PÓLO DO I.S.T

TÉCNICO LISBOA

IPATIMUP

Characterization of E-Cadherin Distribution from Fluorescence Images

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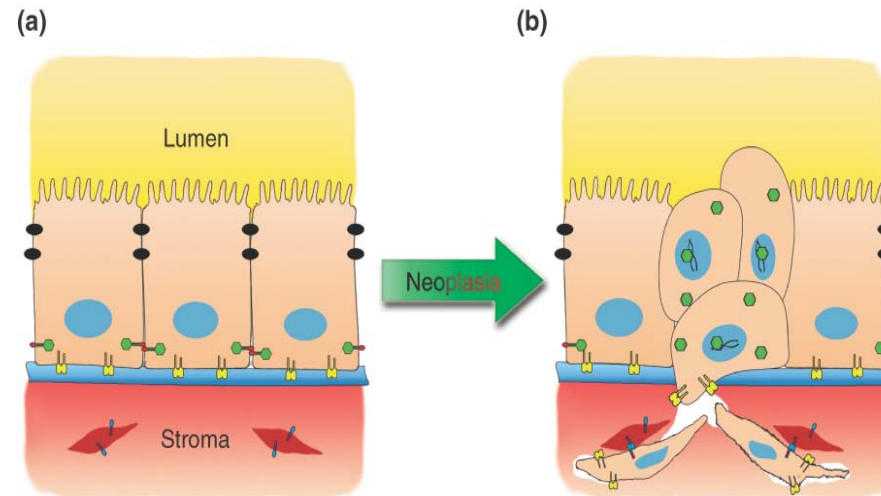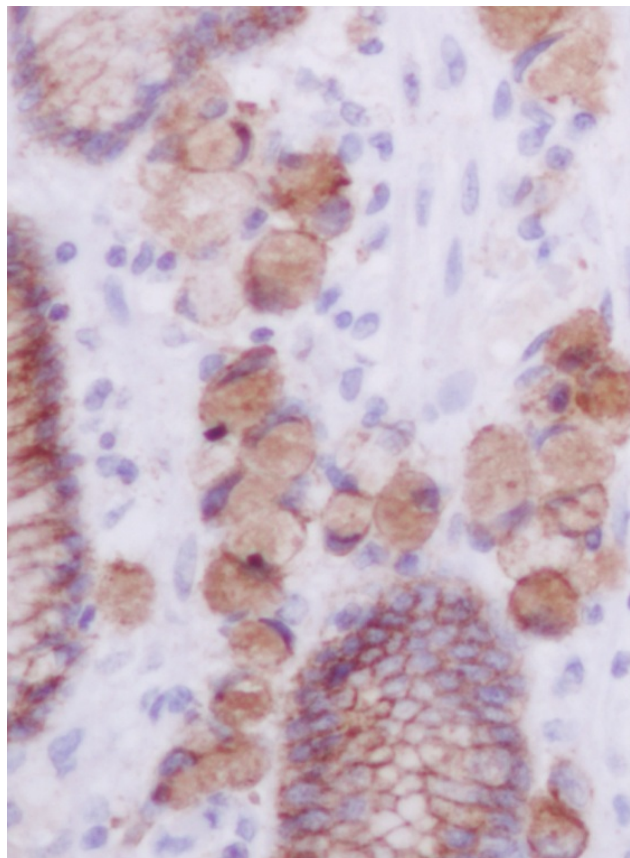
Cell Adhesion

