

Authors: Yu Wang, Farshid Moussavi, Peter Lorenzen, Presenter: Martin Chian

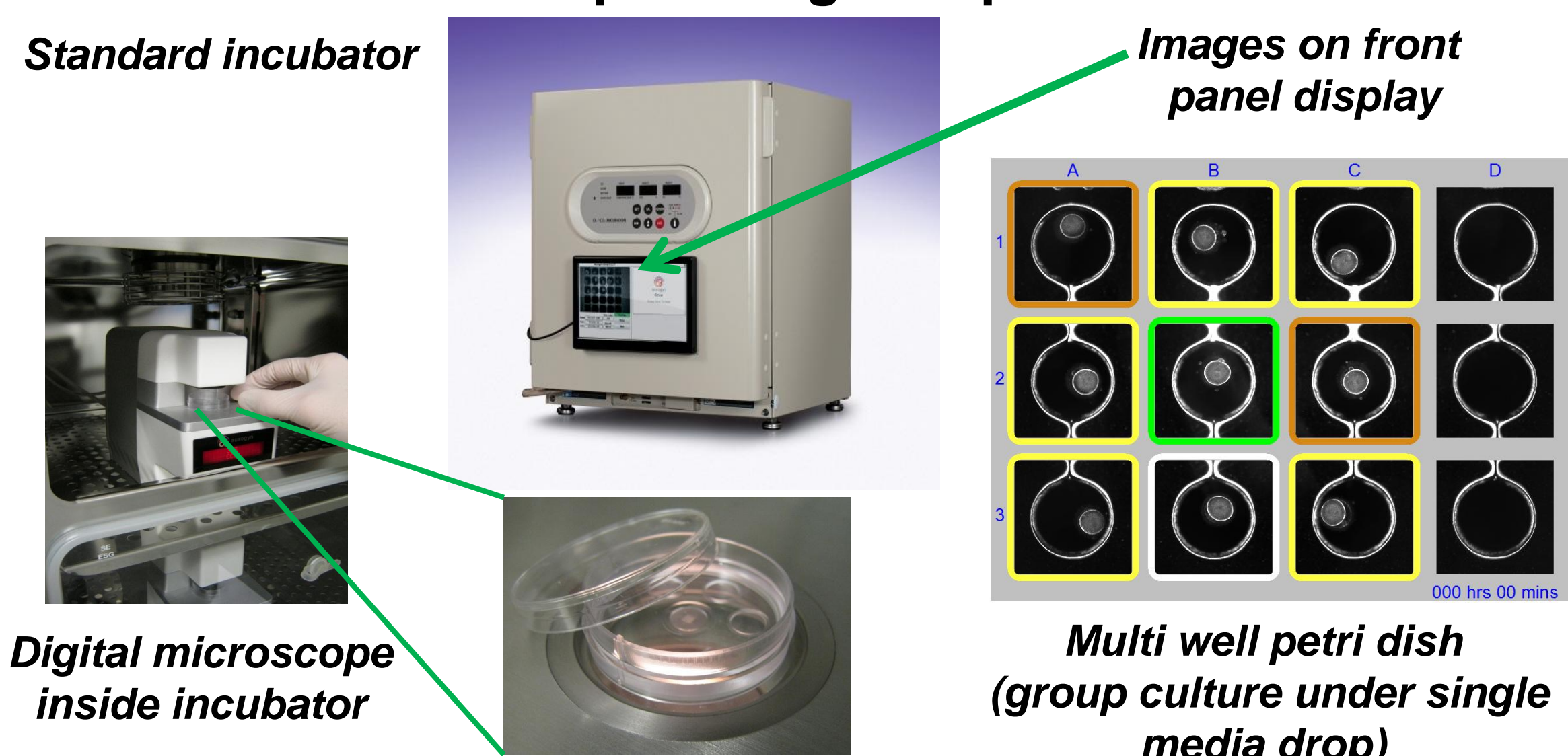
Auxogyn, Inc., Menlo Park, CA 94025, USA

