Draft version April 21, 2012
Preprint typeset using LaTeX style emulateapj v. 12/16/11

THE SCOPE PACKAGE FOR AUTOMATIC ANALYSIS OF SPECTROSCOPIC OBSERVATIONS

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Draft version April 21, 2012

ABSTRACT

Subject headings: Galaxy: halo, structure — Individual: Virgo Overdensity — Stars: K-giants

1. INTRODUCTION

Astronomy is an exceptionally data-rich science. In recent decades the number of large scale surveys has only highlighted this fact.

Astronomers are increasingly trying to automate traditional measurement techniques simply to keep up with the data acquisition rates. However, as the astronomical community transitions from traditional analysis techniques to automated methods, it is of critical importance that we retain tangibility with the data.

2. METHODOLOGY

SCOPE determines the parameters of observed spectra by comparing them against a set of spectra with well-defined parameters. Normally the reference spectra are synthetic, but SCOPE does not enforce such constraints – a well-sampled observed library with trusted, homogeneously derived parameters will suffice. Parameters are determined by minimising the χ^2 value,

$$\chi^2 = \frac{1}{N-M}\sum_{i=0}^{N}\frac{(F_i - f_i)^2}{\sigma_i} \tag{1}$$

between the observed (f_i) and the reference (F_i) flux, where M is the number of degrees of freedom, N is the number of flux points and σ_i is the uncertainty in the observed flux. A χ^2 value is determined against every reference spectra in order to avoid local minima.

SCOPE is completely configurable. Parameters can be measured using the entire spectral regions, or only pre-selected regions which you know will be astrophysically sensitive to that parameter (e.g. Fe lines for stellar metallicity). Solution steps are provided which completely control how a parameter should be measured, and what constraints should be placed on this measurement.

2.1. *Dimensions and Parameters*

An important distinction must be made early on regarding the vernacular employed within this paper, and SCOPE itself. Dimensions are defined as the orthogonal axes of the reference grid, and parameters are values which we wish to measure on the observed spectrum. Usually, these two terms are largely interchangeable: we want to measure effective temperature of our observed spectrum, so the effective temperature of the minimum χ^2 point is our observed temperature. The distinction becomes clear when we wish to measure multiple parameters on the same dimension.

An example of such a scenario is when we may want to measure the effective temperature using multiple spectral regions. The Hβ Balmer line at Λ is an excellent discriminant of effective temperature (**?**), and one may want to compare the H-β temperature derived and the temperature when using a global spectrum fit. SCOPE easily allows for such tests. The techniques of setting up such tests within SCOPE are described in Section **??**, but it is important to clearly distinguish between parameters and dimensions.

2.2. *De-coupled, Pseudo-Coupled and Coupled methods*

2.3. *Normalisation*

2.4. *Doppler corrections*

2.5. *Grid sampling*

2.6. *Multidimensional interpolation*

3. DEFINING A RECIPE

3.1. *Introducing photometric priors*

3.2. *Optimisation algorithms*

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