Physical linkage between cells is the basis of structural mechanical properties of the tissues, e.g, epithelial tissues
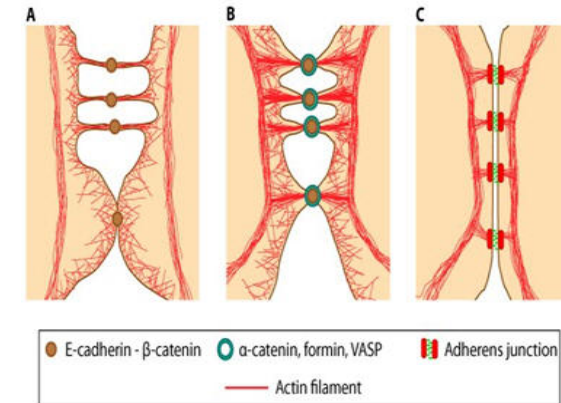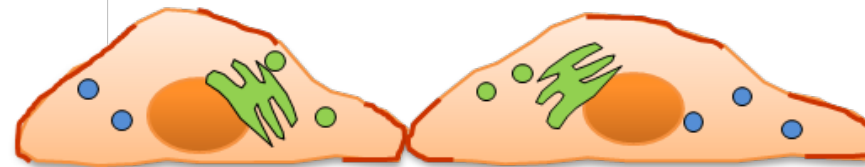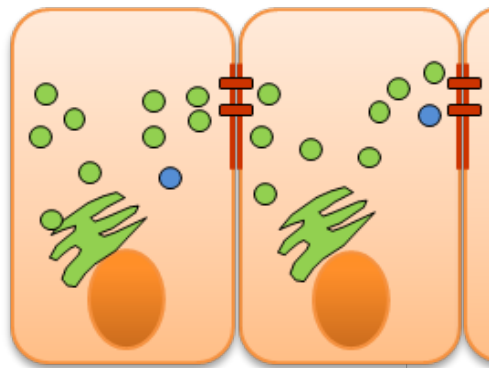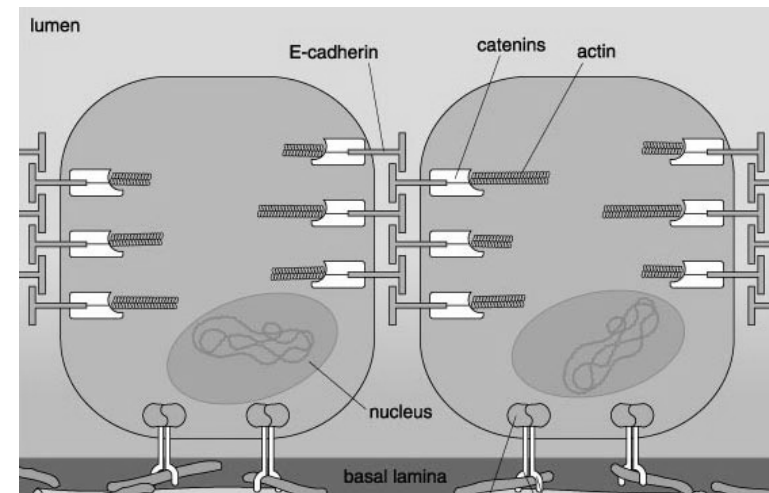
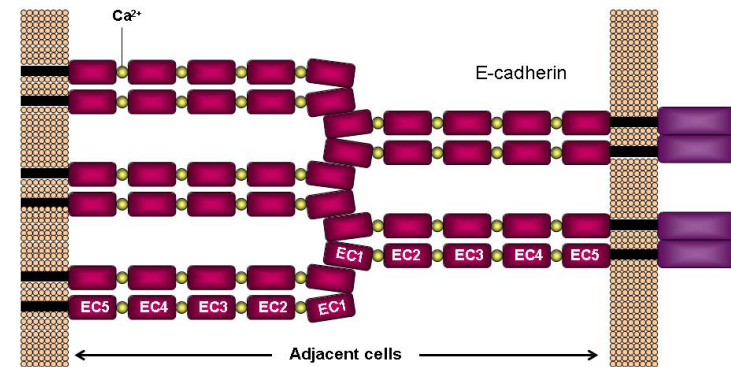# Aberrant adhesion

Cells become **non-adherent** and gain an increase ability to invade the surrounding tissue, e.g., cancer

E-Cadherin

- E-cadherin is a central protein in cell-cell adhesion.

- Mutations on E-Cadherin gene (CDH1) lead to a dysfunctional molecule.

