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## Developmental stereotypy assessment in ascidian embryos

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## Abstract

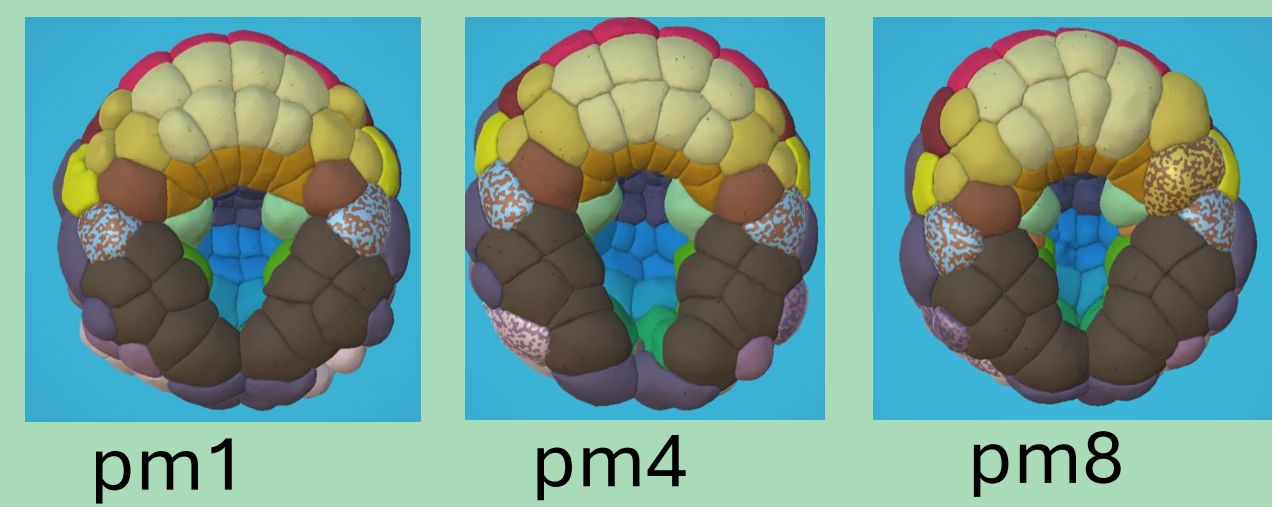
The development of the ascidian embryo is highly stereotyped, allowing for the identification of homologous cells across individuals. However, little is known about variation in the stereotypy. Our aim is to quantify the stereotypy of cell division direction and determine whether certain cells exhibit bimodal patterns of division direction.

## 1. Experimental data [Guignard, 2020]

- 7 temporal sequences (3D+t) of *Phallusia Mammillata* embryos
- e.g. pm1, pm2, pm3 ...