{ywang, fmoussavi, plorenzen, mchian}@auxogyn.com

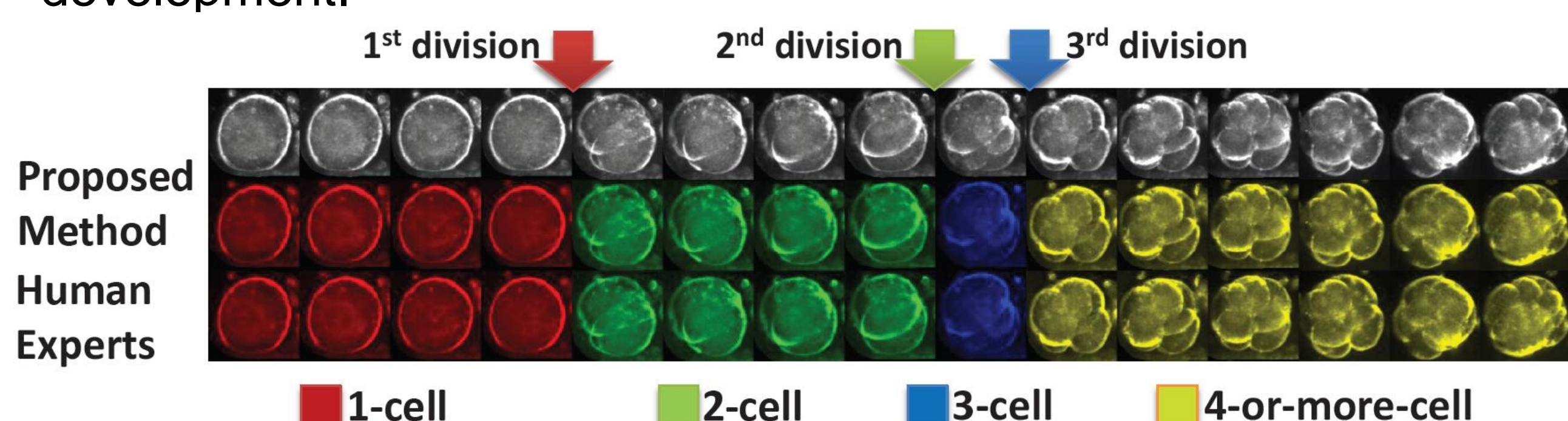
## Background and Significance

- The **Eeva<sup>TM</sup>** (Early Embryo Viability Assessment) Test –was developed to automatically measure cell division timings and provide quantitative information regarding embryo development.

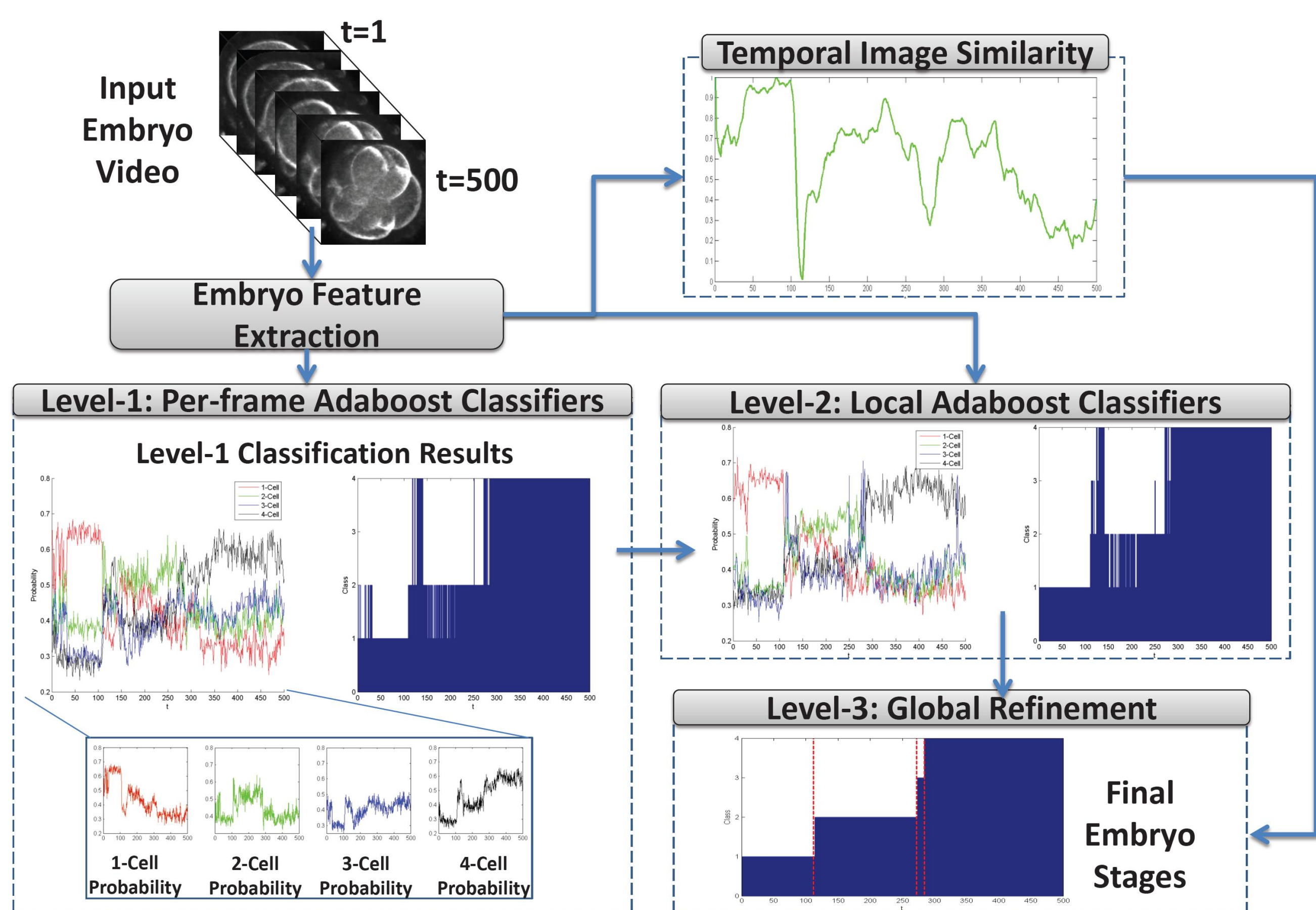
### Eeva<sup>TM</sup> Time Lapse Image Acquisition



