment
- Validation

pipeline (C, Matlab, Avizo)



8 cells

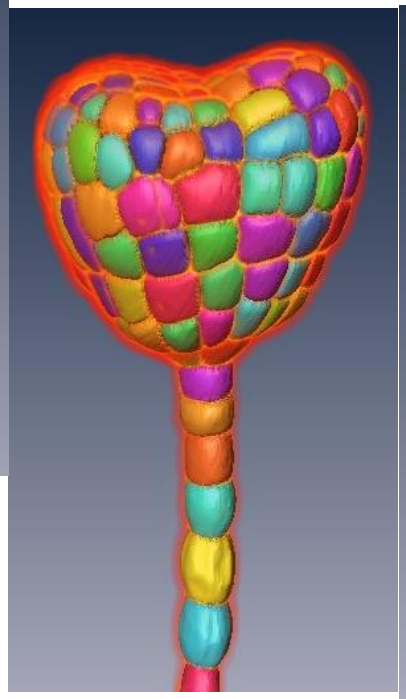
12 cells

25 cells

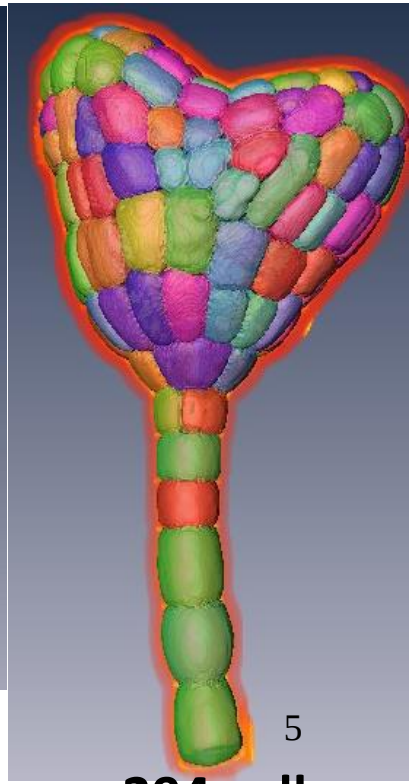
29 cells

32 cells

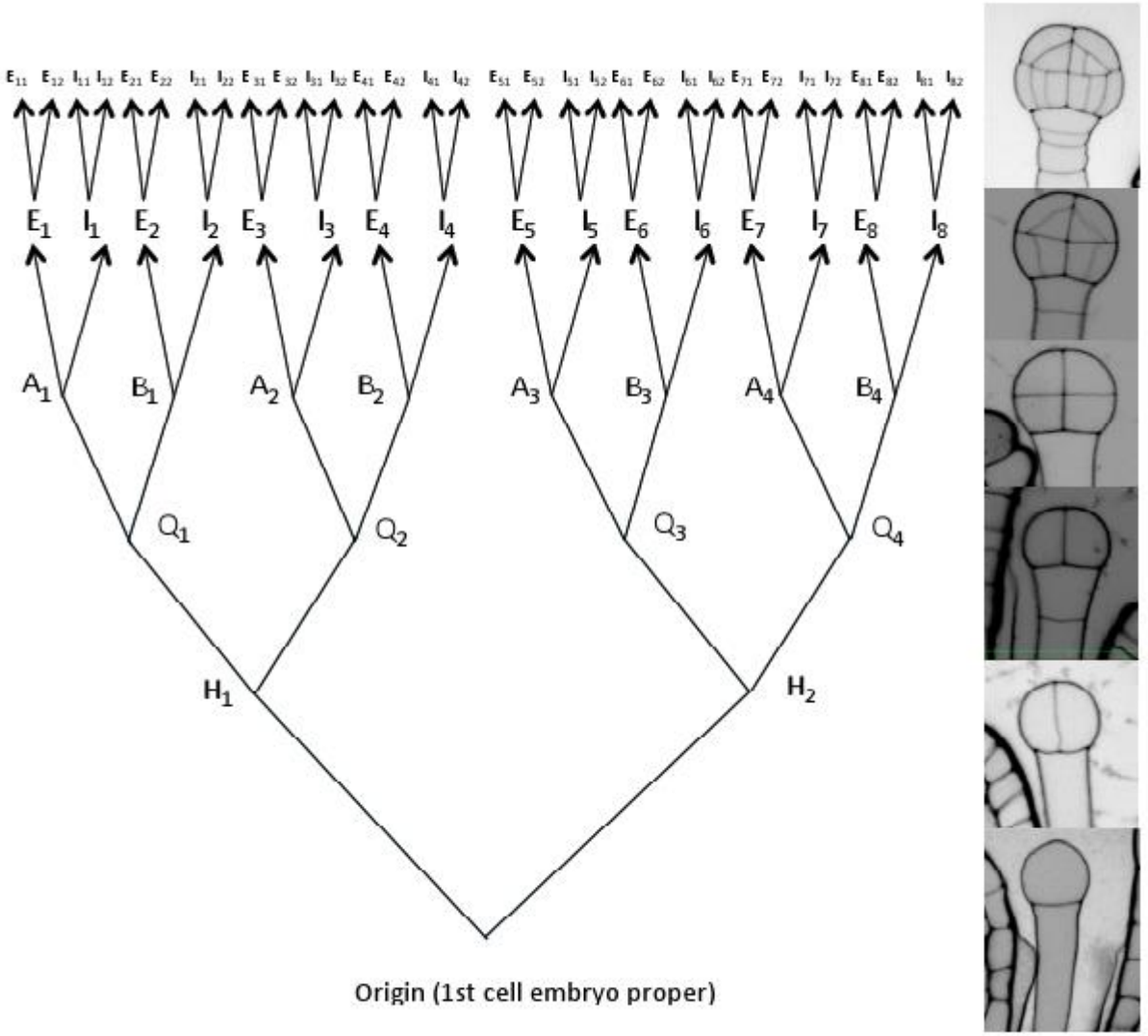
103 cells

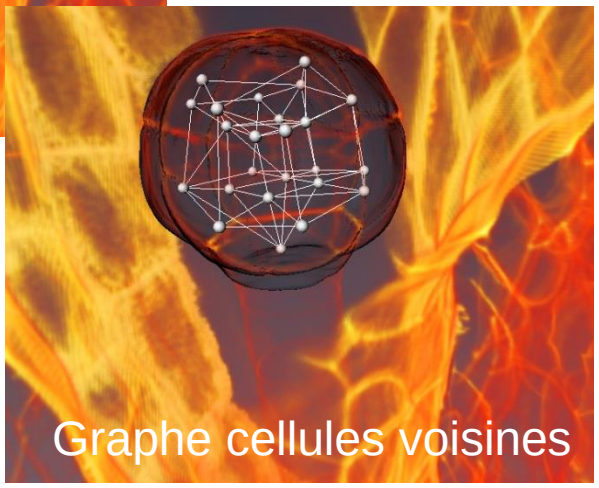


278 cells



294 cells


E11 E12 I11 I12 E21 E22 I21 I22 E31 E32 I31 I32 E41 E42 I41 I42 E51 E52 I51 I52 E61 E62 I61 I62 E71 E72 I71 I72 E81 E82 I81 I82