## 2. Stereotypy in ascidian embryo development [Conklin, 1905]

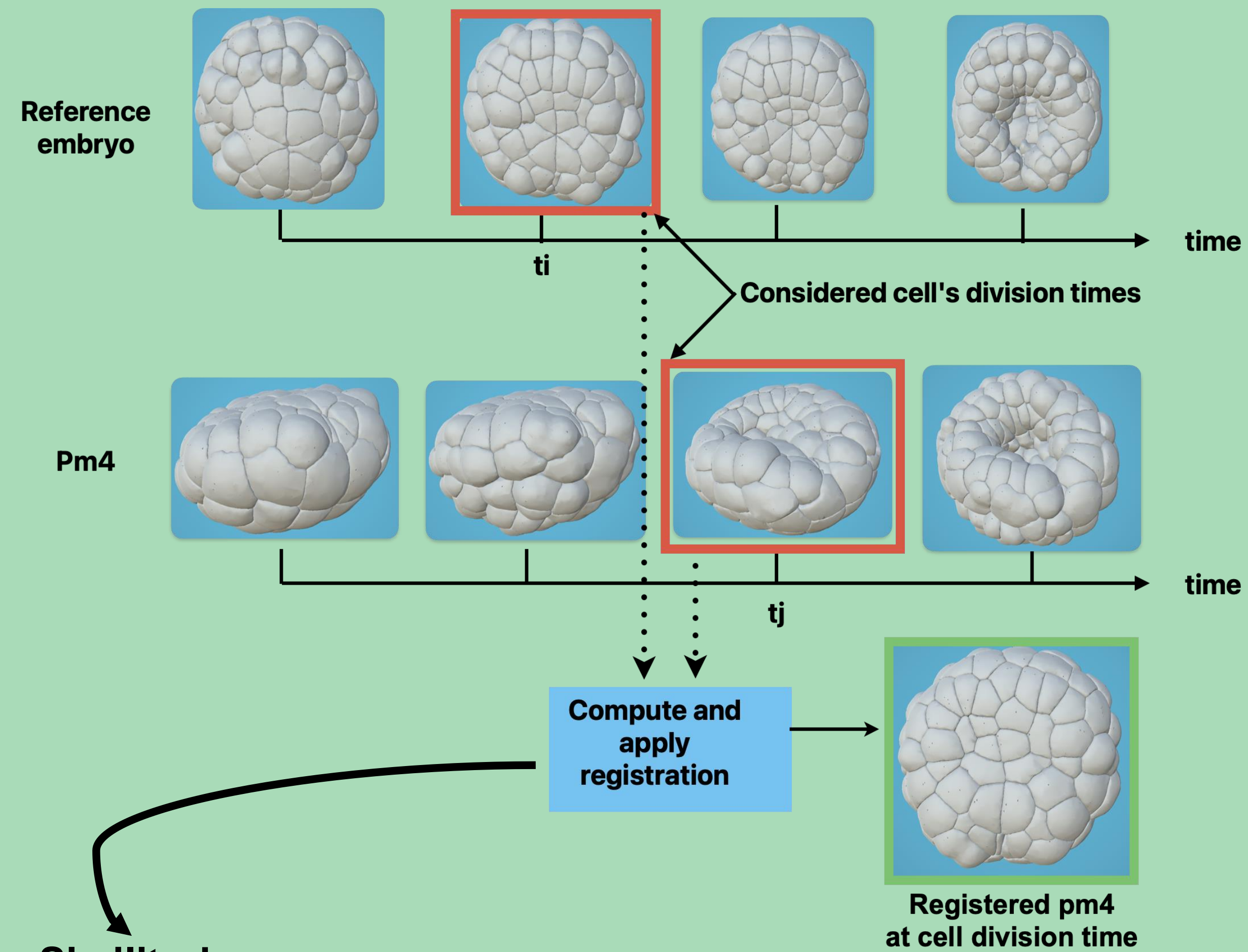


## 3. Aim: Quantify the stereotypy of cell division direction

- For each division:
  - Compare estimated division directions
  - Compare variability in division directions
  - Detection of divisions with multiple modes

