Automated identification of hemolysis producing bacteria colonies on WASPLab™ generated images from clinical specimens inoculated on blood agar plates

[1]Mattia Savardi, [2]Simone Arrigoni, [2]Stefano Lombardi, [1]Alberto Signoroni
[1]University of Brescia, Information Engineering Department, [2]Copan Group S.p.a.

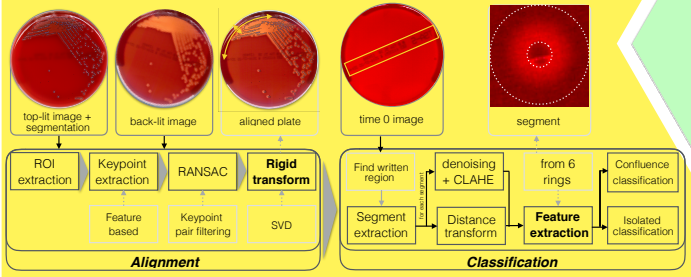
ECCMID
Madrid, Spain
21 – 24 April 2018
Poster Number 0125
April 21, 15:30-16:30

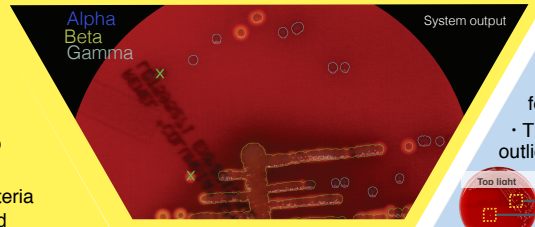
Background

- The presence of hemolysis producing colonies is usually associated to bacteria species often present on throat swab specimens, and its presence can be associated to virulence.
- Is very important to rapidly detect hemolysis forming colonies since it can be used as a presumptive identification of hazardous pathogens to support patient's treatment.
- Copan WASPlab™ automation produces high definition images of bacteria culture plates allowing diagnostic decisions through image analysis and bacteria culture interpretation.
- The acquisition of images using top-light and back-light illumination source emphasizes the presence of hemolysis producing bacteria colonies.

Objectives

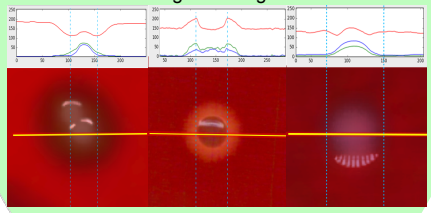
- The objective of this study was to develop and evaluate a method for the detection of clinical relevant hemolysis.





Dataset

- Dataset composed of REMEL 5% sheep blood agar media.
- Inoculated with known hemolysis. producing bacteria colonies.
- 1946 colony segments.
- 298 confluential growth segments.



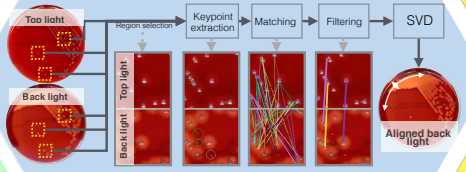
Alpha: brownish halo

Beta: yellowish halo

Gamma: non hemolytic

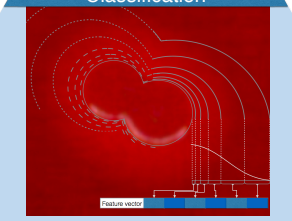
Alignment

- The fine-alignment is carried out by means of specific visual features extracted from the images.
- The features are aligned after a robust outlier removal block.



This phase enable the use of spatially fine-aligned information from top-light image to back-light.

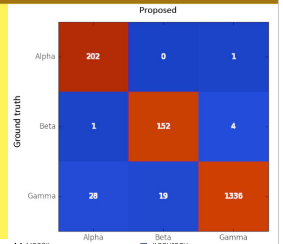
Classification



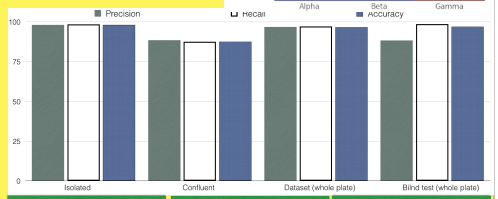
- Use of each segmented portion of the image containing a bacterial colony.
- Extraction of image features from 6 rings.
- Classification with a support vector machine (SVM), allowing hemolysis detection and discrimination.

Results

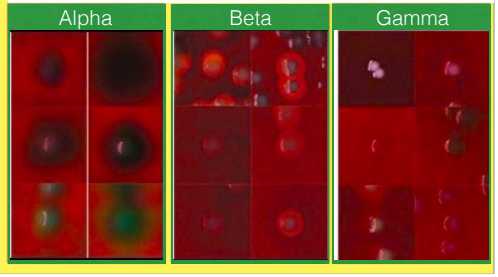
- The optimized image fine-alignment system aligns more than 98.1% images with a residual error of less than 0.13mm.
- On the right a confusion matrix with the results on a test-set of 1747 segments.
- The hemolysis classification block achieves a 96.5% specificity with a sensitivity of 98.6%.



- Mean computational time: 9.7 seconds per plate.
- The alignment is the most time consuming part, while the classification phase is very fast.



- On the right some examples of correctly classified hemolysis.



Conclusions

- Data generated in this study demonstrated that hemolysis producing bacteria colonies were properly detected by WASPLab™ generated images from throat swabs specimens inoculated on blood agar plates.
- The analysis of the data demonstrates the suitability of WASPLab™ system for robust hemolysis detection.
- Additional testing of different detection methods and by increasing the dataset dimensions are ongoing.

References

[1] C. Doern, M. Holfelder, Automation and design of the clinical microbiology laboratory, Manual of Clinical Microbiology, 2015.
[2] K. Mikolajczyk, C. Schmid, A performance evaluation of local descriptors, IEEE Transactions on Pattern Analysis and Machine Intelligence 27 (10).
[4] UK standards for microbiology investigations, investigation of throat related specimen, Standards Unit (9).
[5] M. Savardi, A. Ferrari, A. Signoroni, Automatic hemolysis identification on aligned dual-lighting images of cultured blood agar plates, Computer Methods and Programs in Biomedicine, Vol. 156, 2018, pp. 13-24

WASPLab®

Copyright © 2018 Mattia Savardi – m.savardi@unibs.it