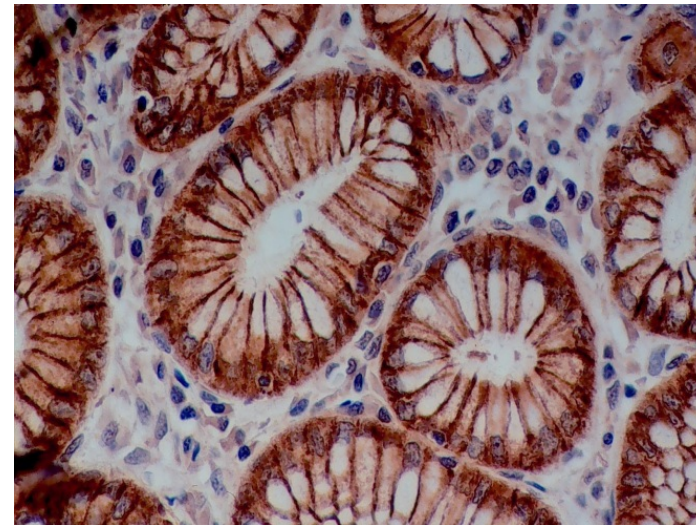- These mutations are involved in epithelial cancer progression.
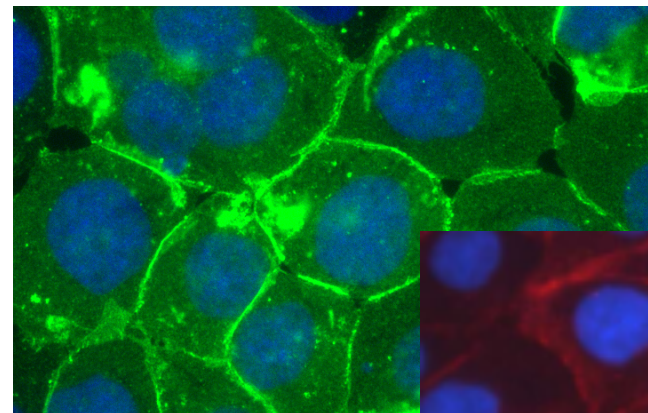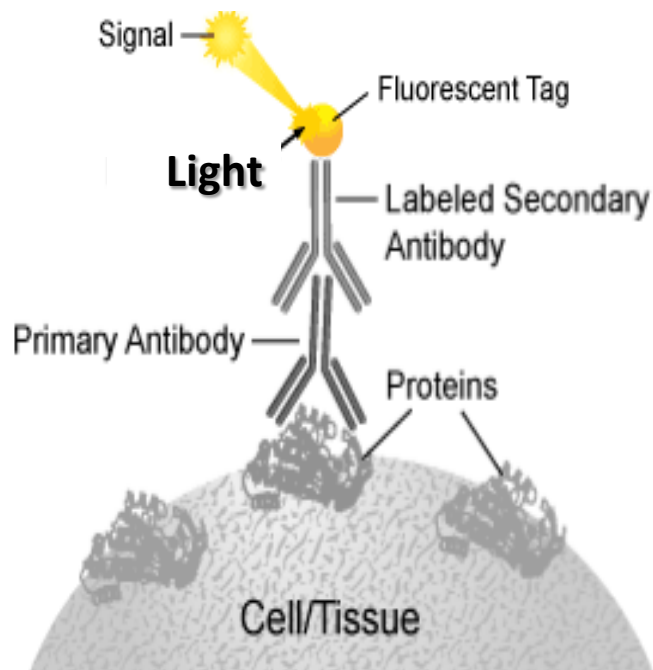
E-Cadherin Distribution

The distribution of E-Cadherin molecule in normal cells is mainly observed at the membrane, where it plays its role in cell-cell adhesion.
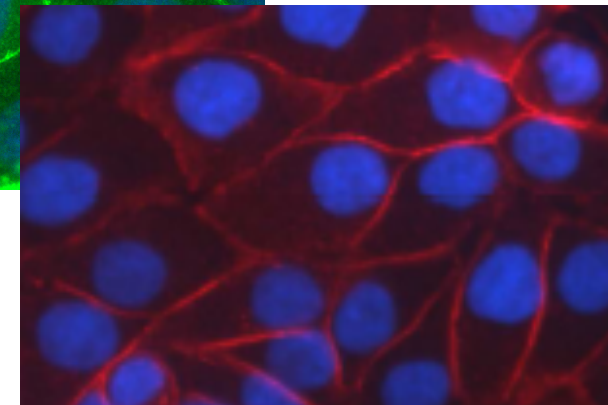
Normal stomach tissue

Fluorescence Imaging

E-Cadherin distribution can be observer in epithelial cell line labeled with E-Cadherin tagged anti-body

Epithelial cell line expressing E-cadherin
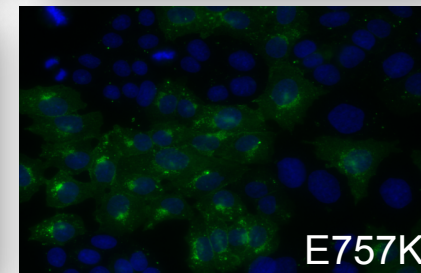
E-Cadherin Mutations
Cell distribution

