Neural machine translation for solar atmospheric modeling

A. Asensio Ramos

Instituto de Astrofisica de Canarias

contact e-mail: *aasensio@iac.es*

We present a novel approach to Stokes inversion by framing it as a language translation task. Solar full Stokes parameters and corresponding atmospheric models are represented as sequences of discrete tokens using Vector Quantized Variational Autoencoders (VQ-VAE). An encoder-decoder Transformer architecture is then employed to learn the mapping between the token sequences of the observed Stokes parameters and the latent representation of the atmospheric models. By training the Transformer to translate from the "language" of Stokes parameters to the "language" of atmospheric models, we leverage the sequence-to-sequence capabilities of this architecture for inversion. Furthermore, the inherent generative nature of the Transformer decoder allows for the estimation of uncertainties in the retrieved atmospheric stratifications. This work demonstrates the potential of applying neural machine translation techniques to complex astrophysical inversion problems.