- We developed a multi-level classification method to identify the embryo stage (i.e. 1-cell, 2-cell, 3-cell, 4-or-more-cell) at every time point of a time-lapse microscopy video of early human embryo development.

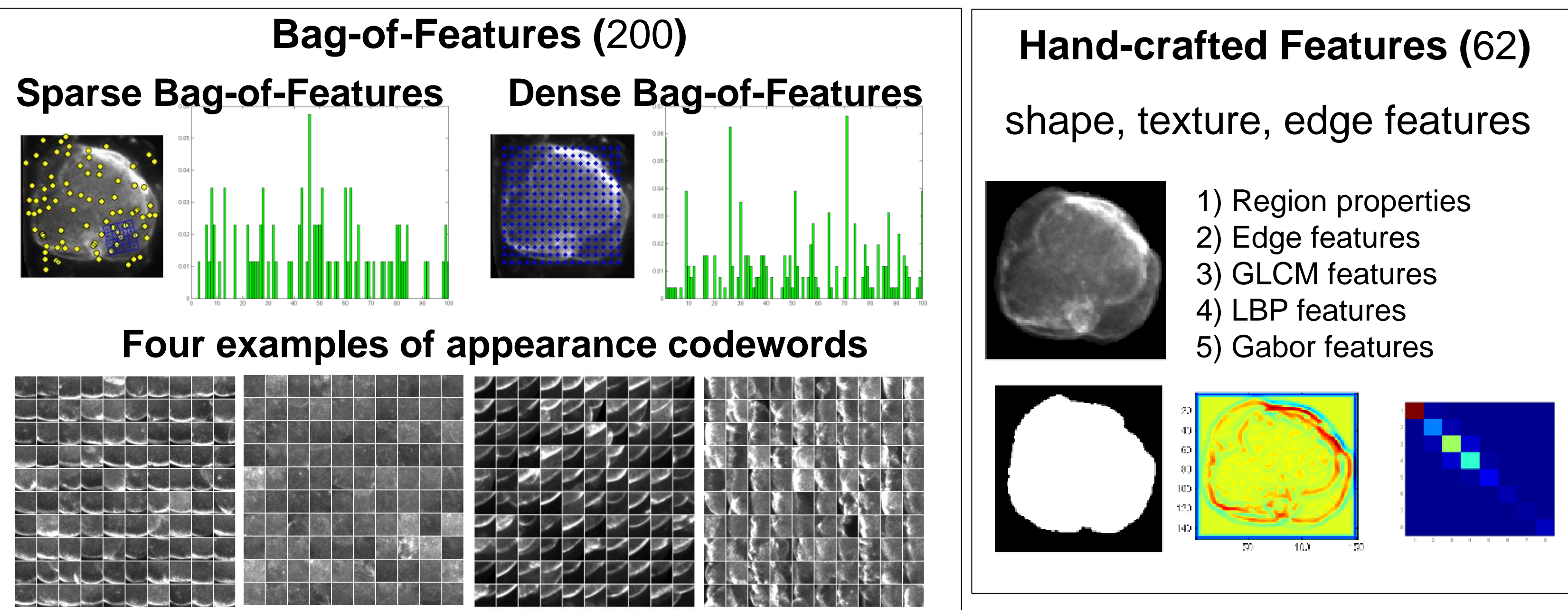


## The Method



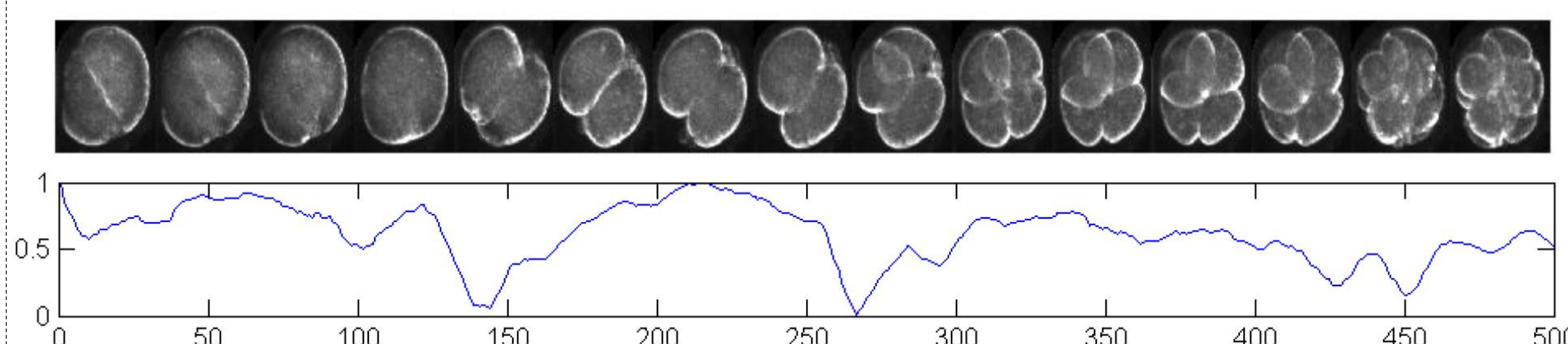
- 3-Level Embryo Stage Classification Framework**
  - Level 1:** per-frame embryo stage classification
    - 4 Adaboost Classifiers with 262 embryo features
  - Level 2:** local embryo stage classification with temporal context
    - 4 Adaboost Classifiers with 262 embryo features and 20 temporal features.