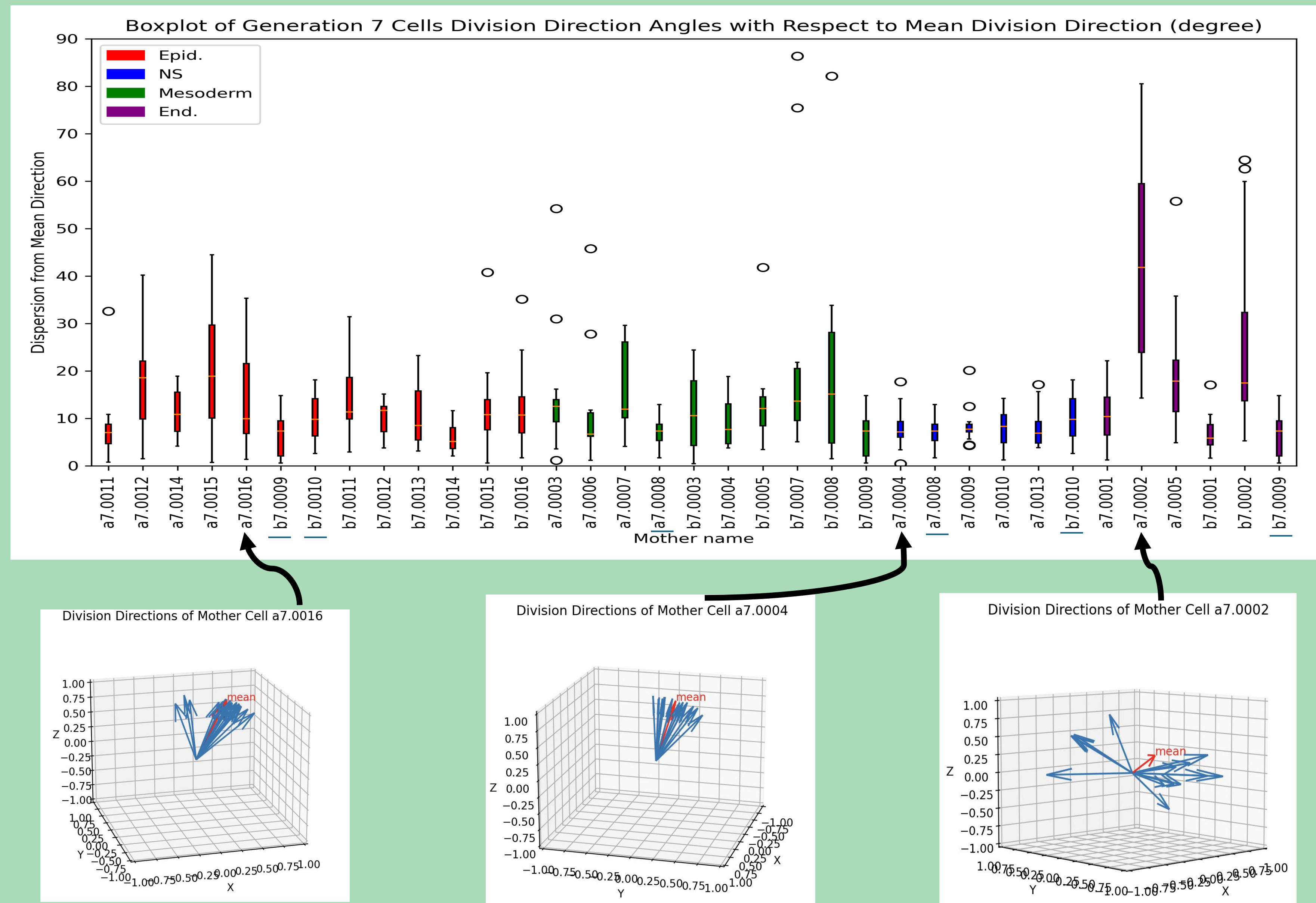
## 4. Prerequisite: Making embryos comparable

- Take the embryos at homologous cells division times
- Spatial alignment: embryos differ in orientation and volume



