

Insight into Biofilm Dynamics: Integrating Experimental Curing, Advanced Imaging, and Machine Learning

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A biofilm is a layer of microbial cells associated with a surface enclosed in an extracellular polymeric matrix. Research in biofilms is associated with the benefits and drawbacks of its growth, which include roles in bioremediation and wastewater treatment as the pros and influence on human health as the cons. We have initially grown biofilms on a glass surface and subsequently obtained its images via optical imaging techniques. We are further in the process of detecting antimicrobial producing capabilities of our microorganism and how this ability can be benefitted by the formation of biofilms by bacteria. This study is being conducted to transform biofilm growth control, with the Intelligent System autonomously adjusting environmental parameters, thus enabling precise growth regulation. Objectives of this study are multi-fold: Generation of a dataset correlating biofilm growth with influential factors, analysing the strengths of different growth drivers and developing a smart framework to regulate biofilm formation effectively. The organism of choice is a non-pathogenic microbe *Pseudomonas stutzeri*, known for its biofilm forming ability. 3D confocal images would be utilized to derive qualitative and quantitative data using BiofilmQ. Machine-learning based models created by applying this data would enforce future adaptability and integration of advanced modules over time, eventually building a model for real-time interpretation and autonomous control of biofilm growth. Ultimately, this project would encourage further research and inclusion of the evolving field of computational biology, potentially creating a substantial societal and scientific impact through its contribution to diverse areas.

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