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IM. SYLWESTRA KALISKIEGO

LIBS data-processing with Deep Neural Networks and Convolutional Neural Networks for chemical composition quantification in the wall of the next step-fusion reactors

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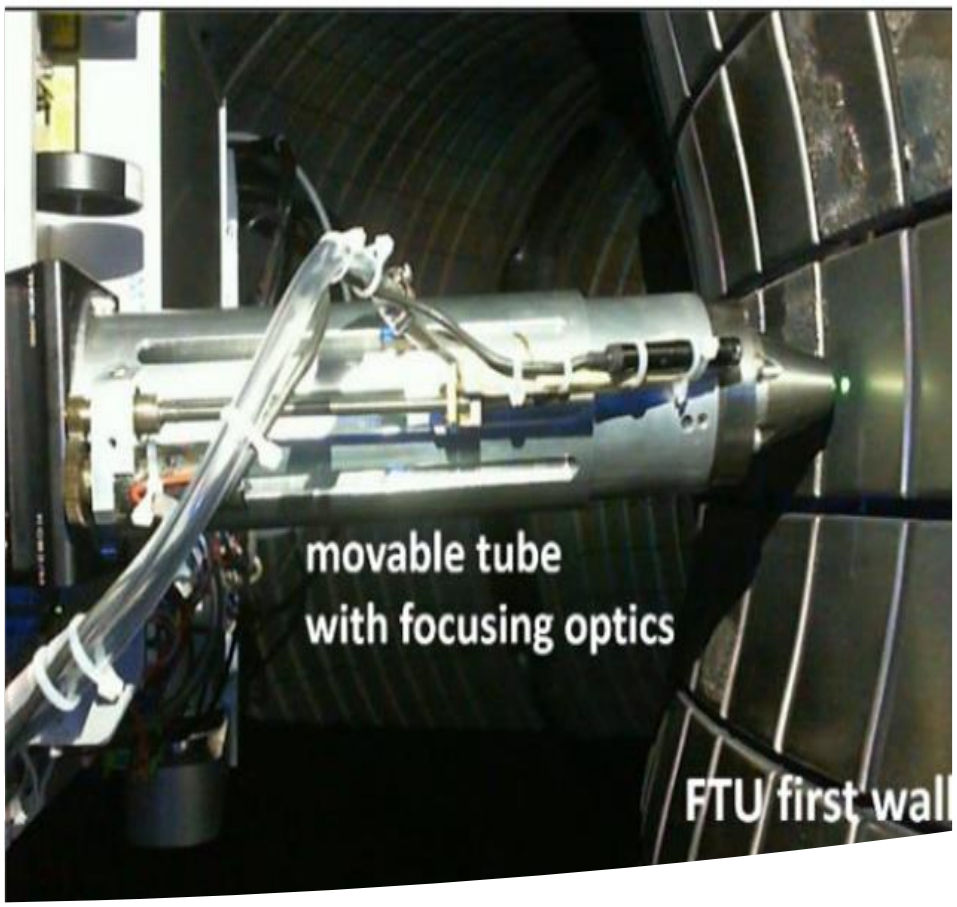
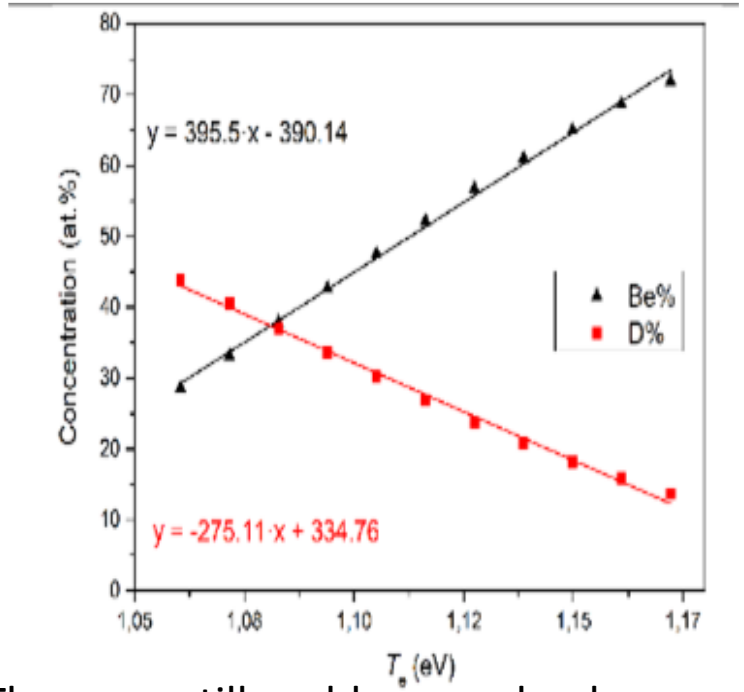
LIBS for fusion – state of art

