Technology of LIBS Imaging

Nordic LIBS
Tampere, March 2024
Poster/handout
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What?

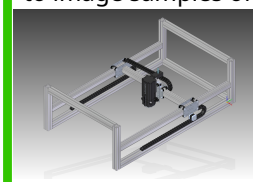
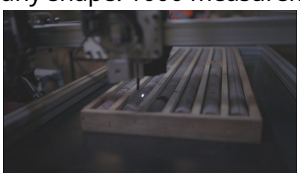
Laser Induced Breakdown Spectroscopy (LIBS)
or Laser Spark Spectroscopy is atomic emission spectroscopy where we shoot laser to make a spark on sample and collect the light into a spectrometer. The wavelengths of this light reveal all elements and some molecules present in the sample.

Imaging means doing many measurements over an area for pretty pictures.

Examples below are of rocks but LIBS imaging works for everything.

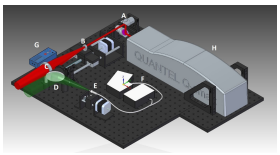
How?

Large Area Scanning Open-source LIBS (LASOLIBS)
to image samples of any shape. 1000 measurements per second

Invented by Lasse Kangas. We aim to publish device assembly instructions. Parts cost ~10000euros.

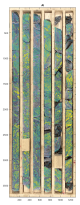
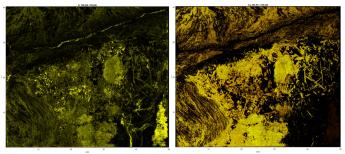
LIBS-LIDAR
for LIBS imaging from distance


Tehcnical details published in my master's thesis.

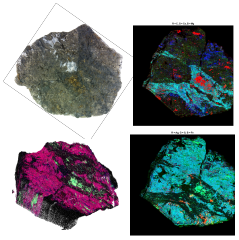
Why?

Elemental and mineral content as image

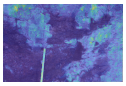
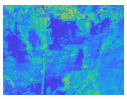



max 20 micrometer resolution

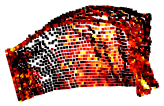
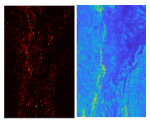
SAM mineral maps



Hand sample elements

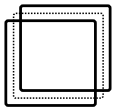
Element mapping

Ore delineation

Math!

LIBS image is a spectral cube
of many (8188) channels.
Simple elemental maps can be done by selecting a channel with elemental peak.



Spectral Angle Mapping(SAM) compares similarity of two measurements. Great for recognizing materials/minerals to a reference.

Interesting Features Finder(IFF) combined with SAM can be used to classify into materials without a reference measurement.

LIBS spectra have a lot of information so many other math methods work too. Hyperspectral imaging tools can work with LIBS data.

Help?

For LIBS limits of detection for different elements and LIBS theory see libs-info.com (great website, not my work).

I can do a LIBS imaging demo for you with your sample if you send it to me. For that or any research projects contact me at ilkka.laine@aalto.fi. For commercial mining/geology projects contact info@lumoanalytics.com.

I'm building my research website at libsimaging.net. It's only draft now but I'm updating it next weeks and months to share LIBS elemental and mineral databases and free software spectral processing tools with you and to explain LIBS imaging as clearly as possible.

for more see libsimaging.net