Key features

No contact

Loss of expression

Loss of expression at cell membrane and
Aberrant cytoplasmic expression
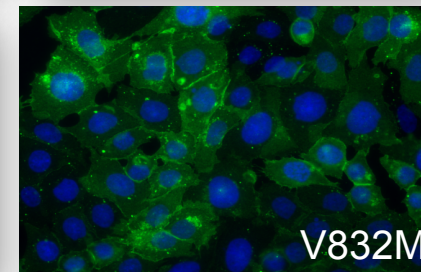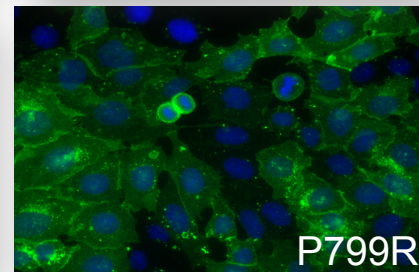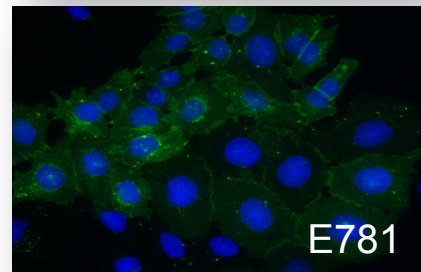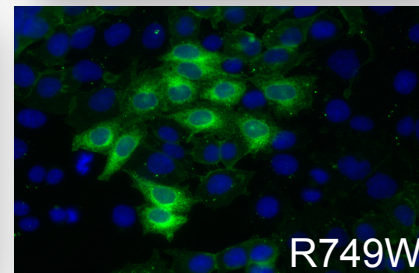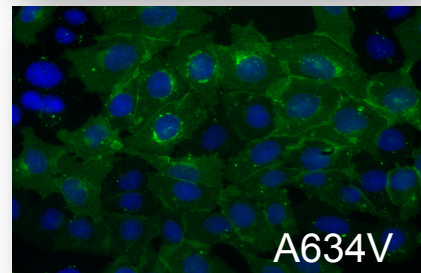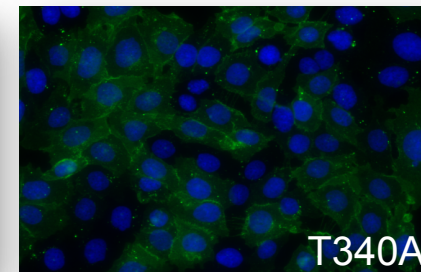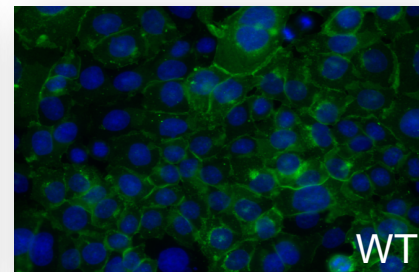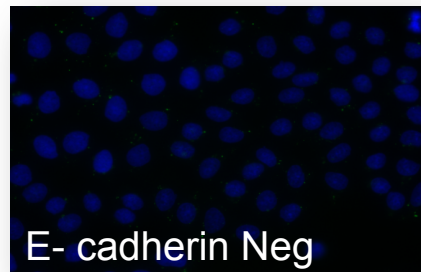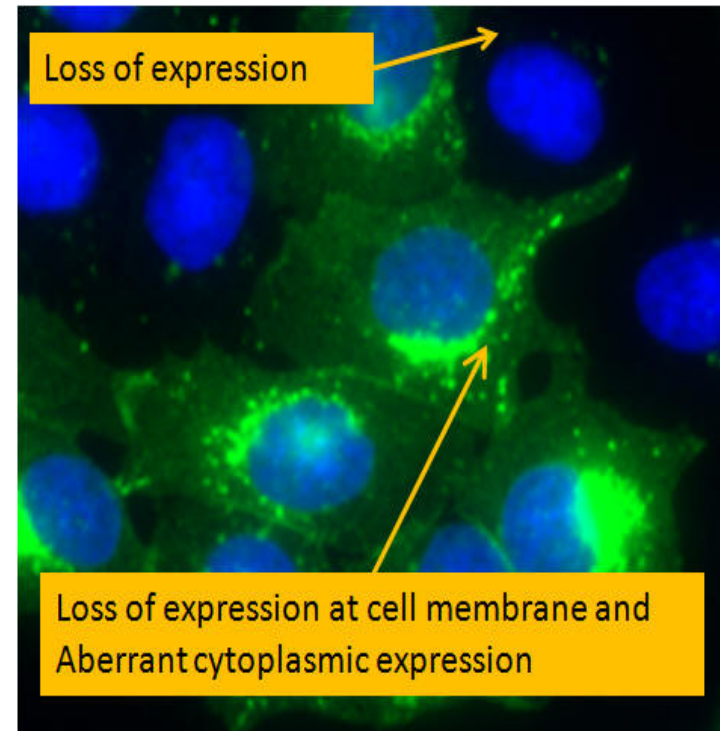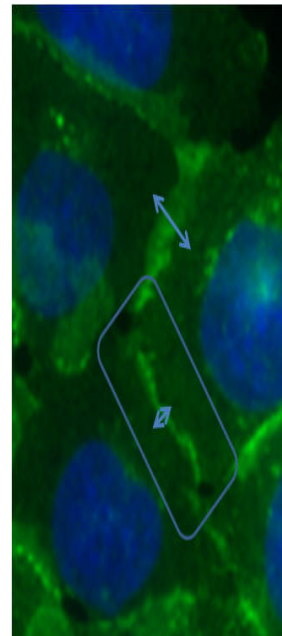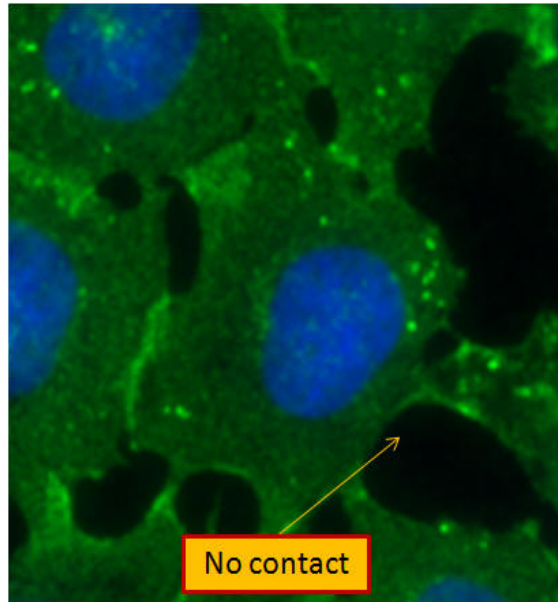
E-Cadherin distribution characterization

