Transfer technique applied to polarized spectral lines

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We present a new approach to produce polarized spectra in the four Stokes profiles using a deep Artificial Neuronal Network (ANN) model. The novelty of our approach is that we employ the so-called transfer learning technique, where one pre-trained ANN is used to train other ANNs to perform a similar task –as for example, for the synthesis of the Stokes profiles at different wavelengths and/or with a different atmospheric model–. For the training of the original ANN were required millions of instances, each one corresponding to different magnetic configurations over the stellar surface. This could be very time consuming particularly if one is interested in the analysis of several spectral lines. However, once the original ANN is trained, and thanks to the transfer learning technique, for the training of the subsequent ANNs only few thousands of instances are required to obtain a comparable performance as the original ANN. This approach has the great advantage that many ANNs can be trained with small databases, a key aspect in machine learning. This approach can be implemented in the solar (local profiles) or stellar (surface integrated) domains. We present the performance of our approach using as test study the inversion of multi-line profiles form a star, finding excellent results to determine the stellar surface magnetic configuration.