EXPLORING THE APPLICABILITY OF DEEP LEARNING METHODS IN MID-INFRARED SPECTROSCOPY FOR SOIL PREDICTIONS PROPERTIES

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Mid-Infrared spectroscopy allows for high-throughput prediction of soil properties.

Partial Least Square (PLS) is the mainstream approach*.

* Including ad hoc pre-processing + features engineering such as wavelength selections.

But yet fails in some ways*. How?

* E.g. in prediction of Potassium or exhibiting poor reproducibility

Mid-Infrared spectroscopy data are high-dimensional.

It suffers from Curse of Dimensionality a.k.a models require billions* of data

* Mid-Infrared spectra are a scarce resource.

In reality, data is concentrated in a much smaller latent region.

The quest is to identify this region of lower dimension containing the information.

Dimensionality reduction + *a priori* information is **the standard.**

PLS is exactly doing so but overly drastically*.

* therefore losing the ability to predict difficult analytes (e.g Potassium).

How can Deep Learning be a part of the solution?*

* although Deep Neural Networks are notoriously data intensive!

By understanding why it works so well in so many areas!

Mathematicians begin to understand how*!

* Understanding deep convolutional networks, S.Mallat

… and show that not everything needs to be learned!

* Understanding deep convolutional networks, S.Mallat

For instance by using Wavelet Scattering Networks

[1]

* http://mathsdl-spring20.willwhitney.com/assets/documents/ScatteringTransform.pdf

Which yield parsimonious* representation by capturing spectra singularities.

*drastic dimensionality reduction is achieved because the selected spectra have very few of the non-zero features.

These features as inputs to DL | ML algorithms = Hybrid*

* In small data regime as dimensionality have been drastically reduced

Higher prediction power?
In small data regime?
Higher reproducibility?
Higher interpretability?

Well, that's the plan!

Our research agenda for the coming year.

Context of these research activities

New CRP: Monitoring and Predicting Radionuclide Uptake and Dynamics for Optimizing Remediation of Radioactive Contamination in Agriculture (CRP D15019)

New Coordinated Research Project

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Optimisation of remediation based on monitoring and prediction of the fate of radiocaesium and radiostrontium in agriculture is essential in the return of the affected territories to normal life conditions. Field crop sampling. (Photo: A. Lee Zhi Yi/IAEA)

Related Resources

- Department of Nuclear Sciences and Applications
- Food and Agriculture
- View project
- Coordinated Research Activities
- How to participate

https://bit.ly/3d805vJ

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