E1 I1 E2 I2 E3 I3 E4 I4 E5 I5 E6 I6 E7 I7 E8 I8
A1 B1 A2 B2 A3 B3 A4 B4
Q1 Q2 Q3 Q4
H1 H2
Origin (1st cell embryo proper)



Prétraitements avant lignage

Matlab, Avizo

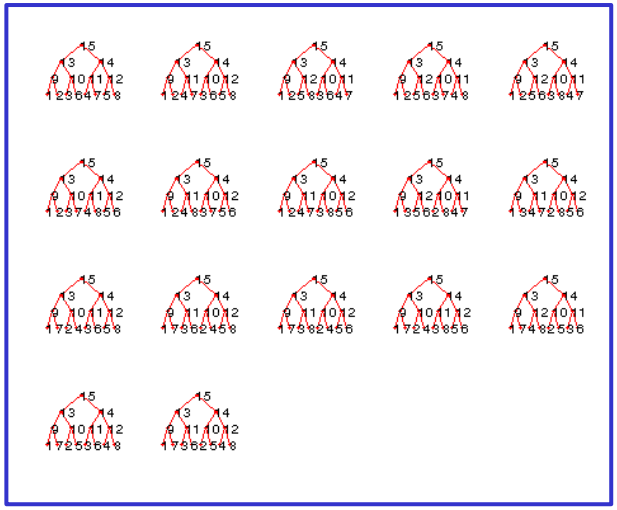
Q1: **Cell lineage,** constrained trees enumeration **(5)**

Input : neighbour graph of cells

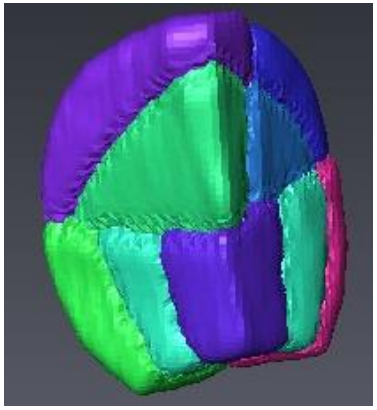
Constraints :

