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CLASSIFICATION OF THE ACROSOME INTEGRITY OF BOAR SPERMATOZOA HEADS USING SURF AGAINST TRADITIONAL DESCRIPTORS

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ABSTRACT

Automatic assessment of sperm quality is an important challenge in the veterinary field. Our proposal is to characterize the acrosomes of boar spermatozoa heads as intact or damaged using SURF descriptors, and compare them with Local Binary Pattern (LBP), Flusser, Hu, Zernike and Legendre descriptors. We classify the images with k-Nearest Neighbours. Experimental results point out that SURF descriptors are better, reaching an accuracy of 94.88%, which makes this approach very attractive.

INTRODUCTION

The main goal of this paper is to evaluate the effectiveness of SURF descriptors to classify boar spermatozoa heads as intact or damaged.

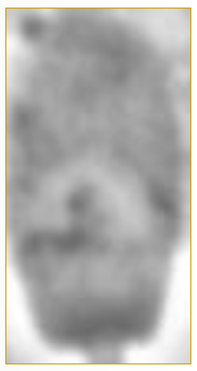
ACQUISITION & PREPROCESSING

Image acquisition

A digital camera connected to a phase-contrast microscope with a 100x magnification were used to capture boar semen images with a resolution of 2560× 1920 pixels.

Two snapshots of the same spermatozoa, one in real color under fluorescent illumination and other in grey scale under positive phase contrast illumination –which let us label heads as damaged or intact –, are taken.

Intact head



Damaged head

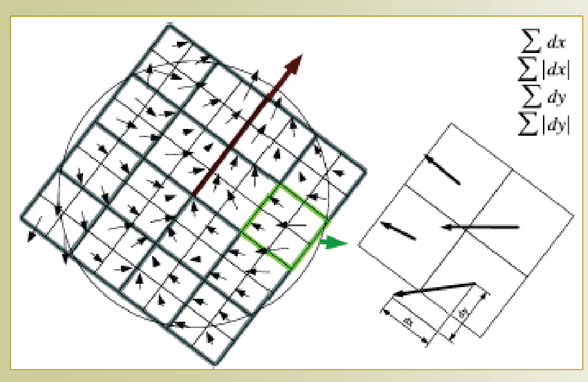
Pre-processing

The heads of the grey scale images are then registered in order to assure scale and rotation invariance. Bad registered images are then discarded. After all this process we have a set of 856 intact and 861 damaged heads.

DESIGN OF THE EXPERIMENT

Interest point detection and description

SURF (Speeded-Up Robust Features) relies on integral images for image convolutions. A Hessian matrix-based measure for the detector and a Haar wavelet-based descriptor is used.



For each 4x4 square over the interest point, the sums and absolute sums of the wavelet responses d_x and d_y are computed.

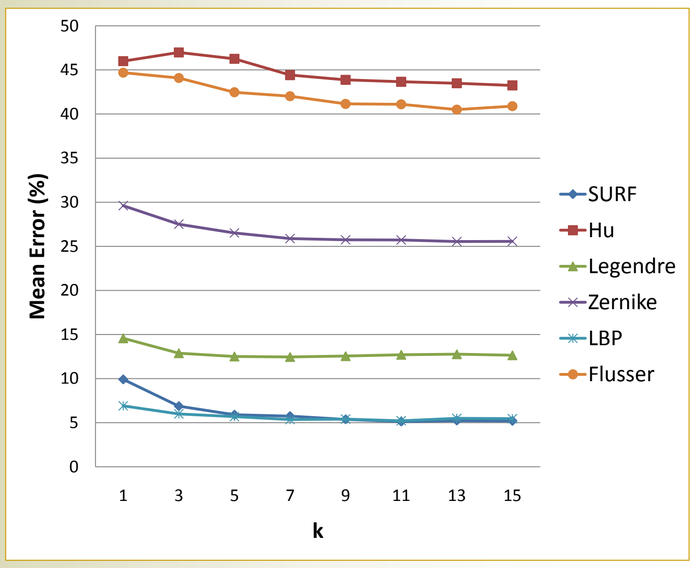
Classification algorithms

k-Nearest Neighbours algorithm was used to classify new parts into the two classes with k=1:2:15.

RESULTS

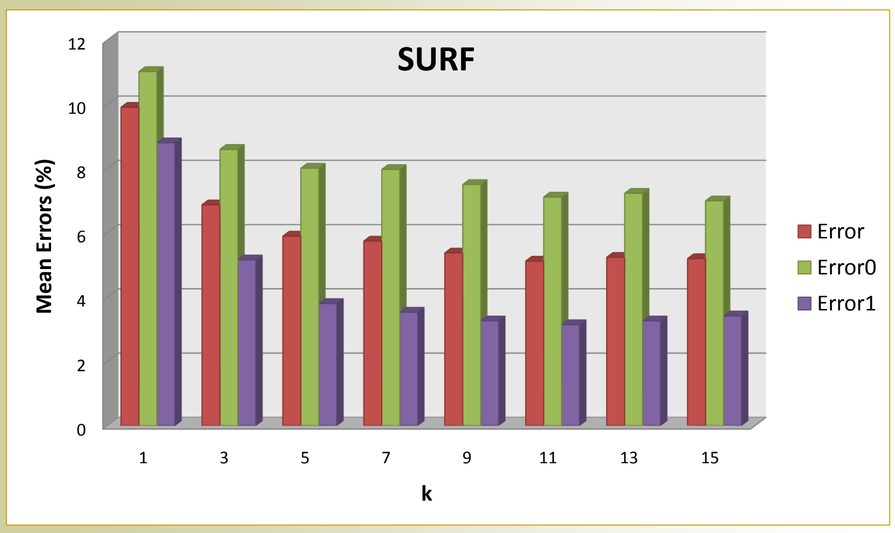
Mean errors over ten iterations are shown.

The lowest error rate is yielded by SURF with k=11 (5.12%) followed by BLP with k=11 (5,21%). The rest of descriptors are less suitable.



Error0 indicates the percentage of intact heads bad matched. Error1 refers to damaged heads. Error includes both of them.

We can appreciate that the lowest error rate 5,12% (k=11) is produced by a higher error rate of intact heads (7,11%) in relation to the error rate of damaged heads (3,14%).



CONCLUSION

This research demonstrated the success of applying a computer vision approach to classify images of boar sperm heads as intact or damaged acrosome.

The best results were obtained using SURF and k=11 with 5.12% error rates. Lower error rates were achieved in the damaged matching than with intact heads.

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