Image-based culture plate readers and microbiological testing of mixtures – is it necessary?

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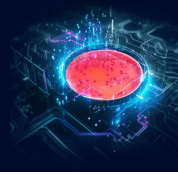

ABSTRACT

- As the use of imaging devices and artificial intelligence (AI) gain traction in culture plate reading, the question of performance on detection of mixtures of organisms often arises
- This is typically borne through traditional thoughts of validating alternative quantitative methods for micro-organisms to ensure methods do not demonstrate any interference or bias towards organism recovery or detection
- This approach, however, may not be applicable to newer technologies such as the APAS Independence
- The system is designed to detect both bacterial and mold colonies ,with each colony being classified as a result of pixel level detection in an independent and uninfluenced manner
- The pixel result is entirely based on the way the algorithm is developed, which remains agnostic to any species identification within bacterial or mold groups themselves

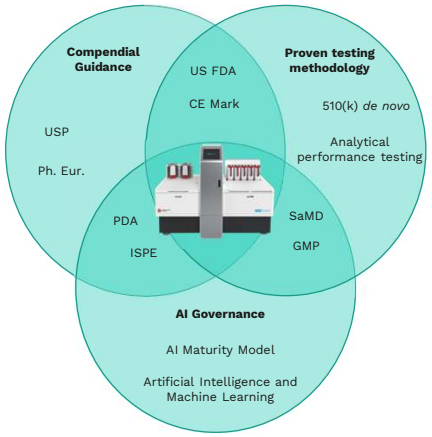

Figure 1. Scientific provenance of developing proven and robust AI tools for analysis

Figure 2. Colonial variation used for AI model training

DEVELOPMENT OF AN AI MODEL ON CULTURE PLATE IMAGES

- Clever Culture Systems are at the forefront of developing these models, being the first company to develop an AI-based system for culture plate reading
- Design and testing of AI models is well established for this system, with over 10 years of regulatory-approved methodology and systems deployed into routine laboratory operations
- Building AI model requires expertise between microbiologist specialists, AI engineers, and quality personnel, working with available regulatory frameworks and testing methods, underpinning the scientific provenance and rigidity of AI-based testing performed (Figure 1)

CLASSIFICATION

- Extensive sampling of colonial morphologies (bacterial and mold) are used for training and testing (Figure 2 provides a snapshot of colonial variation)
- Classification, the output of an AI model, is the "result" of a system and is dependent on the way the model was developed
- Strict development frameworks and AI-governance should be employed to ensure the model is fit for purpose and to ensure bias is minimized
- Because each colonial morphology including in training (input to an AI model) is individually annotated, the results are largely dependent on that annotation and no other factors such as neighboring colonies or artefacts
- In the case of APAS, the classification is performed on a per-pixel basis, where every pixel classification is independent and uninfluenced by the type of bacterial or mold species
- Pixel identification within a 'colony' is not always 100% accurate, however, the detection of a 'colony' is performed computationally on groups of pixels, where specific parameters are met for successful colony assignment
- The presence of neighboring pixels do not influence the final result (there is no interference or detection bias), therefore negating the need for testing of mixtures

CONCLUSIONS

- Classification results from 90 mm and Contact plates (Figure 3) show accurate classification and colony assignment, where the colors on the blue image represent the pixels within a colony
- Images acquired from routine EM samples are resulted simplistically for users where total CFU is presented, in addition to the mold CFU
- Given the independent nature of pixel assignment with APAS, testing of mixtures on the APAS system is not required
- Testing on other systems may be required, dependent on the technology used

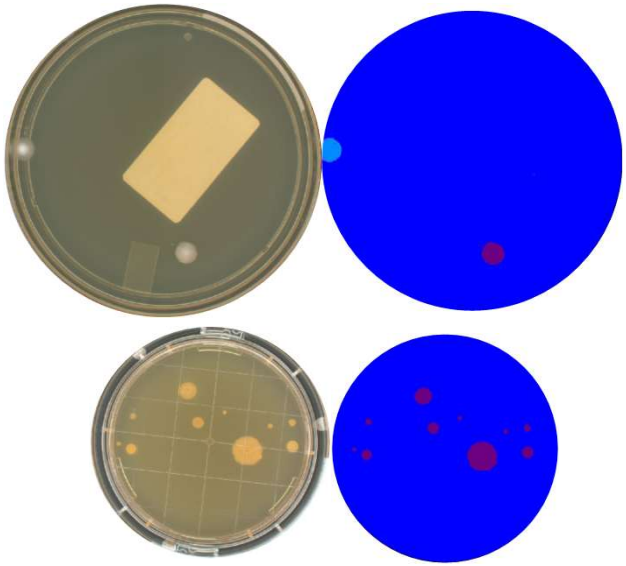

Figure 3. Raw image (left)and APAS classification(right) for 90mm plates (top) and Contact plates (bottom)

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