1. daughter nodes are neighbours,
2. maximal depth difference of branches

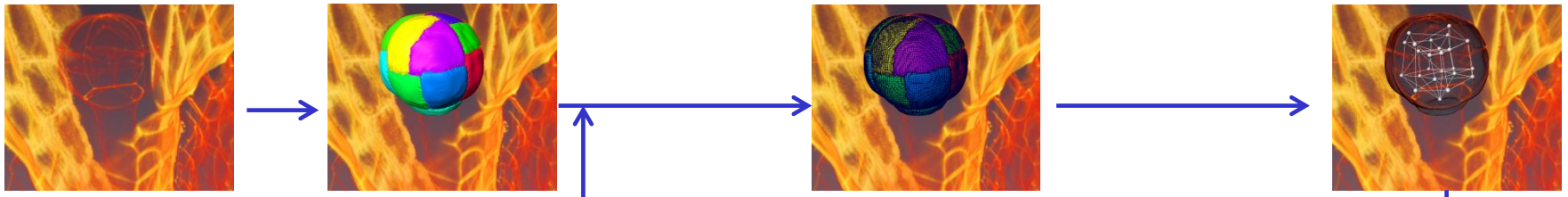
Algorithm : recursive



8 cells: 17 trees



Quarter of 28 cells embryo

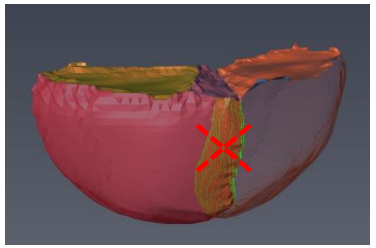


Interactive constraints:

a ----- b or a -x-- b

- Propagate constraints
- Feed DB of pairs

Merge pairs

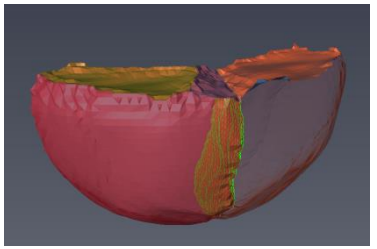


Maximal Matchings (MM)

Maximal cliques in the complement dual graph (Uno et al)

