Towards Automated Early Classification of Embryos

Alain Trubuil, Mounya Belghiti, Véronique Duranthon, Pierre Adenot, Ludivine Laffont, Sylvie Ruffini, Brigitte Le Guienne, Alline de Paula Reis

Conference Program

BioImage Informatics 2017

September 19-21, Banff, Canada

Venue

BANFF
CENTRE
FOR ARTS AND
CREATIVITY

Support

NSF

Towards Automated Early Classification of Embryos

Alain Trubuil[1,*], Mounya Belghiti[2,3], Véronique Duranthon[3], Pierre Adenot[3], Ludivine Laffont[3], Sylvie Ruffini[3], Brigitte Leguienne[4], Alline de Paula Reis[2,3]

[1] MIA, INRA, Jouy-en-Josas, France
[2] Ecole Nationale Vétérinaire d'Alfort, Université Paris Est, France
[3] UMR BDR, INRA, ENVA, Université Paris-Saclay, Jouy-en-Josas, France
[4] ALLICE, Jouy-en-Josas, France
[*] Corresponding author (alain.trubuil@inra.fr)

Abstract

The early classification of embryos observed in time-lapse video is a challenging issue (1). On the one hand high success after transfer is looked for, on the other hand eliminating good embryos is a problem. Herein we propose a three steps strategy: Annotation, Selection of the most important factors, Automation of the annotation for selected factors.

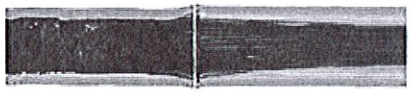
Annotation: Dataset of 178 embryos observed by PrimoVision videomicroscopy for 6 to 8 days after fecondation every 15mn. Each embryo is annotated by an expert on morphological and kinetic traits all along the development (150 quantitative or qualitative traits).

Selection with Random Forest (a) and VSURF (b): Classification issue along dead or alive state is considered. Classification trees (R package *randomforest* (2)) are estimated as well as selection of variables for interpretation and prediction based on the mean decrease Gini homogeneity measure (VSURF R package). In the prediction proposal *VSURF* (3) exhibits a subset of least correlated predictors. Several predictors rely on the evaluation of dead cells.

Deciding of dead cells: The typical phenotype of a death cell event rests upon the swelling of the cell, the loss of texture activity inside the cell and the rupture of the cell wall (Fig. 1). We propose a sampling strategy investigating the occurrence of death inside an embryo along the development. A fix number of locations are sampled on several rays originating from the center and cross-sections along time for each of these rays are analyzed with respect to texture (4). Simple filters based on the estimation of variation coefficient on a variable neighborhood oriented along the time dimension are proposed.

Main Results: Automated selection of important features on a new collection of annotated bovine embryos.

Fig. 1. A cross-section in a video, occurrence of dead cells (in red).



References

1. C. Manna, L. Nanni, A. Lumini, S. (2013). Artificial intelligence techniques for embryo and oocyte classification. *IEEE Transactions on Image Processing* 26(1):42-49
2. L. Breiman (2001). Random Forests. *Machine Learning* 45(1):5-32.
3. R. Genuer, J.-M. Poggi, C. Tuleau-Malot (2015). An R Package for Variable Selection Using Random Forests. *The R journal* 7(2):19-33.
4. J. Yuan, D.L. Wang, A.M. Cheriyadat (2015). Factorization-based texture segmentation. *Machine Learning* 24(11):3488-3497.