- Succesful prototype of a remote system on FTU (Frascati Tokamak Upgrade)
- Succefull operation with berillium
- LIBS @ JET scheduled fo this summer



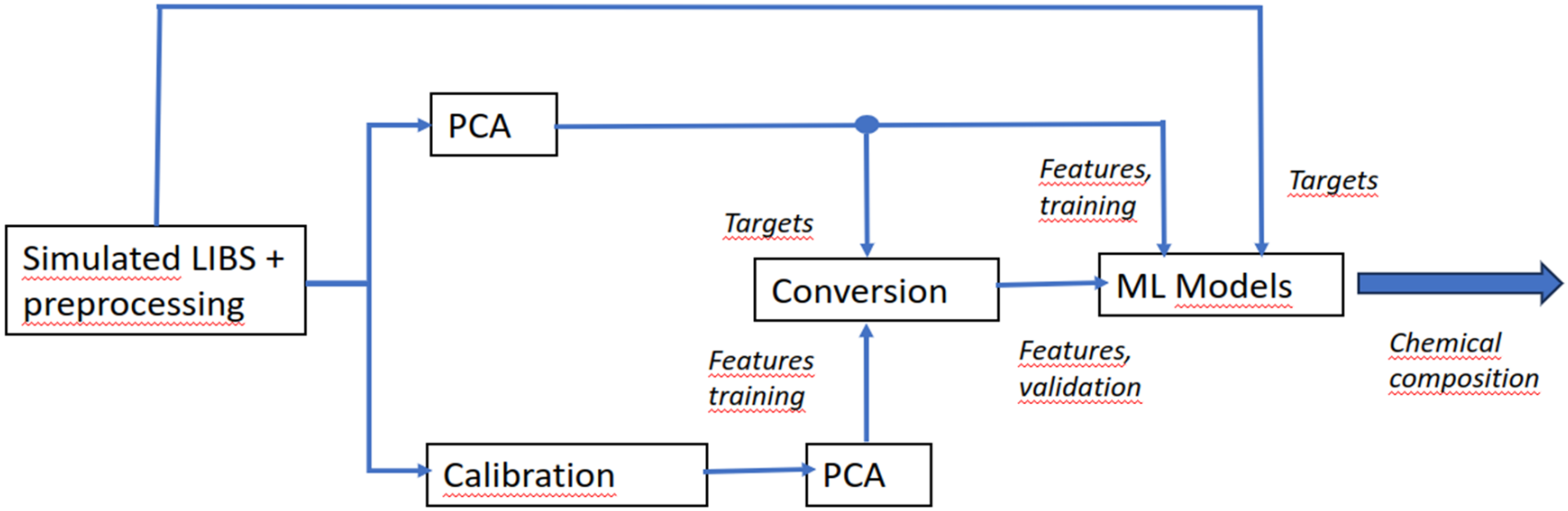


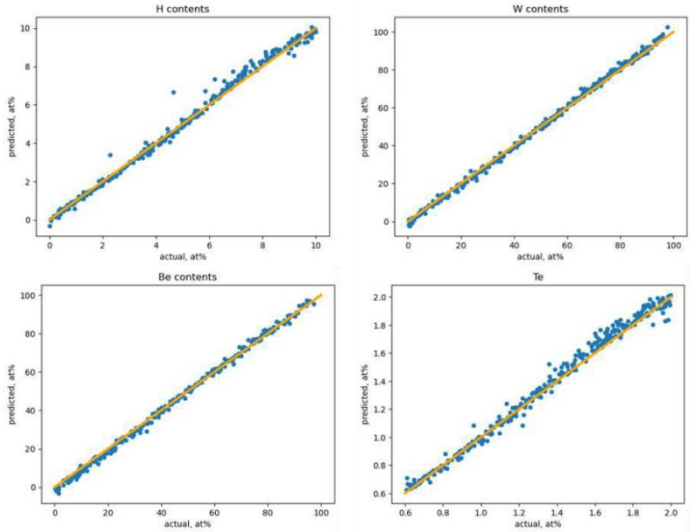
There are still problems and unknowns:

- Operation under atmospheric pressure
- Unknown desposits morphology
- Susceptibility for the Te uncertainty
- <u>Massive amount of data.</u>

