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# Bayes in Space: A Bayesian Deep Learning approach for coronal temperature estimation

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The outermost layer of the Sun - the Corona, is a region of intense activity and showcases a range of solar phenomena affecting the thermal distribution of its constituting plasma. The study of the temperature distribution across the corona is essential in learning about different heating mechanisms that lead to the strikingly high temperatures reached by the solar corona. The temperature distribution can be estimated using photometric observations taken in multiple bandpasses by imaging surveys like the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory. However each bandpass spans a range of temperatures and hence, cannot be estimated directly through these observations. The temperature distributions at each bandpass can be estimated by inverting the intensity or the irradiance i.e. number of photons hitting the detector through the channel passband. We propose an uncertainty based deep learning approach to generate Differential Emission Measure (DEM) maps from solar images, that contain information of the amount of thermal plasma emitted by the solar corona along a specific line-of-sight (LOS) at a certain temperature. We train a neural network to read the AIA image in multiple optically thin channels and develop their DEM maps across a range of temperature bins as an output. We further introduce an uncertainty in the existing deep learning methods for obtaining the DEM maps from AIA images by incorporating Bayesian techniques like variational dropout and bayes by backdrop into our machine learning model, and discuss how these different Bayesian approaches perform on our given data. We compare our uncertainty incorporated results to analytical estimates obtained by regularised least squares methods for DEM inversion.

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