Strategy to validate the deep learning methods for focal-plane wavefront sensing in the lab and on the sky

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Abstract

Non-common path aberrations between the wavefront sensor of the AO system and the science camera imposes a severe restriction on the efficiency of high contrast imaging system. We aim here to present the strategy to validate deep learning methods for focal-plane wavefront sensing using the SCExAO VAMPIRE bench in the visible regime and the Vortex Optical Demonstrator for Coronagraphic Application (VODCA) test bench in the near - to mid-infrared domain. We get rid of the sign ambiguity for this focal plane wavefront sensing experiment, by introducing defocus in one of the two focal plane images of SCExAO VAMPIRE instrument and by splitting the two circular polarization states downstream of the vector vortex coronagraph in VODCA test bench. We are currently retraining the neural network models and testing them on SCExAO VAMPIRE using both synthetic and experimental data, before to jumping to on-sky application. On the other hand, the main goals with VODCA are (i) the simultaneous measurements of both (left and right) circularly polarized focal plane images, (ii) the generation of large learning data sets, and finally (iii) the wavefront retrieval using our trained neural network models. The purpose of those two experiments is to mature and enable the use of deep learning-based focal plane wavefront sensing for high contrast imaging. Here we present the strategy, the status of our experiments, a summary of the latest improvements of the neural network models and the setup.

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