Working with ROBOSPECT (Oct 10, 2013)

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A quick and dirty guide to getting ROBOSPECT to measure spectral lines

Robospect is initialized from the terminal, and will read/write in the directory you are positioned in.

Robospect terminal inputs currently in use:

Multi-image FITS input:

robospect -L *linelist* -F -f 3 -M pre -P *outputfile inputfile.fits* −−fits_row *rownumber* −−radial_velocity *xx.x* -i 25 -C boxcar -V 20

Text file input:

robospect -L *linelist* -F -f 3 -M pre -P *outputfile inputfile.txt* −−radial_velocity *xx.x* -i 25 -C boxcar -V 20

Robospect will then run through the input spectrum, and output 3 files per input file- *outputfile.robolines*, *outputfile.robospect*, and *outputfile.robo.ps*. If fits image input is being used, then robospect will also include the fits row number in the output file names. The file *outputfile.robolines* contains measured equivalent width information, and *outputfile.robospect* contains the synthetic spectrum robospect generates as it is measuring equivalent widths, as well as the fitted continuum and noise profile. In theory, the postscript file should contain a plot of the synthetic spectrum, but as of 10/09/2013 it doesn't work on deneb. Output files are space delimited (though consecutive delimitors should be merged).

Brief descriptions of input commands:

-L linelist: Points robospect to a text file with spectral lines it should look for. Tested linelist format has 4 tab-delimited columns: wavelength (in angstroms), excitation potential (eV), element name, and ionization state. The first row is dedicated to column titles. **Note:** Robospect will always return an equivalent width measurement for a line specified in the linelist, regardless of whether or not that line actually appears in the spectrum.

In my experience, robospect more accurately measures isolated lines (i.e. lines that aren't blended with anything else). Furthermore, robospect also measures desired lines more accurately if the linelist also includes neighboring spectral lines. Otherwise it occasionally includes several neighboring lines in its fit to the target line, causing an artificially high measured EQW. My strategy has been to give robospect a linelist that includes target lines as well as neighbors, and then to

discard the measurements for the neighboring lines.

-F -f 3: Naive line finder with a cutoff of 3σ (cutoff can be altered). Basically, robospect will flag any line that deviates more than a given number of standard deviations from its continuum fit as a spectral line, even if the line wasn't specified in the linelist. This command is essential if the linelist isn't exhaustive (it doesn't include every single line present in the spectrum) since robospect's continuum fit will be altered by any missed lines. Also useful for excluding transient features (cosmic rays, etc) from robospect's continuum estimate calculations.

-M pre: Deblending algorithm. The *pre* command doesn't let robospect attempt to deblend lines (lines are fitted with a single gaussian). Including line deblending makes robospect take a very long time to execute, and since I choose isolated lines to include in the linelist in the first place, accuracy isn't improved by deblending.

outputfile: Desired name for output files.

inputfile: Spectrum for robospect to measure. If using text file input, robospect works with text files consisting of 2 tab-delimited columns: wavelength and normalized (continuum fit) flux. If using FITS input, be warned that robospect is persnickety about the FITS header. If it returns an error, it is likely due to the FITS header; this can be confirmed by converting the spectrum to text and running robospect on the text version.

−−fits_row: Image in a multi-image FITS file robospect will analyze (image number, not aperture). Robospect numbers from 0, and our images number from 1, so if the target spectrum is numbered 5 in the FITS file, then robospect should be fed "−−fits_row 4".

−−radial_velocity xx.x: Radial velocity of star in km/s. Robospect uses this to correct the spectrum. Robospect also inverts the sign of radial velocity (so a measured radial velocity of 30km/s should be given to robospect as −−radial_velocity -30.0.

-i 25: Number of continuum fitting iterations robospect should execute. Basically, robospect works by identifying significant lines in the spectrum, subtracting their signal, fitting a continuum to the residuals, and then repeating the process with the new continuum fit. The more iterations, then, the more accurate robospect's measurements should be. The robospect documentation suggests 5 iterations; we use 25 since compute time is very fast without deblending, and 25 iterations allows more wiggle room in choosing boxcar size (see below).

-C boxcar: Continuum fitting model. With boxcar, robospect will continuum fit in sequential wavelength windows across the spectrum. This command is actually unnecessary, since robospect chooses boxcar by default. Can be changed to *logboxcar* in the case of significant trends in the

initial continuum fit.

-V 20: Boxcar width, in Angstroms. Unclear how sensitive robospect is to this parameter since the number of iterations is so high. Robospect will automatically alter the boxcar width if too few points are within each window or the spectrum is spanned by too few windows.

Other notes:

Robospect is reasonably tolerant of errors in radial velocity. If the lines it is looking for are isolated and strong enough, it will return accurate EQWs for radial velocity errors of at least ±6km/s.

Robospect has the option to output continuum fit/EQW measurements for each iteration, if verbose output is enabled (this and other commands are described in the official manual). However, these files are very large.

Most of the non-critical commands listed here (radial velocity, boxcar size) can be omitted from the terminal command line and robospect will still execute. The official manual notes which options robospect defaults to.