1. Pre-processing and semi-automatic cell selection

2. Image radial profiles computation

3. Compensation for geometric distortions

4. Features extraction and distribution characterization

Cell centroid estimation and semi-automatic selection

- Centroids selection and computation

Image of intensity profiles

Geometric compensation

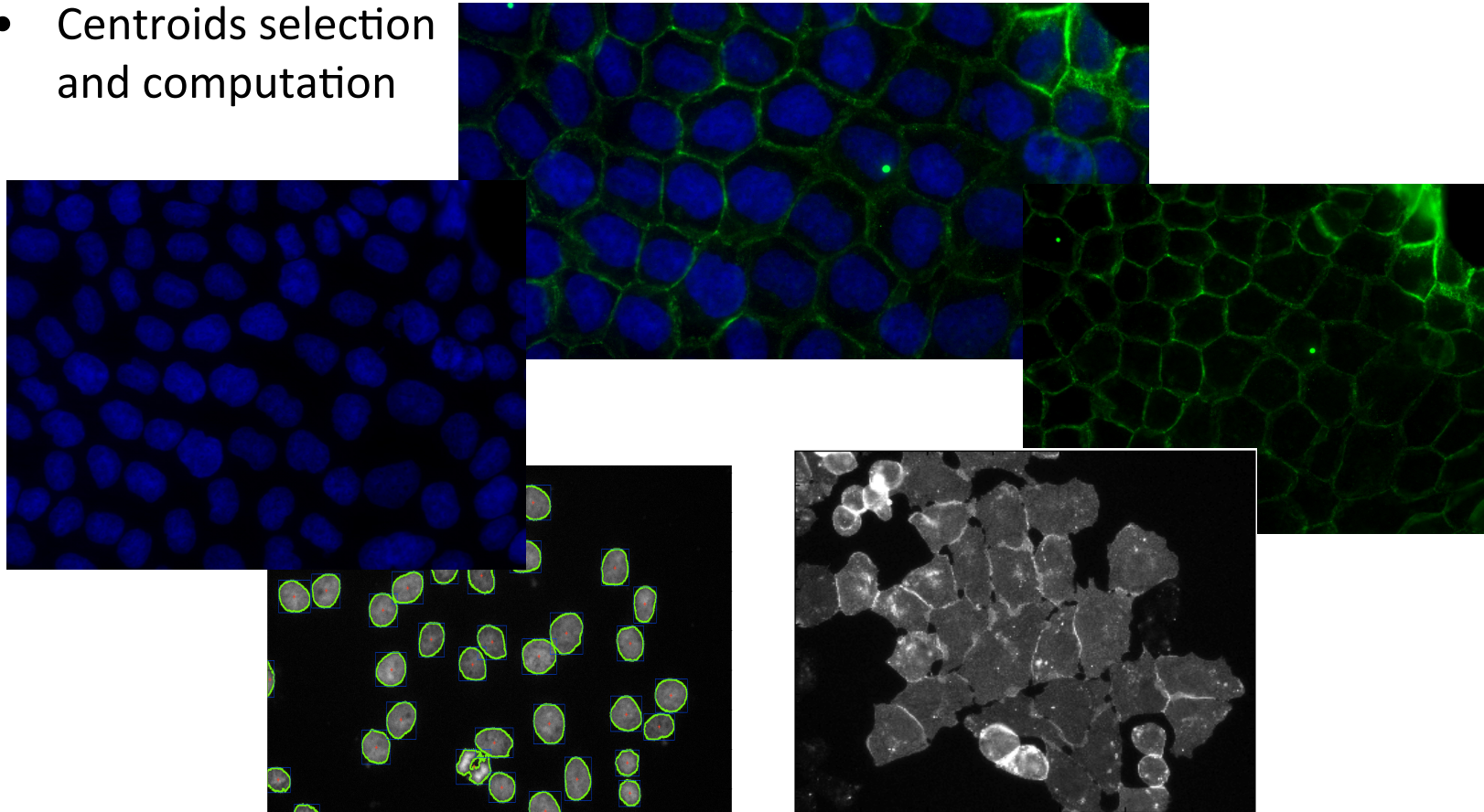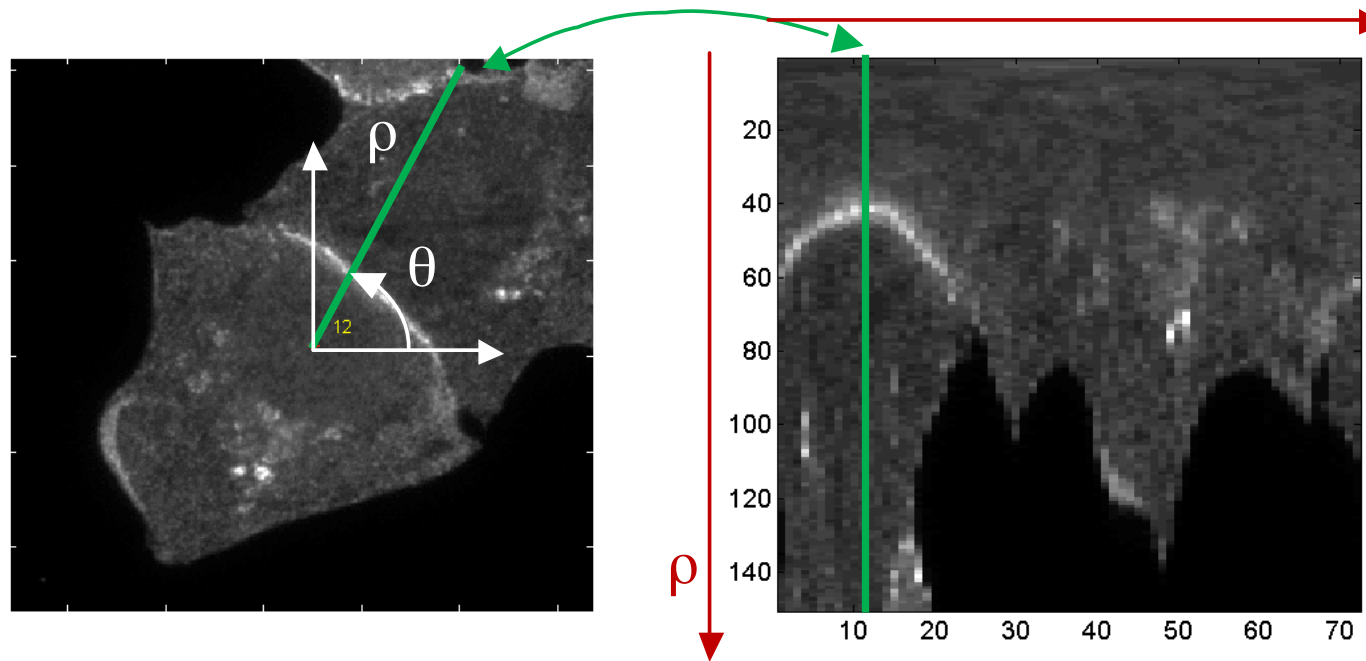- Each profile (column) is modeled as a finite dimension 1D continuous function estimated *by imposing similarity among columns*

