Updates to Fe I Reduction Manual

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Contents

1 Overview: starRoutine

This directory contains scripts to process e2ds files, and returns RVs, relative depths, and outputs for applying the methods of Meunier's 2017 paper. 'starRoutine' is the main file– to use the directory, add the GEN_reduced folder of interest and run starRoutine. I'll briefly sketch the key scripts involved in the processing/fitting/modeling processes to put useful snippets of code in context. I've included other miscellaneous scripts (hopefully descriptively named) that I won't discuss here, but may be useful someday.
The process fits a large line list by breaking it in to chunks of 400 lines. Lines in the extreme red or blue sides of the order will be fit twice, with fit values averaged together. The main loop in starRoutine is responsible for this fitting process for Gaussian profiles. Once the primary fit is done, bisectors and polynomial fits can be calculated if needed.

2 Processing

2.1 getCoordBounds

Pre-loop: Finds all unique lines within bounds of HARPS-N in the list stored in preCoord. starRoutine then divides these lines into chunks of at most 400.

2.2 findLineCoords

For a sublist of 400 lines, finds CCD location of line. Includes separate entries for red/blue occurances if line exists in overlap between orders.

2.3 grabIronLinesSun

Finds pixels at these coordinates from each fits e2ds file. Also stores relevant header values.

2.4 grabWavesBlazes

Finds wave and blaze values for same coordinates.

2.5 normalizeSun

Applies cloud cuts, imposes min 5 exposures per day, performs blaze correction, applies RV correction for JPL Horizons and drift.

3 Fitting

3.1 firstFit

For generic initial guess parameters, performs Gaussian fit; saves average width, RV offset per spectral line.

3.2 fit2

Using width and offset parameters to improve fit ranges and initial guesses, re-fits spectral lines with Gaussian profile.

3.3 quadratic

Using width (no offset), fits second-degree polynomial of the form $b(1)+b(2)(x-b(3))^2$ to line center.

3.4 bisectors

Computes bisectors (and spans) for individual spectral lines. Uses average line offset from firstFit

Note

All fits are processed per chunk of line, either in an explicit external loop (Gaussian fits in starRoutine), or with the loop built in to the script in question. Chunks are combined automatically; for Gaussian, in another loop in starRoutine; for polynomials/bisectors,

4 Processing (postProcess)

4.1 getCoords

Composes list of coordinates of spectral lines fitted– in same order as ironA. Includes red/blue duplicates as separate entries.

4.2 findDup

Identifies locations of duplicate red/blue fits in ironA list.

4.3 getFilteredRvsRB

Averages red/blue fit values for same spectral lines; applies filters to ensure lines are well fit; computes RVs. Saves results of Gaussian fit in gaussianSeries, and polynomial fit in rbCorrectedRVs.

5 Analysis

5.1 MeunierRB

Applies methods from Meunier 2017 paper to compute RV sublists and estimate alpha. Uses results of all processing functions– make sure that postProcess is called first (starRoutine does this automatically).

5.2 synthTest

Performs comparison between RVs derived by MeunierRB and daily averaged SDO timeseries from Tim. To generate daily averages, use getNewSdo.m. Uses results of MeunierRB, so should be called after MeunierRB (starRoutine does this automatically).
Note: loop to generate daily binned "newSDO" commented out at top

5.3 bisectorAnalysis

Runs pca on accumulated bisector span of depth bins (defined in edges on line 10), plotting first 4 PC's. Can be changed to run on individual lines– see comment on line 15.

6 Figures

6.1 thirdSigPlot.m

Makes the Reiners 2016 comparison plot.

6.2 RV0 vs RV1

Makes absolute and zeroed plots of RV1 plotted against RV0.

6.3 Paper figure note

- Plot of 617.3 nm line from forNailah used in paper draft.
- Tables taken from statistics of realData.mat
- SD0 comparison figures made in synthTest

7 forNailah

Saves images of a chunk (about 400) individual spectral lines for a given day in a folder called forNailah (create an empty folder called forNailah in order to run). Additionally, saves wavelengths for lines in blank xls file (wavelengths.xls); my full fit info in fitParams.xls; and err info in errParams.xls.

8 Functions of interest

8.1 wmean.m

Takes nObs by nLines matrix of values and another of same size of corresponding errors. Returns weighted mean timeseries of length nObs.

8.2 wmeanSeries.m

Takes nObs series and corresponding errors; returns weighted mean value of series (as a scalar).

8.3 dateMovingAvg

Takes a timeseries, accompanying errors, and scalar number of days, and returns timeseries smoothed over that number of days.