

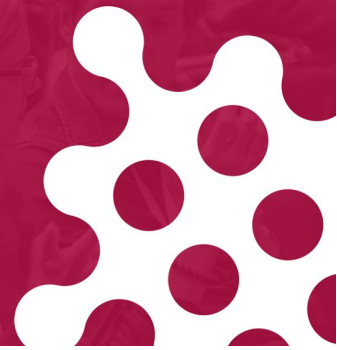


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ABSTRACT



03590 Artificial intelligence and large field, high-resolution lensless imaging for

non-destructive, label-free identification directly on agar

04. Diagnostic bacteriology & general microbiology

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Background

The pursuit of non-invasive and non-destructive identification methods has raised an increasing interest for label-free optical techniques, e.g. vibrational spectroscopies (infrared and Raman), elastic light scattering and lensless imaging. Among these technologies, elastic scattering and lensless imaging can be performed directly on agar plates, making them particularly compatible with the growing need for automated methods. Lensless imaging uses partially coherent light source to illuminate a standard Petri dish. The images are processed using Artificial Intelligence algorithms, resulting in an efficient identification. The large field of view allows imaging a significant number of colonies unlike elastic scattering. In addition to gaining a statistical advantage, the large field, high resolution imaging device can provide the simultaneous identification of several colonies at the single colony level

Methods

We report here the very first example of identification down to species with a widefield 24x36mm lensless imaging device. A partially coherent light emitting diode illuminated different microbial cultures growing on tryptic soy agar at 36°C in a standard Petri dish. Cultures of Gram-positive, Gram-negative and yeast reference strains were imaged every 10 minutes, for 22 to 23 h of incubation. An example of a full field image of *E. coli* culture is given at 20h of incubation. For the analysis, classical machine learning algorithms, as well as deep learning models were compared.

Results

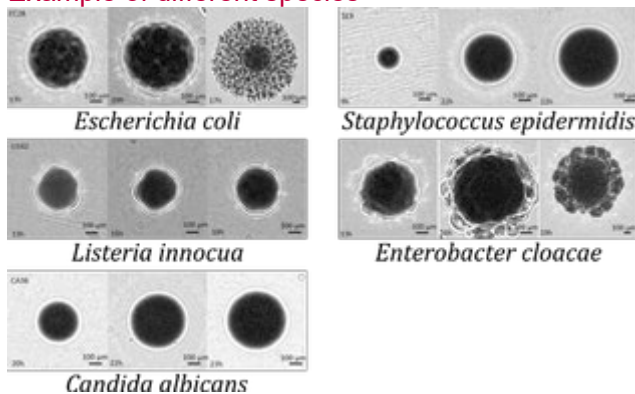
Deep Neural Networks, as well as classical machine learning algorithms, were investigated for the analysis of the collected database (15 reference strains). Several

convolutional neural network models were assessed, with up to 2000 samples (i.e. images of colonies) per species. The algorithms yielded unambiguous identification of the fifteen species, with at least 98% accuracy.

Conclusions

This very first database paves the way towards a future large field imaging device for the simultaneous identification of all the isolated colonies on a 90mm Petri dish. Furthermore, as culture growth is being recorded in situ with high resolution, the technique is capable of identification during the early stages of incubation. An extended database, including clinical isolates, will soon be collected.

Example of different species



Staphylococcus lentus



24 x 36 mm image of E. coli after 20h