$$\emptyset_1(d) \stackrel{\text{def}}{=} \oint_{\partial d} \delta(s)ds$$

Evaluate and Filter MM



Visualize partial lineages

. Display shared pairs

. Display non shared pairs

- Display new pairs
- Display known pairs

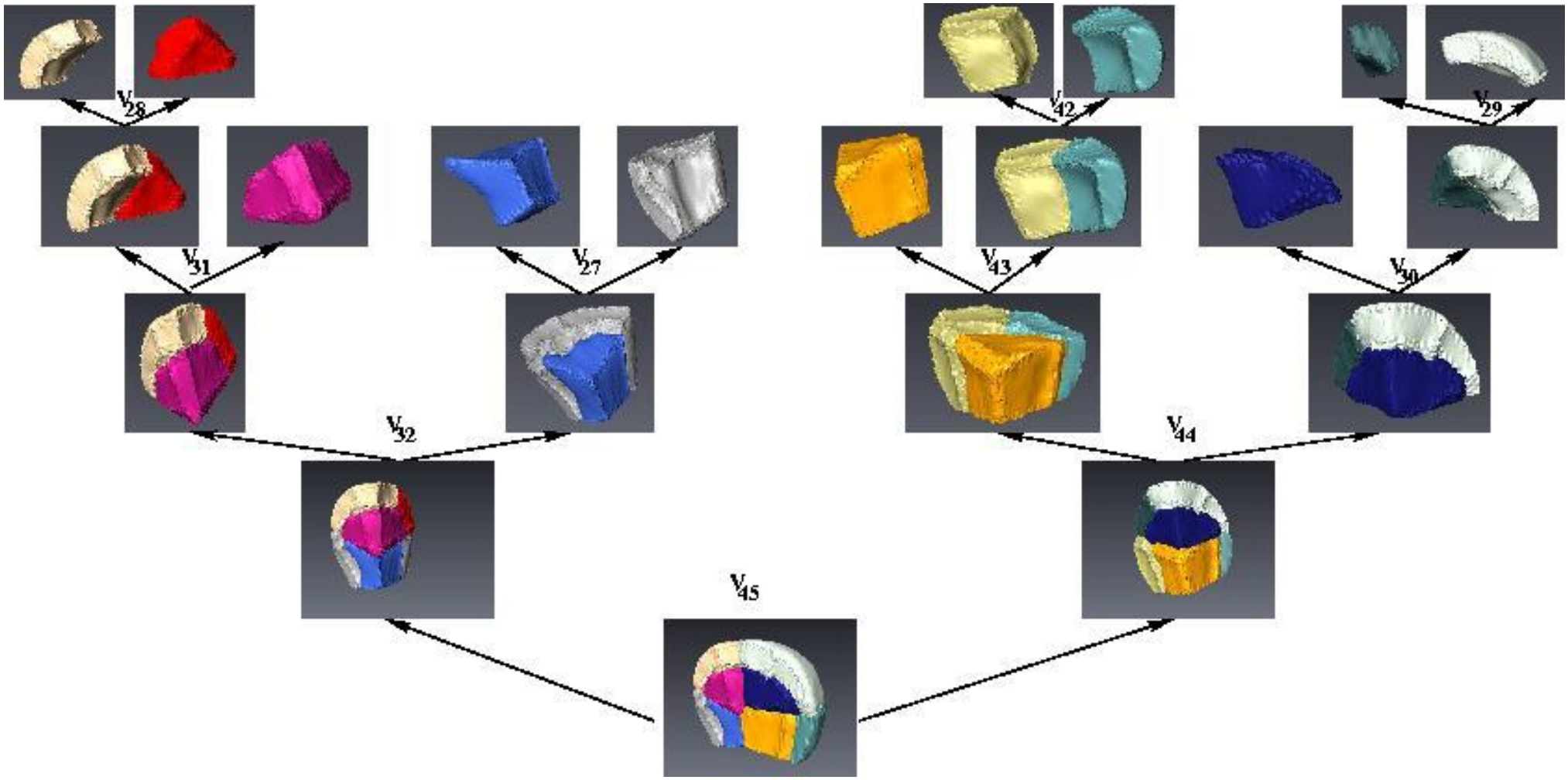
Feed DB of matchings

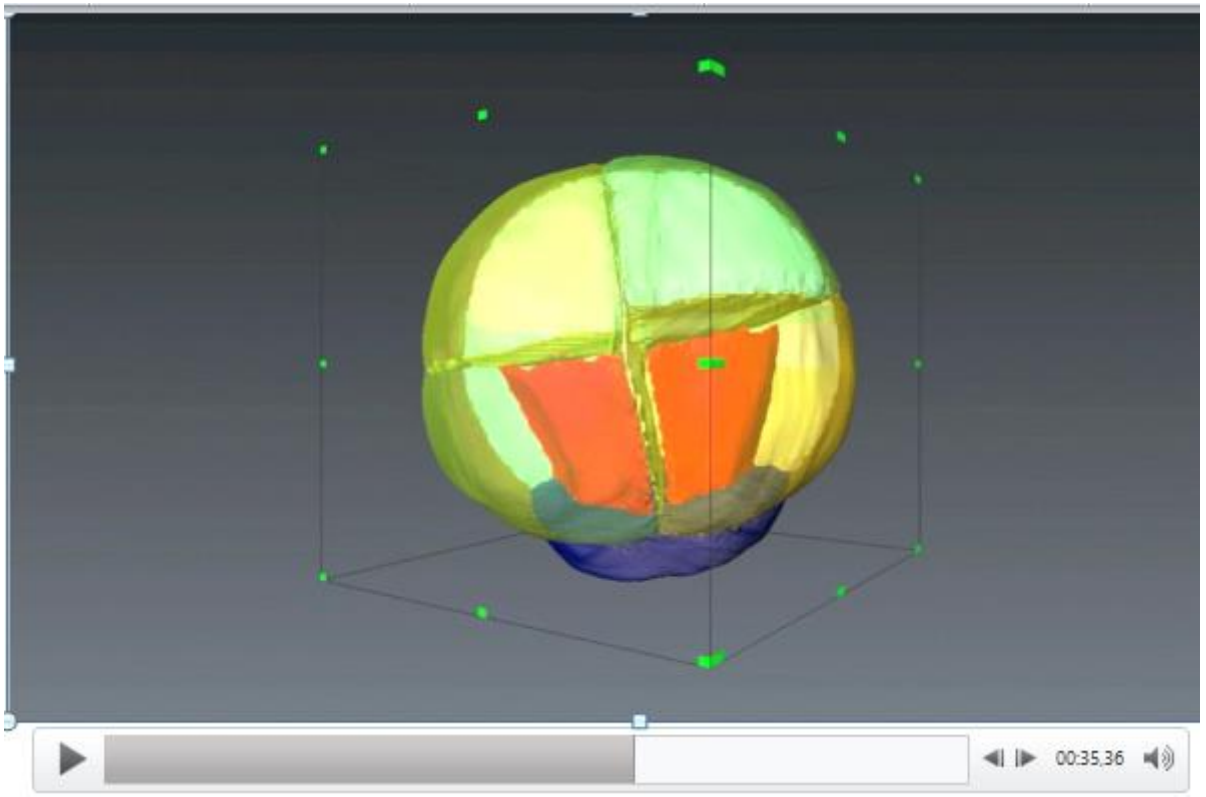
Next round?

