Ces: a new stellar spectral noise reduction algorithm

Yang Jiaming[1], Tu Liangping[1,2,*], Liu Hao[2] and Zhao Jian[2]

[1]School of Electronic and Information Engineering, University of Science and Technology Liaoning, Anshan, 114051, China
[2]School of Science, University of Science and Technology Liaoning, Anshan, 114051, China

We propose a stellar spectral noise reduction algorithm named Ces. The Hermitian interpolation algorithm is utilized to replace the cubic spline interpolation module in the empirical mode decomposition algorithm. Additionally, the shape of both upper and lower envelopes are constrained by continuous spectrum information from celestial spectra. The specific steps involved are: (i) The continuous spectrum of stellar spectra is fitted using a 10th-order polynomial. (ii) Calculate the derivative of the continuous spectrum at the extreme point of the stellar spectrum. (iii) Input the calculated derivative into the Hermite interpolation algorithm, utilizing it as a fitting parameter to generate upper and lower envelopes. Ces algorithm firstly decomposes and reconstructs stellar spectra to achieve initial noise reduction effect. The singular value decomposition algorithm is used to process the initial noise reduction data again to further remove the noise and recover part of the spectral line information.

Keywords: Empirical mode decomposition, ...

used near-infrared spectroscopy to measure the radial velocity of celestial bodies. Coulombe *et al.*[10] studied the wideband thermal emission spectra of the superhot Jupiter WASP-18b. Willis *et al.*[11] identified mature galaxy clusters with a redshift of 2 using spectra. The stability and efficiency of spectral analysis make it one of the most mature tools for astronomical research.

The spectral data of celestial bodies are doped with some noise, which greatly reduces the quality of the spectrum, so it is important to find a suitable method to remove the spectral noise. Wu *et al.*[12] proposed a stellar spectral noise reduction algorithm based on Spectra-GANs. In this article, we show the application of the Ces algorithm in the study of stellar spectrum, and successfully apply it to the task of stellar spectrum noise reduction, and achieve good results.

CEMD algorithm principle

Here we refer to the improved empirical mode decomposition