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## AI-based reconstruction of spectra and images

Wednesday 1 January 2025 11:15 (5 minutes)

The reconstruction of experimentally inaccessible quantities is a common challenge in many research areas. In case the conversion from sought-after quantities to experimental observables is governed by stochastic processes, an unfolding/deconvolution is required to extract the quantities of interest. Detector effects generally further enhance the smearing in the experimental observables.

A number of algorithms for solving inverse problems exists. Classical approaches, however, lose the entire information on individual events during the unfolding process. This is not the case, if the binned version of an inverse problem is interpreted as a classification problem and accordingly solved via the application of classification algorithms (see: <https://sfb876.tu-dortmund.de/deconvolution/index.html>), which greatly enhances the robustness and interpretability of the algorithms.

Although the application of machine learning-based unfolding algorithms like DSEA and DSEA+ is a story of success, some research questions still have to be addressed. One of the most pressing questions concerns the enhancement of the algorithm's performance via the consideration of neighborhood relations of individual classes (the classifier is unaware of these). Furthermore, the extension to spectral reconstruction in multiple dimensions is of large interest.

If you are interested in this topic feel free to contact me (Tim Ruhe, [tim.ruhe@tu-dortmund.de](mailto:tim.ruhe@tu-dortmund.de)).

### List of Committees:

**Please describe your expertise/areas in which you would like to contribute / advise.**

Deconvolution/Unfolding, Machine Learning, atmospheric neutrinos, spectral reconstruction

**Do you consent to the data usage and public abstract data posting in the ErUM-Data Community Information Exchange?**

Yes

**In ErUM-Data, what kind of data are you dealing with?**

Data from large scale facilities in astroparticle physics.

**What is your expertise in computing and / or software development?**

machine learning, deconvolution/unfolding, DSEA and DSEA+

**What is your field and role?**

astroparticle physics, currently working as a PI in an SFB, plenty of collaborations with Computer- and data scientists

**Your ErUM - Committee is**

KAT - Komitee für Astroteilchenphysik

**Please describe areas in which you can contribute to “data handling” teaching.**

see above

**My current most burning research question, I like to find partners for, is:**

How can the existing approaches machine learning-based deconvolution algorithms be enhanced, to exploit the full scientific potential of current and next-generation physics experiments?

**Please describe areas in which you would like to improve your knowledge / skills.**

mutli-dimensional deconvolution

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