Feed DB of pairs

Visualize lineages

Lignage cellulaire (embryon 23 cellules [moitié])




00:35.36

1. Besoin d’IHM pour le lignage cellulaire

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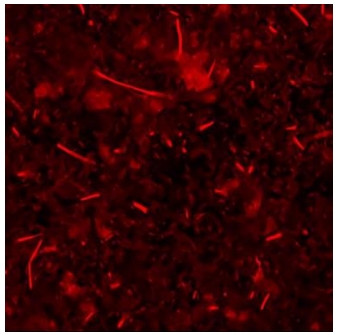
Exploration of movies and Visualization of content : Examples

- ✓ A collection of 2D+T or 3D+T movies
  - ❑ Biofilms (GreenSwimmers project)
  - ❑ Lipid Droplets
  - ❑ Vesicles
- ✓ Detect, classify, show events
- ✓ Conclusion

EXAMPLE 1 : VIDEOS FROM BACTERIA SWIMMING INSIDE BIOFILMS

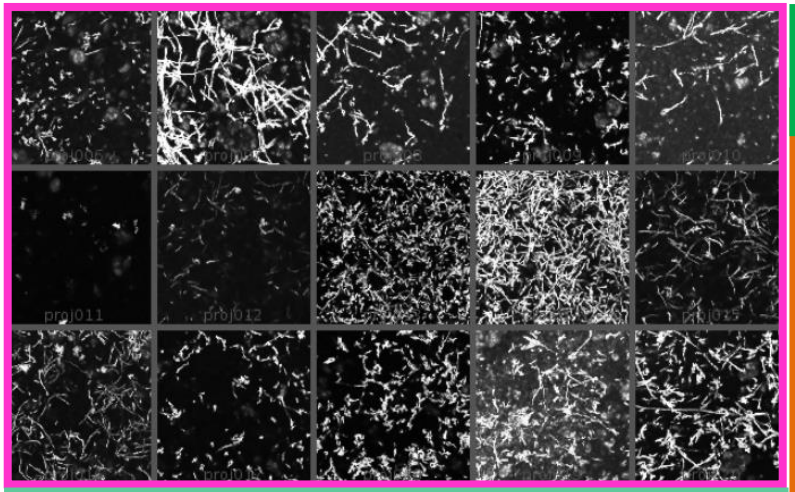


125 strains x 2-5 videos for 30 seconds

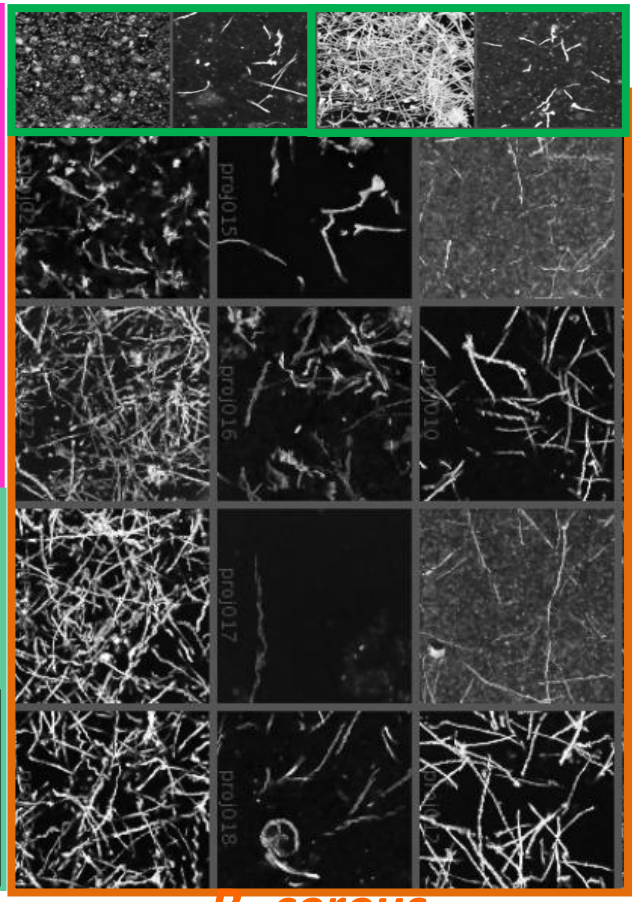
- Speed of swimmers
- Persistance of swimmers
- Surface coverage of swimmers

