The Past Fifteen Years of RVSAO: Redshifts and More

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Tasks in the IRAF RVSAO Package

emsao - Find redshifts by measuring emission line shifts

*pemsao - Fit an emission line in a spectrum saving results as parameters

xcsao - Find redshifts by cross-correlating spectra with templates

*pxcsao - Cross-correlate spectra and save results as parameters

*eqwidth - Compute equivalent widths for specified lines in spectra

contpars - Set parameters for continuum removal

sumspec - Combine multiple spectra into an assigned-velocity spectrum

contsum - Set continuum removal parameters for template making

linespec - Make a spectrum from a list of emission and absorption lines

*listspec - Print an ASCII list of a spectrum with optional per pixel info

bcvcorr - Compute radial velocity correction to solar system barycenter

*emplot - Plot a spectrum with emission velocity and labelled lines

*pix2wl - Compute the wavelength for a specific pixel in a spectrum

qplot - Check results of previously-run xcsao and emsao

*qplotc - Check results of previously-run xcsao and emsao

(continuum and bad lines removed)

relearn - Set parameter values in parameter file of new version

of a task using the values in the current parameter file

setvel - Shift a single spectrum to a several radial velocities

*skyplot - Plot a night sky spectrum with labelled emission lines

velset - Set velocity by modifying starting wavelength

*wl2pix - Compute the pixel for a specific wavelength in a spectrum

*wlrange - Find the overlapping wavelength range in a list of spectra

*xcplot - Plot a spectrum with xc velocity and labelled lines

zvel - Run emsao and xcsao on list of spectra

* = New since RVSAO 2.0

Galaxies from Emission to Absorption

1. Reduce 9,795 spectra using Hectospec pipeline

2. Find redshifts using **xcsao**, saving them in spectrum headers

3. Compute equivalent widths of H-alpha emission line in all spectra using **eqwidth**

4. Sort output table by H-alpha equivalent width

5. Extract a list of pathnames from sorted table

6. Read sorted list of spectra with **sumspec,** shifting them to rest wavelength and stacking them into a FITS file from bright emission to deep absorption at H-alpha.

7. Convert to JPEG file using **ds9**

Equivalent Widths using EQWIDTH

EQWIDTH computes equivalent widths and a variety of variations which provide information with which to compare emission and absorption lines between and within spectra. Several standard band descriptions—center plus continuum samples—are included, including those from Brodie and Hanes and others from Faber and Burstein, as well as some put together by John Huchra, who helped a lot with algorithm and error computation.

Because it is often useful to compare strengths of emission lines in spectra where the measured continuum is often in the measurement noise, a flag can be setl to return a scaled area in the line without a reference to the insignificant continuum.

The task can also redshift band descriptions to work with unmodified spectra so the noise characteristics are preserved. A lot of effort went into getting the errors correct as the formula in the literature didn't always seem to give reasonable numbers.

EQWIDTH is made to be run on many spectra at once, though limited interaction is possible.

Since the last paper describing the IRAF RVSAO radial velocity package was published almost 15 years ago, this collection of tasks dealing with wavelength-shifted spectra has continued to grow and evolve.

Many changes have been made to improve robustness and accuracy in the **XCSAO** cross-correlation and **EMSAO** emission line fitting tasks. Spectra can now be cross-correlated in pixel or wavelength space as well as velocity space.

Two new tasks, **PXCSAO** and **PEMSAO**, find radial velocities using the same methods, but save the results as task parameters, making them easier to use in CL scripts.

A major task, **EQWIDTH**, based on the IRAF **BANDS** task, computes equivalent widths and areas under lines in redshifted, as well as rest wavelength, spectra

SUMSPEC, which rebins, normalizes, re-redshifts, sums, and/or stacks spectra, has proven to be useful in multi-fiber spectrograph reduction pipelines.