- The locations, x, of the original observations are adjusted in this continuous space according an energy function

$$f_\theta(\rho, \mathbf{x}_\theta, \mathbf{c}_\theta) = \sum_k c_{k,\theta}(\mathbf{x}_\theta) \phi_k(\rho)$$

$$\mathbf{c}_\theta^t = \arg\min_\mathbf{c} \left\| f_\theta(\rho, \mathbf{x}_\theta^{t-1}, \mathbf{c}_\theta) - \mathbf{y}_\theta \right\|^2 + \alpha \left\| D\mathbf{c}_\theta \right\| + \beta \left\| \mathbf{c}_\theta - \mathbf{c}_{\theta'} \right\|^2$$

$$\mathbf{x}_\theta^t = \arg\min_\mathbf{x} \left\| f_\theta(\rho, \mathbf{x}_\theta, \mathbf{c}_\theta^t) - \mathbf{y}_\theta \right\|^2 + \gamma \left\| D\mathbf{x}_\theta \right\|^2$$

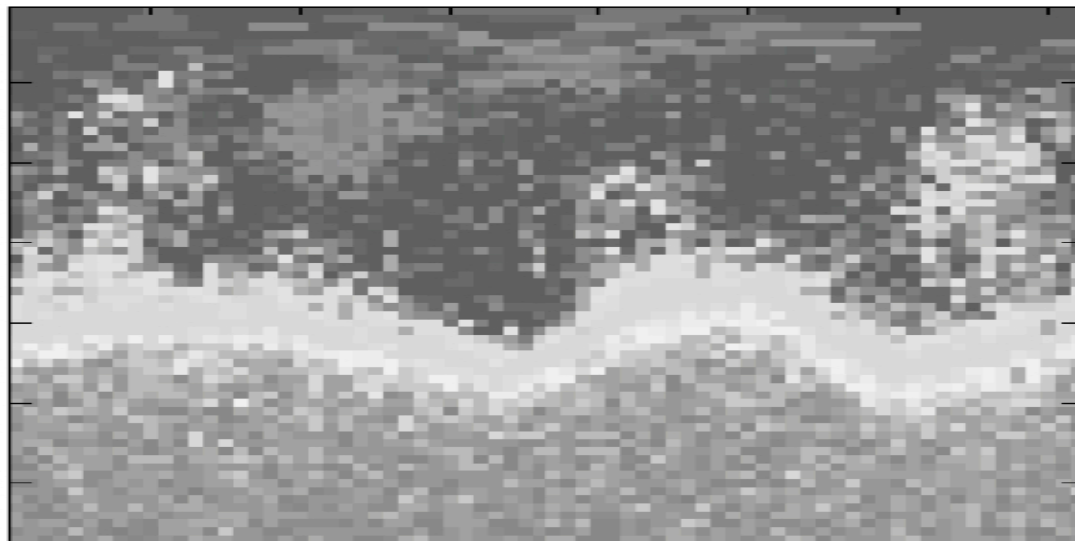# Distribution characterization

- Image profiles - 2D based characterization
- Prototype profile estimation
  1D based characterization

Conclusions

- Distribution of E-Cadherin protein across the cell from fluorescence images of microscopy

- Characterization metrics for discrimination for CDH1 gene mutations

- Radial E-Cadherin prototype distribution
  - Geometry invariant

Thank you

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