H.J. van der Meiden et al 2021 Nucl. Fusion 61 125001

General idea and tools for ML for LIBS for fusion





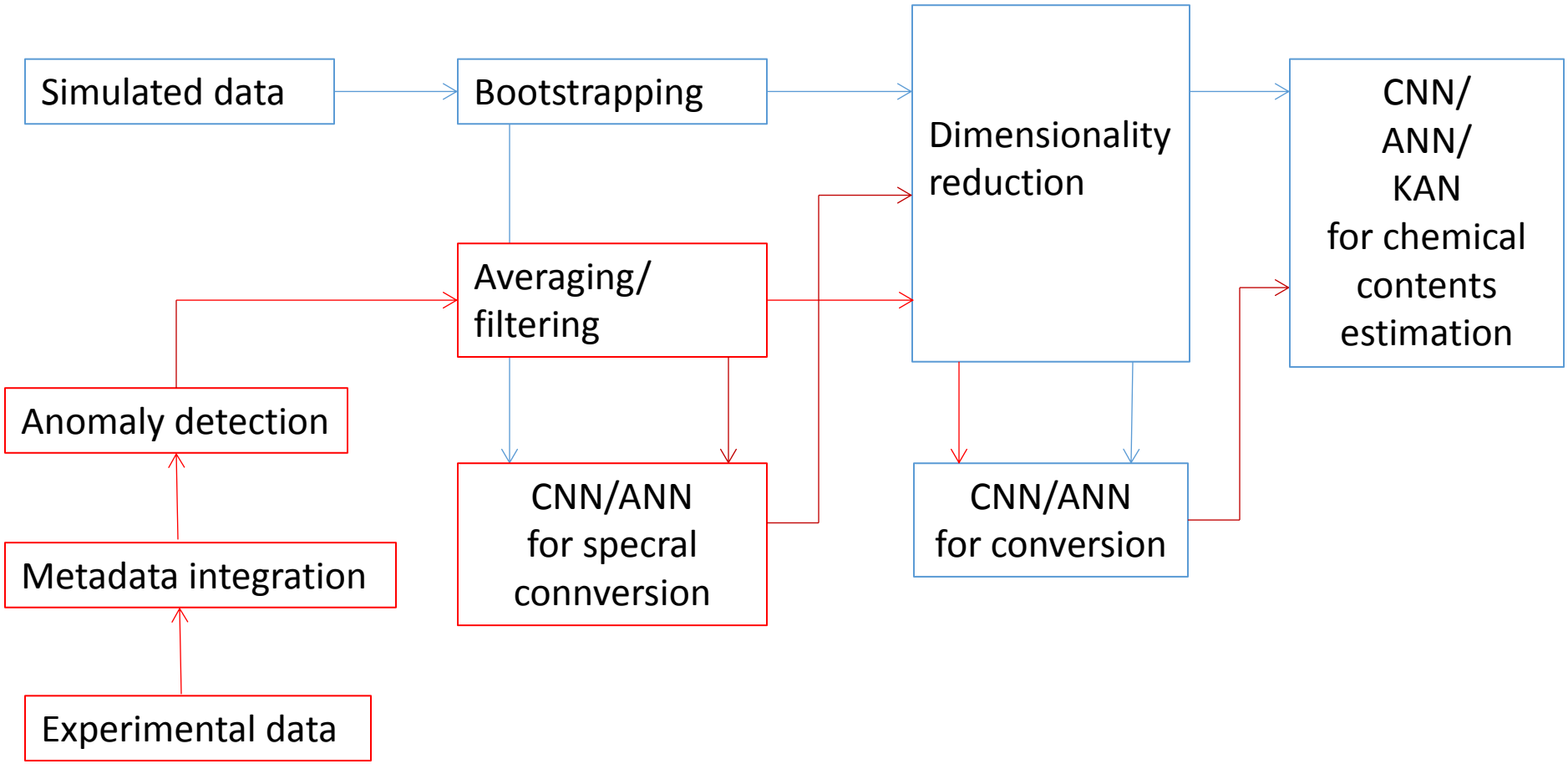
In principle it is OK, however, still need to validate on eperimental spectra.

There is a need to model spectra which resemble experimental spectra better, or to find a more suitable representation: autoencoder.

Objectives

- Developement of DNN and CNN models trained on synthetic LIBS spectra and validated on converted experimental data.
- Enhanced simulated LIBS spectra incorporating spectral features from experimental data.
- Developed resolution enhancement and line separation models for precise spectral analysis.
- Models with Averaged/bootstrapped synthetic spectra for analyzing non-equilibrium LIBS spectra.
- Determination of the minimum SNR required for accurate predictions.

Pipelines


Simulated data
Bootstrapping
Dimensionality reduction
CNN/ ANN/ KAN for chemical contents estimation
Averaging/ filtering
Anomaly detection
CNN/ANN for specral connversion
CNN/ANN for conversion
Metadata integration
Experimental data

Power of neural networks (I)

Power of neural networks (II)