LISTSPEC lists spectra in a variety of user-selected formats,

EMPLOT, **XCPLOT**, and **SKYPLOT** plot spectra with labelled emission and absorption lines.
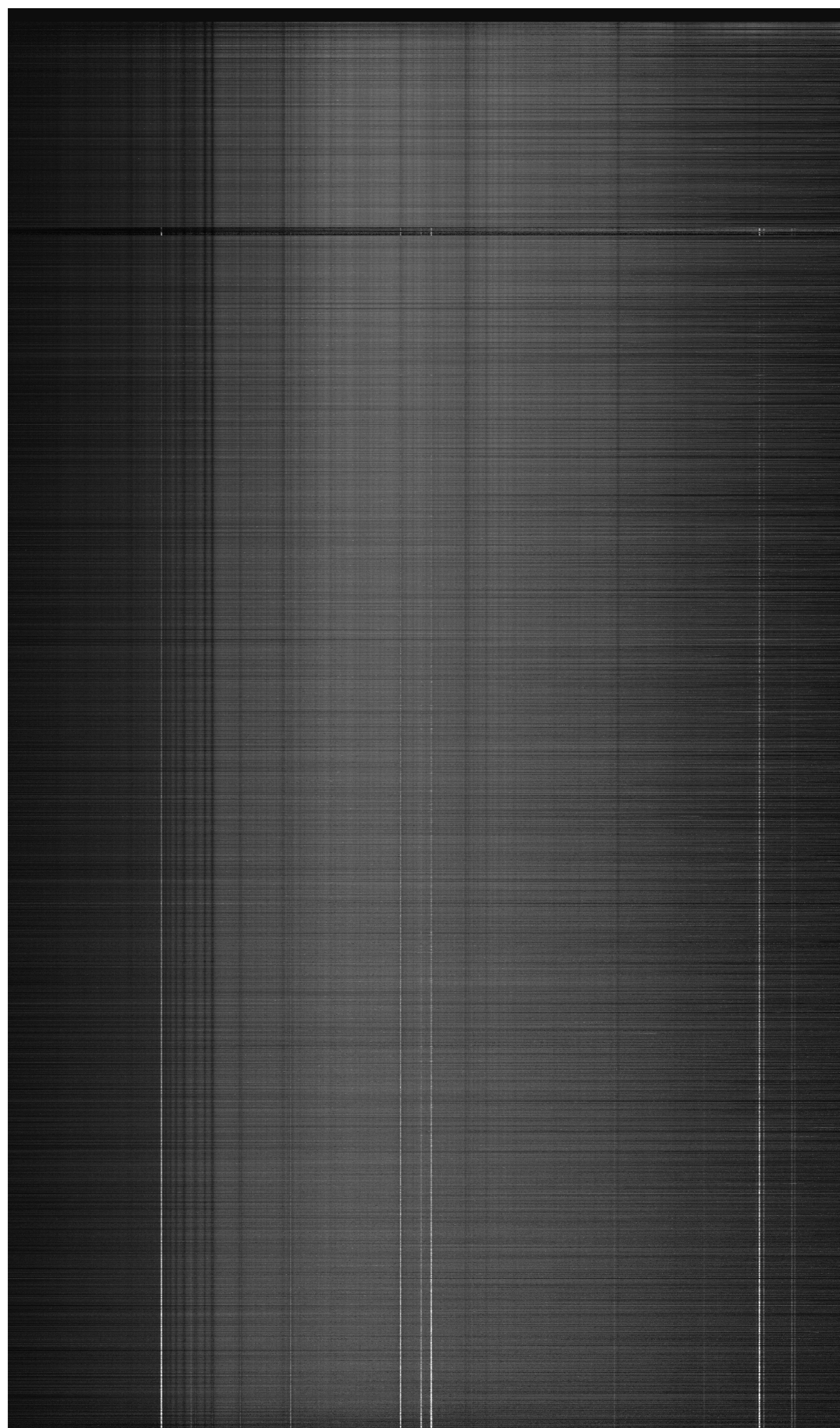
Return Cross-Correlation Results as Task Parameters

PXCSAO adds the following parameters in addition to those in the **XCSAO** task:

Returned information for the last spectrum:

besttemp	Best template
velocity	Velocity for best template
velerr	Velocity error for best template
r	R-value for best template
velmed	Median velocity for multiple orders
velq1	First quartile velocity for multiple orders
velq2	Second quartile velocity for multiple orders

Return Emission Line Results as Task Parameters

PEMSAO adds the following parameters in addition to those in the **EMSAO** task

Returned line fit information for the last spectrum:

nlfit	Number of lines found and fit

The following information is returned about the first line which is fit in the last spectrum:

emline	Name of first emission line
wlrest	Rest wavelength of first emission line Angstroms)
velocity	Velocity of first emission line (km/sec)
velerr	Velocity error of first emission line (km/sec)
lineheight	Height of first emission line
linewidth	Width of first emission line
lineeqw	Equivalent width (or area) of first emission line

If there are multiple orders or apertures (*specnum* is a range or list), mean and median velocities and error information is returned:

meanvel	Mean velocity (km/sec)
meanerr	Mean velocity error (km/sec)
medvel	Median velocity (km/sec)
medq1	First quartile velocity for multiple orders
medq2	Second quartile velocity for multiple orders
Meanpix	Mean pixel shift of first line
medpix	Median pixel shift of first line
meandwl	Mean wavelength shift of first line (in Angstroms)
meddwl	Median wavelength shift of first line (in Angstroms)

Using RVSAO Tasks from a Unix Shell

The following tasks of the IRAF RVSAO spectrum package may be run from the Unix/Linux command line almost as if you were inside IRAF. The parameters used come from the IRAF home directory defined by the irafhome environment variable or if that is not present, the IRAF/ subdirectory of the user's home directory.

bcvcorr	Compute barycentric velocity correction for a spectrum
contpars	Set continuum fitting parameters for xcsao and emsao
contsum	Set continuum fitting parameters for sumspec
emsao	Find velocities (red shifts) of emission lines in a spectrum
pemsao	Find velocities (red shifts) of emission lines in a spectrum
emplot	Plot a spectrum labelling emission and absorption lines
eqwidth	Find equivalent widths of emission and absorption lines in a spectrum
ihelp	Print help file of an IRAF task
irafhelp	Print help file of an IRAF task
linespec	Make an emission line template spectrum given a line list
listspec	List the spectrum in the specified format
rvsao	Type this message
sumspec	Add spectra, shift them, and/or remove continua
Xcsao	Cross-correlate a spectrum against a set of templates
pxcsao	Cross-correlate a spectrum against a set of templates

If you type the command with no arguments, you will get a simple help message with options for parameter access and more complete help, for example:

XCSAO: Cross-correlate a spectrum against a set of templates
usage: xcsao spectrum [templates=xxx][other arguments]
       xcsao help for IRAF help
       xcsao dpar to dump parameters
       xcsao epar to edit parameters
       xcsao lpar to list parameters

where
[task] dpar dumps the parameters using IRAFs dpar as task.parameter=value
[task] epar edits the parameters using IRAFs eparam
[task] help opens IRAF help for the task
[task] lpar list the parameters using IRAFs lparam

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