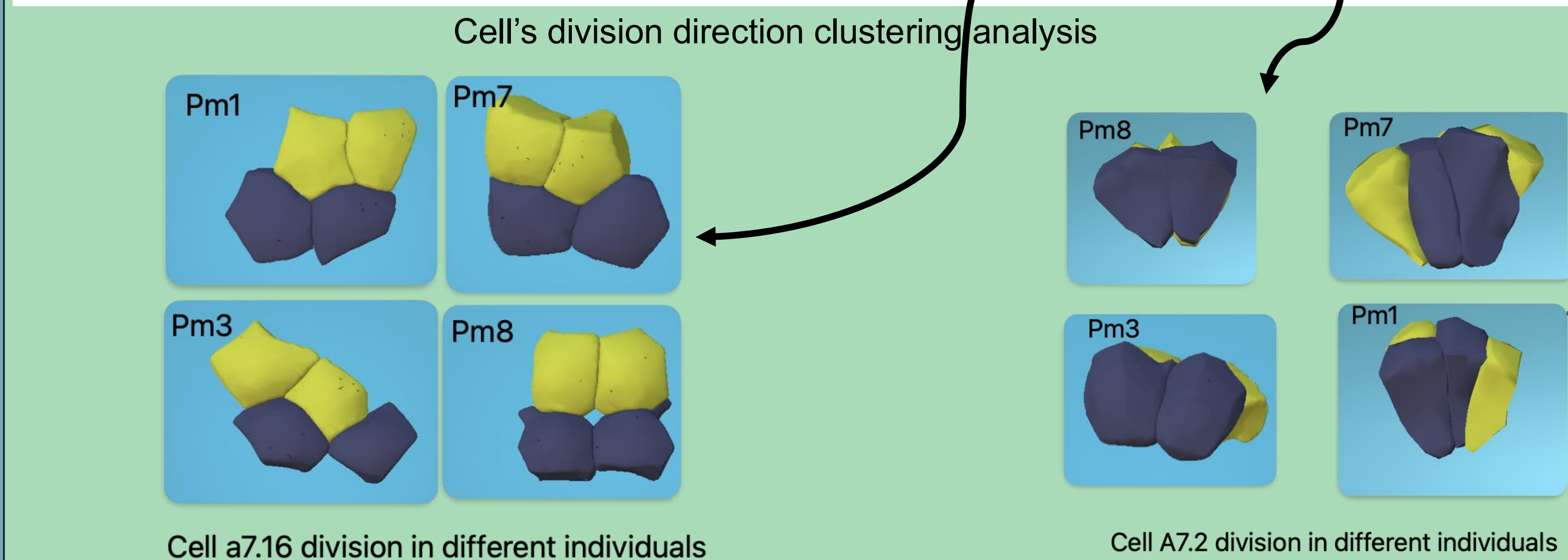
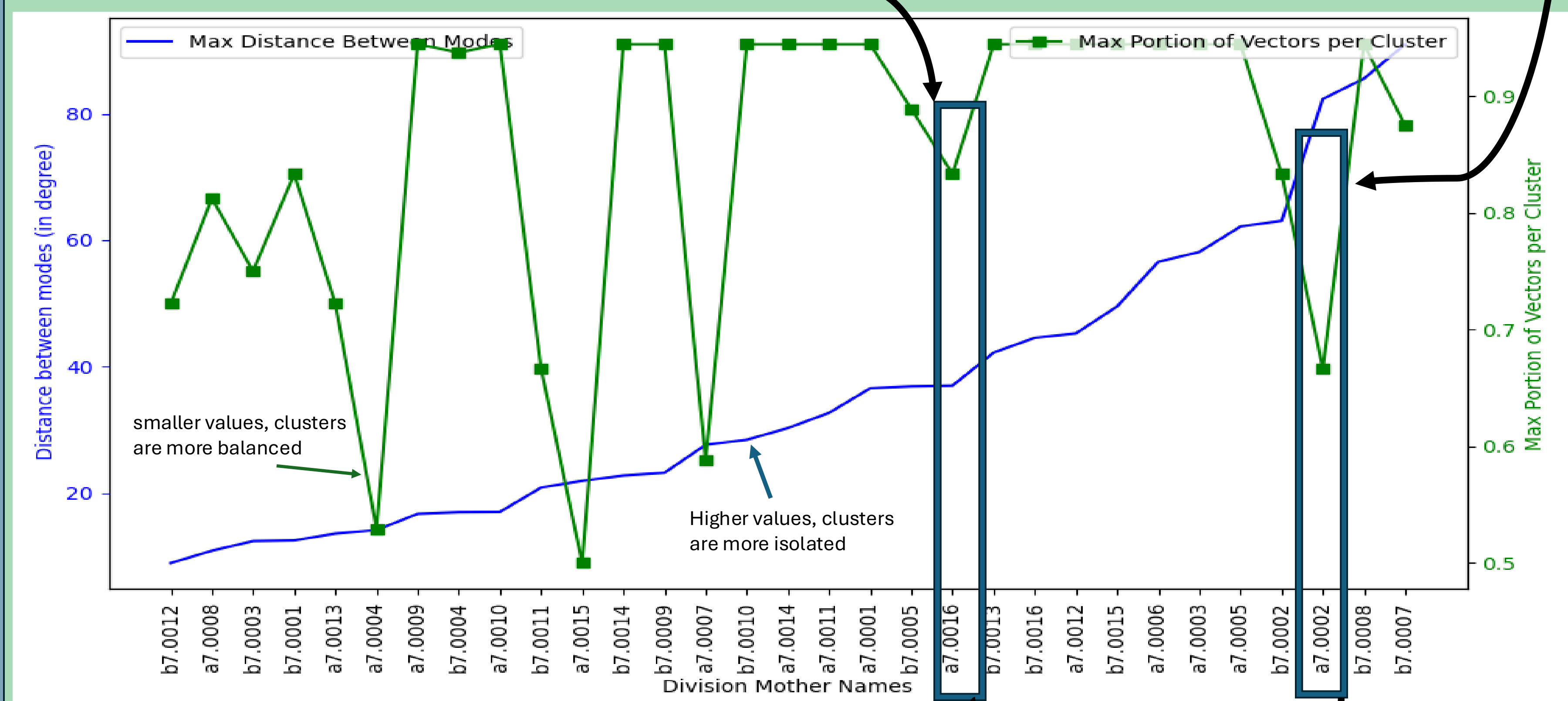
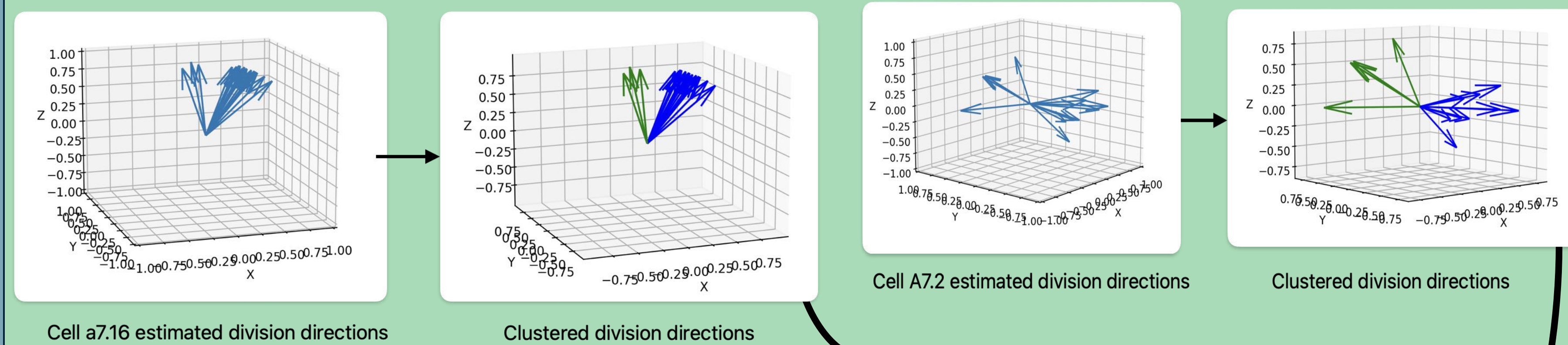
- Similitude**
    - computed using least trimmed square method [Rousseeuw, 1984]
    - Registers the embryos to reference embryo
  - Bilateral symmetry**
    - Enrich database by embryo symmetrisation
- A7.7 Division: Left vs. Right (pm3)** → **A7.7 Division: Right hemisphere (pm3, after symmetry)**

## 5. Dispersion in cells division direction distribution



## 6. Modes of cells division direction distribution

- Division directions of a given division are not expected to be totally random
  - We expect at most to have two modes
- To detect divisions with bimodal patterns of division [Nakamura, 1998]
  - Cluster cells division directions into two clusters
  - Analyse the clustering isolation and balance



## References

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## 7. Conclusion & Prospect

- Quantified division direction variability for each cell
- Detected cells with bimodal division orientation
- Prospects:
  - Why we have cells with multiple pattern of division directions?
  - What are the factors that influences this variability?
  - Assesment of variability in cells division times