Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4202** Type: **Poster Competition (Undergraduate Student) / Compétition affiches (Étudiant(e) du 1er cycle)**

(UG*) (POS-23) Diagnosing Bacterial Urinary Tract Infections Using Laser-Induced Breakdown Spectroscopy

Tuesday 28 May 2024 18:17 (2 minutes)

Urinary tract infections (UTIs) are the second most common infectious disease for which people seek treatment. The current gold standard for diagnosis requires the culturing of bacteria, a method that is time-consuming, costly, and can result in false-negatives. As an alternative diagnostic technique, laser-induced breakdown spectroscopy (LIBS) is being investigated for the rapid and accurate identification of pathogenic bacteria in clinical specimens of urine.

LIBS utilizes a nanosecond laser pulse to ablate a target, producing a plasma upon which spectroscopic analysis is performed. A broadband high-resolution Echelle spectrometer with an intensified-CCD camera allows for the measurement of a high signal-to-noise optical emission spectrum which can be used to make a near-instantaneous determination of the elemental composition of a target. To stimulate clinical UTIs, sterile urine specimens obtained from four patients at a local hospital were spiked with known concentrations of different bacterial species including *Escherichia coli*, *Staphylococcus aureus*, and *Enterobacter cloacae*. A partial least squares discriminant analysis (PLS-DA) performed on the spectra obtained from these specimens resulted in a 98.3% sensitivity and a 97.9% specificity for the detection of pathogenic cells in urine when single-shot LIBS spectra were tested. When the model was constructed using the average of thirty single-shot spectra acquired from a single target, a 100% sensitivity and a 100% specificity was obtained. Once a sample was identified as bacteria-positive, more advanced machine learning techniques were needed to differentiate the spectra acquired from the three bacterial species. The average sensitivity and specificity of an artificial neural network analysis with principal component analysis pre-processing (PCA-ANN) was 70.9% and 85.5% respectively. Ongoing work to improve these discrimination algorithms will be presented as well as efforts to improve the deposition method to increase the repeatability and improve the signal to noise of the spectra acquired from urine specimens.

Keyword-1

LIBS spectroscopy

Keyword-2

Bacteria

Keyword-3

Urine

Authors: BLANCHETTE, Emma (University of Windsor); MALIK, Hadia (University of Windsor)

Co-authors: TRACEY, Emily (University of Windsor); BAUGHAN, August; JOHNSON, Grace; Ms ALIONTE, Caroline (University of Windsor); ARTHUR, Isabella (University of Windsor); CHEVALIER, Rachel; SAAD, Jasmine (University of Windsor); BOLTON, Nicholas; PONTONI, Matteo; MUSTAFA, Abdullah; DMYTROW, Lauren; Ms VASQUEZ, Mila; Prof. REHSE, Steven (University of Windsor)

Presenter: MALIK, Hadia (University of Windsor)

Session Classification: DPMB Poster Session & Student Poster Competition (28) | Session d'affiches DPMB et concours d'affiches étudiantes (28)

Track Classification: Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)