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Raman Spectroscopy for In Vivo Bacterial Infection Diagnostics: From Animal Models to Patient Samples

We investigate the diagnostic accuracy of machine-learning (ML)–based Raman spectroscopy for bacterial infection across three in vivo and clinical scenarios: murine wound models, patient urine, and patient chronic wounds, without any cultivation step.

Rapid identification of bacterial pathogens remains a critical bottleneck in clinical practice. Although MALDI-TOF mass spectrometry is the current reference, it requires a pre-cultivation period of approximately 24 hours and specialized laboratory infrastructure, and discrimination between closely related strains may remain challenging [1]. Raman spectroscopy combined with ML has been proposed as a faster, cost-effective alternative [2]; here we evaluate how well it performs when applied directly to biological samples, with no cultivation in between.

Three sample types are investigated (Figure 1): (i) controlled wound infections in mice, (ii) urine from patients with suspected urinary tract infection, and (iii) chronic wounds in patients. All measurements are performed with the Lightnovo Raman microscope (iv), and analyzed using a common automated pipeline. We address two complementary tasks: (A) binary detection of infection and (B) species-level identification of the causative pathogen. This work aims to demonstrate that in vivo Raman, without any cultivation step, can reach the accuracy required to support its use as a point-of-care tool for accelerating infection diagnostics

References

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Figure



Figure 1: Sample types and measurement setup. (i–iii) Representative samples: (iv) Sample placement under the Lightnovo Raman microscope.