**IPAL**

Automated analysis of tissue organisation :
application to the cyto-architecture of Islet of
Langerhans

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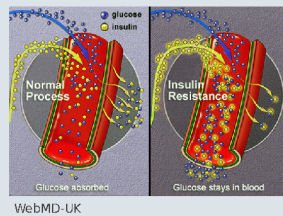AURA – 18/10/2016

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IPAL Biomedical imaging

- Hosted by BioInformatics Institute (BII)
- Analysis of biological complexity in 3D/4D
- **Denoising** (Coll. CINTRA)
- 3D **segmentation** and analysis, 4D tracking
- **Analysis** of spatial and temporal organisation

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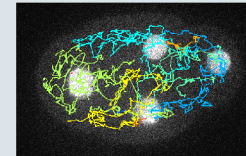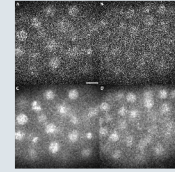
IPAL Langerhans Islets
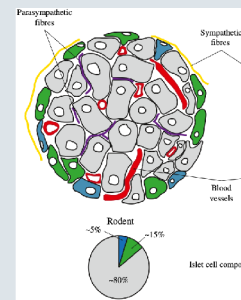
- Small structures in the pancreas
  – 0.1 mm, 3 millions
- Role is to secret and deliver insulin
- Malfunctions will cause high level of glucose in blood
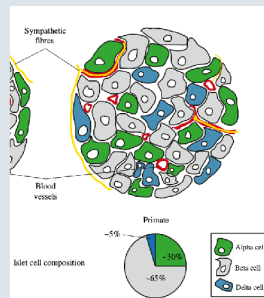- → Diabetes
  – Type I and II

WebMD-UK

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IPAL Langerhans Islets

- Composed of 3 main cell types :
  – Alpha, beta and delta
  – Beta cells are most numerous and secret insulin
- Spatial organisation differ between species
  – Especially between mouse and mokeys/humans

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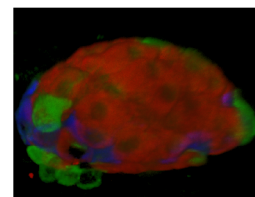 – Especially between mouse and mokeys/humans
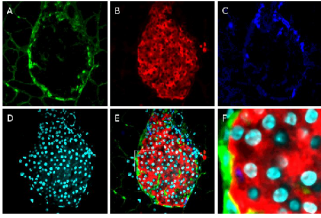

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IPAL Islets analysis

- Automated analysis of the cyto-architecture of the Islets of Langerhans in mouse and monkeys
- → toolbox for automated 3D tissue analysis

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Islets analysis

- Automated analysis of the cyto-architecture of the Islets of Langerhans in mouse and monkeys
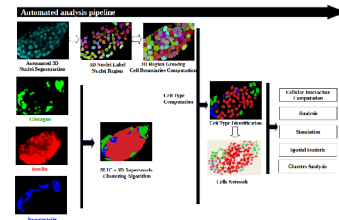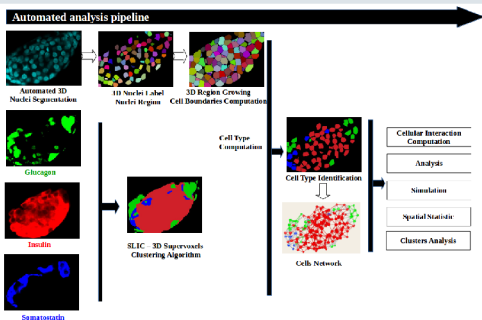- → toolbox for automated 3D tissue analysis

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Islets analysis

- Automated wokflow for :
  - nuclei segmentation
  - cell type computation
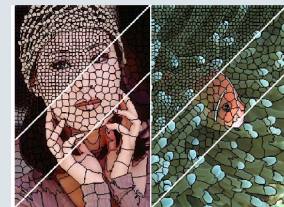 - cellular interactions
  - spatial organisation

