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May 16th, 1:45 PM

## Cancer Diagnosis using LIBS and Machine Learning Tools: Progress and Challenges

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*Et al.*

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Melikechi N, Gaudiuso R, Ewusi-Annan E. (2017). Cancer Diagnosis using LIBS and Machine Learning Tools: Progress and Challenges. UMass Center for Clinical and Translational Science Research Retreat. Retrieved from [https://escholarship.umassmed.edu/cts\\_retreat/2017/posters/53](https://escholarship.umassmed.edu/cts_retreat/2017/posters/53)

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## **CANCER DIAGNOSIS USING LIBS AND MACHINE LEARNING TOOLS: PROGRESS AND CHALLENGES**

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Despite numerous research and development efforts that provide important tools to fight cancer, this disease still poses great challenges to diagnosis and treatment, and it remains one of the leading causes of death worldwide. Early diagnosis is crucial to increase the survival rate and quality of life of cancer patients. Thus, developing non-invasive screening methods would represent a key step towards point-of-care large scale screening and prevention of asymptomatic tumors such as Epithelial Ovarian Cancer (EOC) and others. Our group has developed two experimental strategies to pursue early cancer diagnosis through Laser-Induced Breakdown Spectroscopy (LIBS), a versatile atomic spectroscopy technique whose main advantages are: little or no sample preparation required; real-time multi-elemental response; virtually no limitation about the kind of sample that can be analyzed. The first is a LIBS-based immunoassay (Tag-LIBS), where a cancer biomarker is tagged with a suitably functionalized inorganic microparticles, which are in turn quantitatively and sensitively detected by LIBS. The second is based on the direct analysis of biological fluids through the combined use of LIBS and machine learning algorithms. By combining femtosecond LIBS with unsupervised classification techniques, we have shown that it is possible to discriminate blood samples extracted from healthy and diseased mice with an accuracy that approaches 80%. We will present our most recent results obtained with both approaches, and in particular we will report about the effects of various substrates used for LIBS measurements on the classification accuracy of blood samples extracted from cancerous and healthy mice.

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