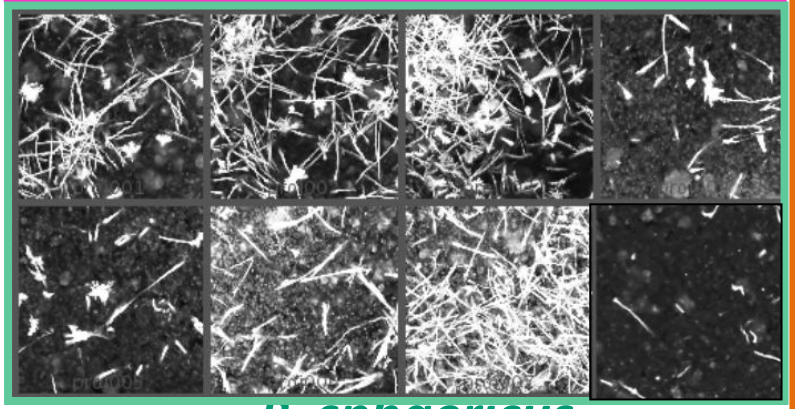
Trajectories projection for 30 seconds

B. polymyxa



B. subtilis



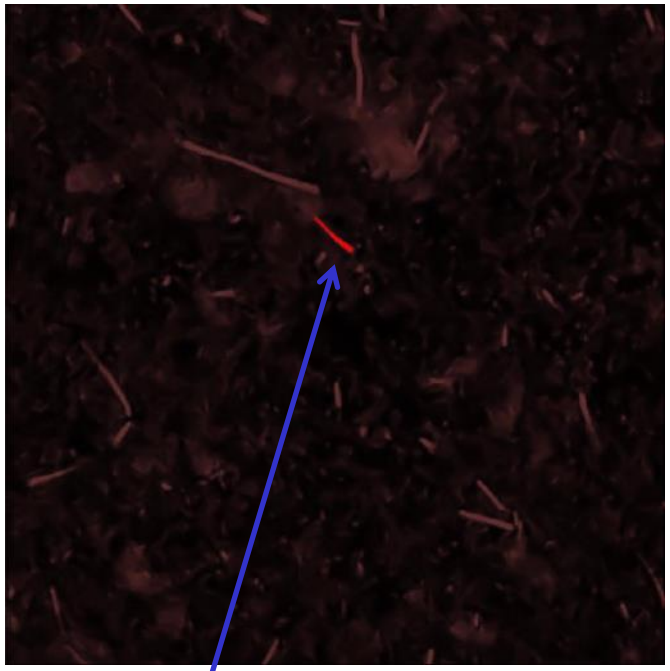


B. sphaericus

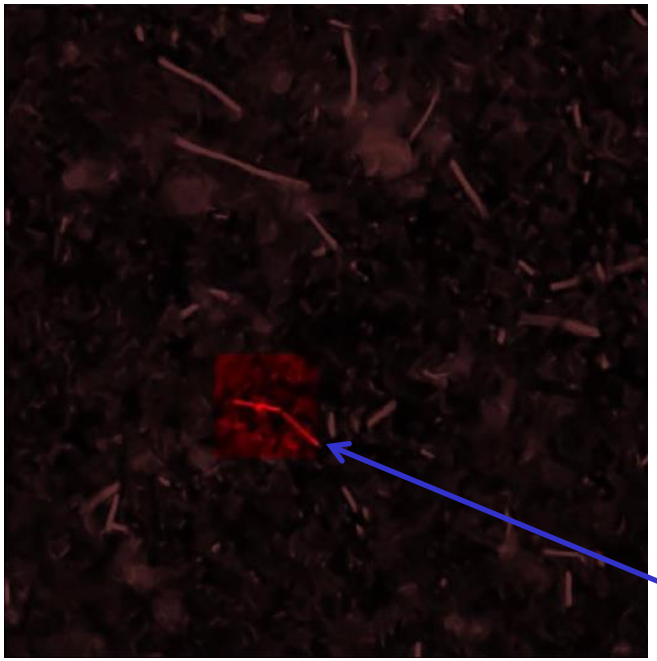
B. cereus

Species	# of strains
B. polymyxa	*17*
B. subtilis	*18*
B. licheniformis	*31*
B. pumilus	*19*
B. sphaericus	*4*
B. megaterium	*3*
B. cereus	*30*
B. mycoides	*3*
Total	125

