Deep learning denoising by dimension reduction: Application to ORION-B line cubes

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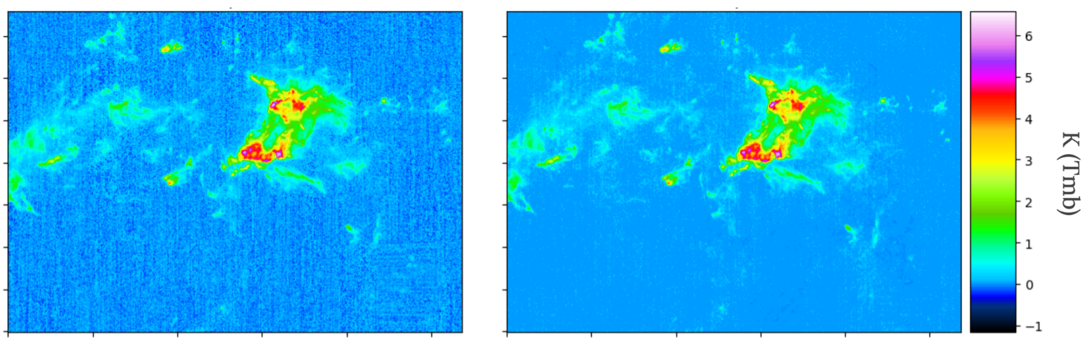
The availability of large bandwidth receivers for millimeter radio-telescopes allows the acquisition of position-position-velocity data cubes over a wide field of view and a broad frequency coverage. These cubes contain much information on the properties of the emitting gas, but their large size coupled with inhomogenous signal-to-noise ratio (SNR) are major challenges for a consistent analysis and interpretation.

In this talk, I will present a new denoising method of the low SNR regions of molecular line data cubes. The nature of astronomical data cubes is distinct from that of the one usually studied in the Earth remote sensing literature. In particular, there is a lack of redundancy in data which led us to adapt the method, notably by taking into account the sparsity of the signal. This method therefore implements significant improvements of typical autoencoder neural networks, often used to denoise hyperspectral Earth remote sensing data. When applied to a ^{13}CO (1-0) cube of about 10^7 voxels, the proposed method allows to recover the low SNR emission without distorting the signals with high SNR as shown in the attached figure. We have compared the resulting denoised data with those derived with the multiple Gaussian fitting algorithm ROHSA, considered as the state of the art procedure for line data cubes and show that the new method performs better. This algorithm opens interesting perspectives for wide-field studies of star formation.



^{13}CO (1-0) 3.0 km/s channel before and after denoising.

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