  - Level 3:** global refinement with Viterbi algorithm
    - Performs refinement with global context
    - Fuses different sources of information (i.e. classification probabilities, temporal image similarity)
    - Integrates prior and enforces non-decreasing number of cells

## Embryo Features



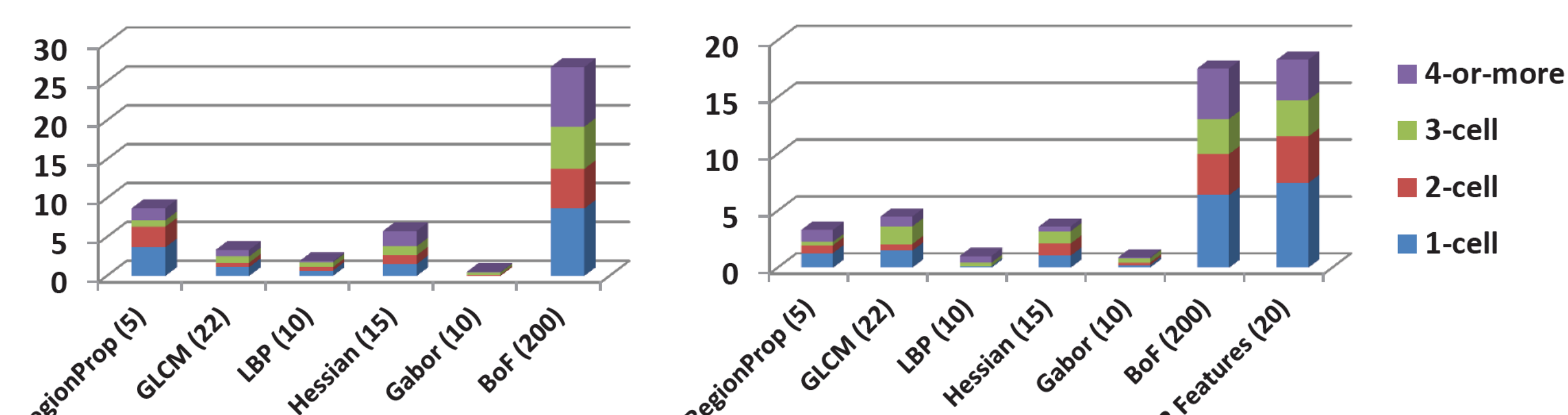
## Temporal Image Similarity

- Based on Bhattacharyya distance of the BoF histograms of consecutive frames
- Registration free, rotation and translation invariant
- “Dips” in the plot are good indications of stage transitions
- Used by the Viterbi algorithm to define state transitional probability