SHOW EVENTS

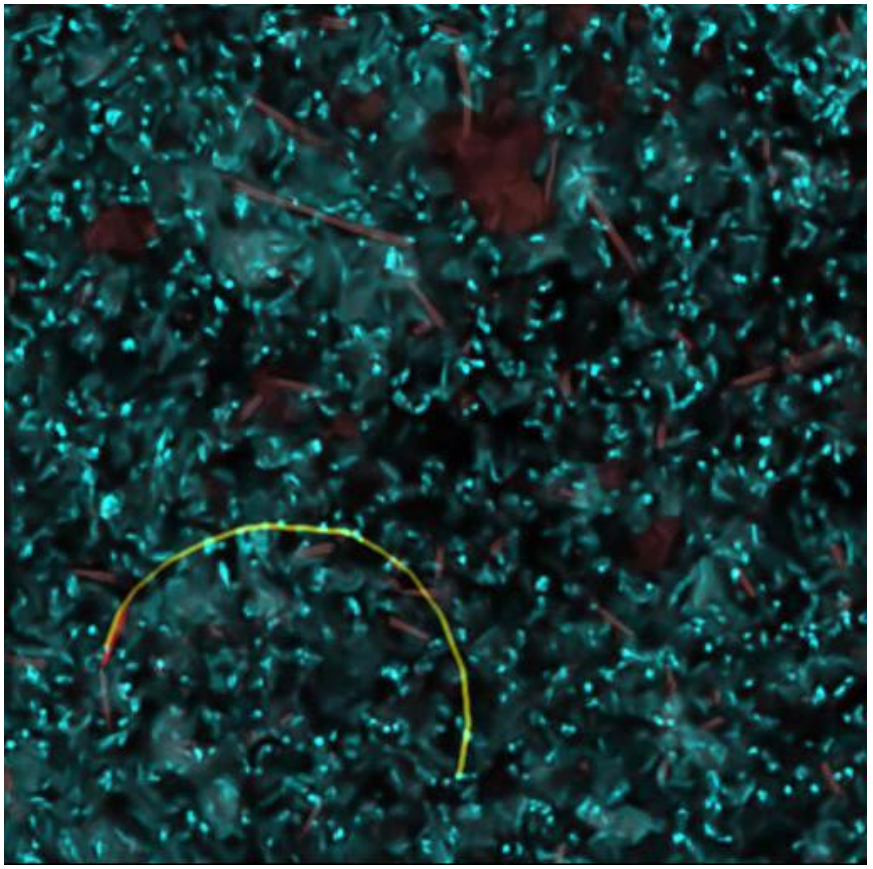


DNA pocket attraction

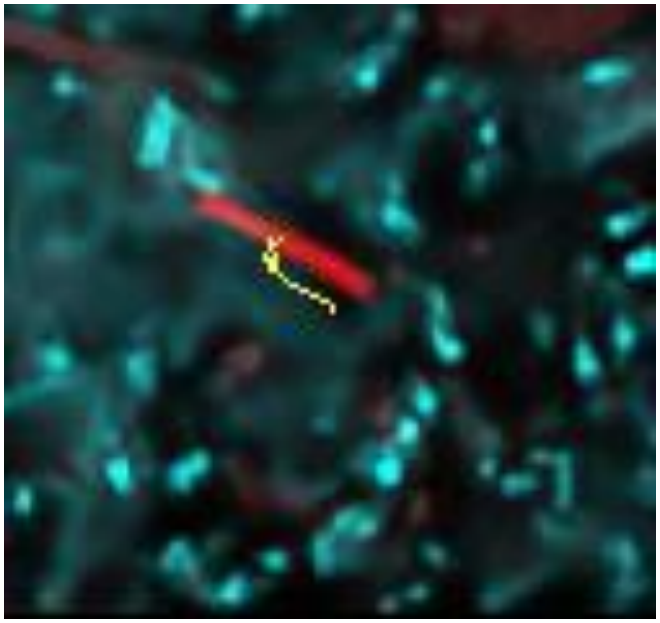


Circular motion?