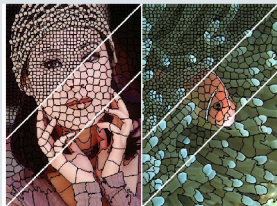- Revision for *Sci. Rep.*

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Islets analysis

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Super-pixels

- Superpixels
- Consider cluster of pixels instead of individual pixels
- Multi-scale analysis
- New way of seeing an image
  - Values and coordinates
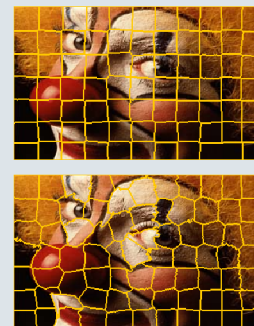 - Neighborhood

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Super-pixels

- Define a grid with a defined size
- For each zone, iterate over surrounding pixels and compute distance between pixel and zone
- Assign pixel to the zone with smallest distance
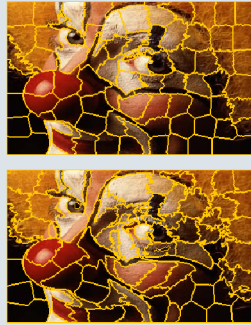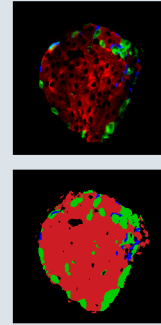- Iterate …

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Islets analysis

- We apply the superpixels method to our data
- Cluster together pixels having similar content of alpha, beta and delta markers
- Define the cell-type according to the SLIC content outside the nuclei
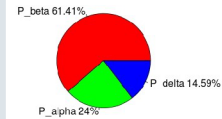
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Islets analysis

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Cell composition of mouse islets

P_beta 69.4%
P_delta 8.04%
P_alpha 22.56%

Cell composition of monkey islets
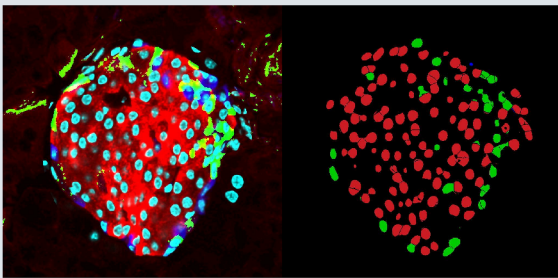
P_beta 61.41%
P_delta 14.59%
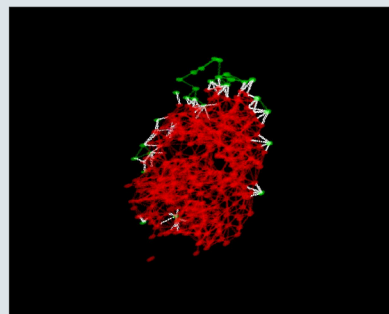P_alpha 24%

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Islets analysis

- We then compute cellular interactions as touching cells
- Compare frequencies of observed interactions to random organization
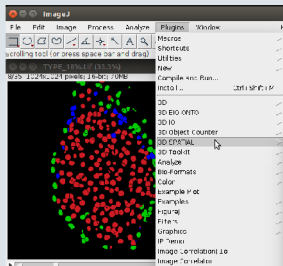- Monkey organization a bit more random than mouse organization
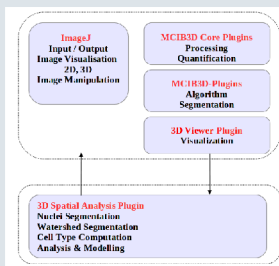
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Islets analysis

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Islets analysis

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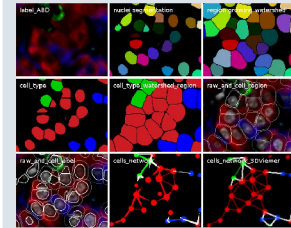
Islets analysis

http://imagejdocu.tudor.lu/doku.php?id=plugin:stacks:3d_ij_suite:start

Conclusion

- Future directions :
  - Compare more islets in different physiological conditions
  - Integrate information about blood vessels
  - → develop an integrated model of spatial organization for tissue
  - → dynamic simulation of Islets of Langerhans, that can be considered as a mini-organ

Merci

- Master students
  - Amal TISS and Marcelo MATA, tracking
  - Etienne DAVID, denoising
- Ph. D. students
  - Lamees NASSER, vessel architecture
  - Hoa TRAN, modeling spatial organisation