## Results

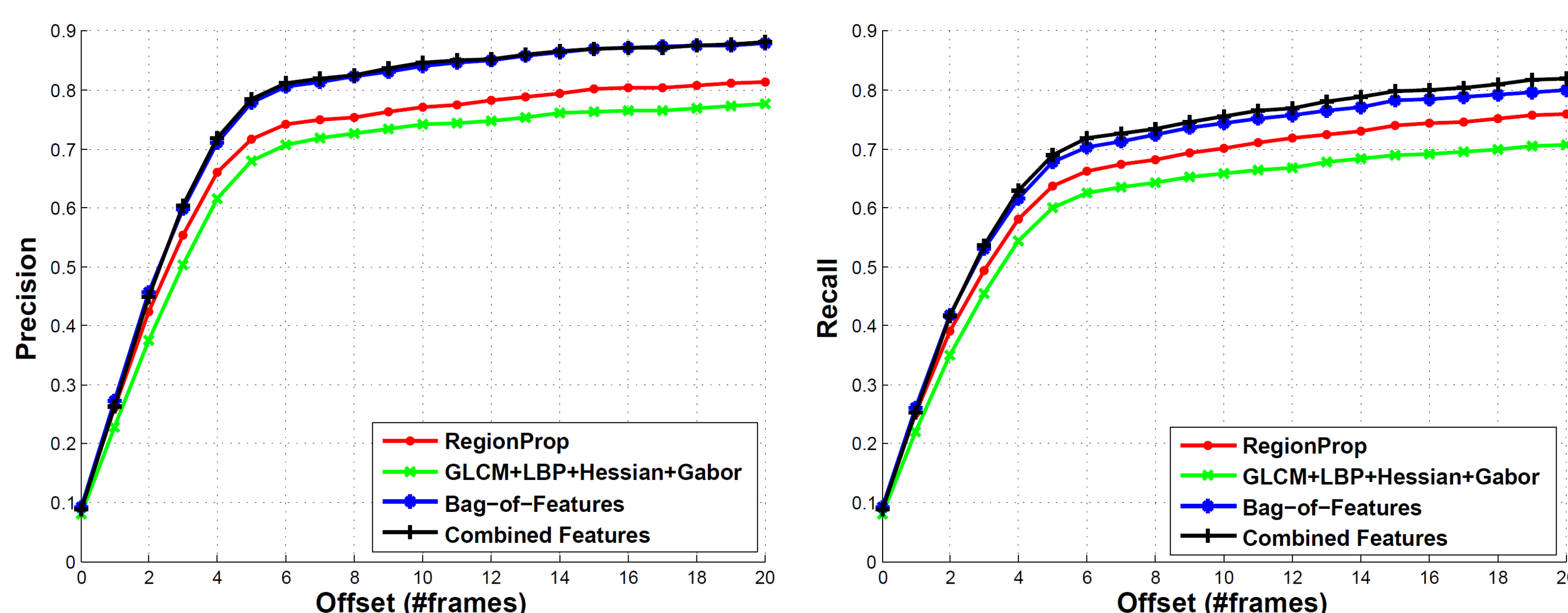
- 327 human embryo videos (500 frames, each with 151 x 151 pixels) for training, 389 embryo videos for testing.
- All the embryo videos were captured using the **Eeva<sup>TM</sup>** system.
- Two human experts annotated the embryo stages of each frame.



Importance of different sets of features in trained level-1 (left) and level-2 (right) classification models

	1-cell	2-cell	3-cell	4-or-more	Overall
Level-1	87.96%	77.45%	7.79%	85.03%	80.10%
Level-2	88.04%	72.05%	10.71%	92.94%	82.53%
Level-3	91.95%	85.58%	20.86%	94.14%	87.92%

Classification performance at different levels



Precision (left) and Recall (right) of cell division detection as functions of the offset tolerance