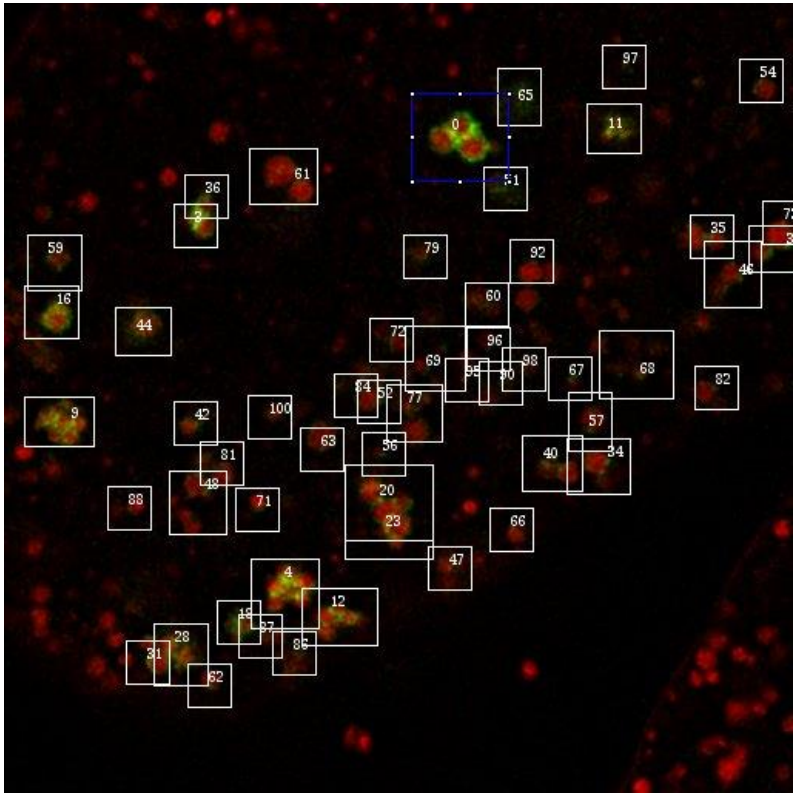
Sphaericus 10C3



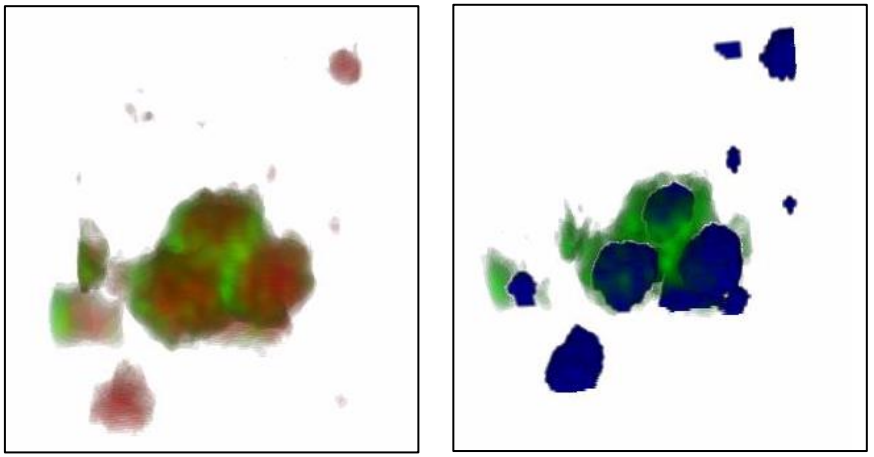
Circular motion



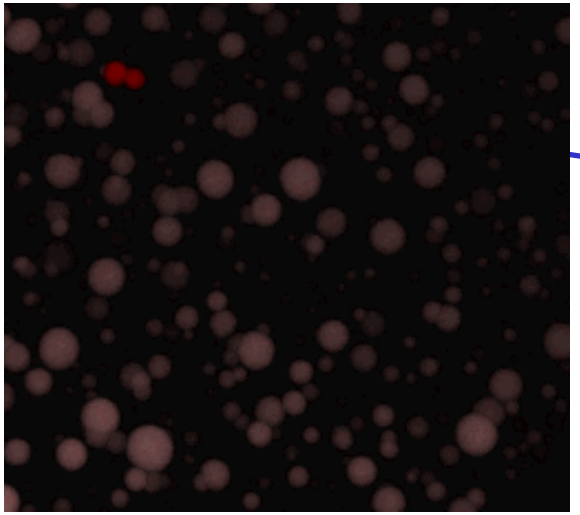
DNA pocket attraction
or biofilm obstacle



- **Several stages along the development**
- **Several genotypes**
- **Several instances from one or several embryos**



Selection and 3D visualization of LDs



Fusion of two LDs is highlighted

With F. Deslandes

CONCLUSIONS

1. Many advanced visualization for latge audience
   - sport (see TV)
   - security
   - cinema
   - biomedical?

2. Not so much for microscopy ….(to check)
   - Identify class of objects that should be visualized
   - How to put forward spatio-temporal interactions
   - Video summerization for cell biology

THANK YOU

INRA MICALIS

Se Yeon Kim

Julien Deschamps

Romain Briandet

INRA MAIAGE

Yingbo Li

François Deslandes

INRIA/IJPB

Jean-Christophe Palauqui

Martine Miquel

Bertrand Dubreucq

ANR – 12 – ALID – 0006