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Youth analysis of low-mass stars and brown dwarfs using machine learning methods

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The formation of low mass stars and brown dwarfs can be studied through comparison of the low mass population statistics of young clusters across different environments. Robust low mass populations of young clusters need to be obtained through near infrared spectroscopy, where the low-mass and young nature of member candidates can be confirmed. Traditionally, the spectroscopic analysis of these objects is not performed in a uniform manner, and the assessment of youth generally relies on the visual inspection of youth features whose behavior is not so well understood.
In this contribution, we will present a data set containing almost 3000 near infrared spectra of low-mass stars and brown dwarfs divided into three age classes: young, mid-age and field. We will first present the performance of the traditional methods used for the assessment of low mass and youth, and how we derive a homogeneous set of parameters for the entire data set. We will then present the application of four different machine learning (ML) methods with the aim of producing the best separation between age classes. We compare the performance of applying these methods on spectral features (spectral index + spectral type) or the entire spectrum. When applying ML methods on the entire spectrum we obtain metrics over 98% for the separation of the young and field classes, meaning an almost complete separation between members of young clusters and field contaminants, that will be of special interest for upcoming multi-object facilities such as NIRSPEC and NIRISS/JWST and MOONS/VLT. Using Random Forests we are able to identify what are the most important features in the near infrared spectra of cool dwarfs for youth classification.

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