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Versatile Inverse Problem Framework

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In the exploration of universe and matter, dealing with inverse problems is often a central challenge. In many experimental investigations, which are carried out in particular at large-scale research facilities such as FRM II, DESY or European XFEL, the essential phase information in the experimental data is lost due to the measurement principle (phase problem). Therefore, methods based on direct inversion are not applicable, so that the solution of the underlying non-convex optimization problem is usually very time-consuming and expensive to implement.

Here we present our project “Versatile Inverse Problem fRamework”(VIPR), recently funded by the Federal Ministry of Education and Research (Grant 05D23CJ1). The stated goal of our project is to develop a flexible software framework for data-driven solutions to inverse problems. First we plan to focus on using invertible neural networks. Other architectures can be also considered at later stages of the project. The main application areas envisioned include grazing incidence small- and wide-angle scattering with both neutrons and x-rays, neutron/x-ray reflectivity, and ptychography. Development will also take into account requirements from spectroscopy and particle physics.

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