HALE rotation project: Neural network-assisted inversions

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March 25, 2019

This is an alternative approach to the spectropolarimetric inversion, one using the neural networks. The main difference with respect to the "standard" neural network approaches is in the training itself. Namely, 'classical' neural networks train on a fixed set output and input parameters and try to propagate back and forth until the parameters of the neural network allow prediction as close to the original one as possible. In the case of inversions this means we go from the spectra to the parameters, and we try to train the network so the predicted atmospheres are as close to training ones as possible. Then we hope the network will be able to generalize to the unseen data.

In this project we will try to make the process bi-directional, that is we will ask that the spectra resulting from the predicted atmosphere has to fit the original spectra. The idea is to implement the forward synthesis module into an existing neural network architecture and modify the backpropagation algorithm so it also calculates the spectra from there, and uses so called response functions to modify the coefficients of the neural network so the agreement is optimal.

The idea for this comes from Andrés Asensio Ramos (IAC), and we would be collaborating with him intensively. For this project specifically he has implemented a SIR module into a pytorch based neural network, which allows synthesis of the Stokes profiles from within a neural network.