From Interacting Binaries to Exoplanets: Essential Modeling Tools
Proceedings IAU Symposium No. 282, 2011
Mercedes T. Richards & Ivan Hubeny, eds.

doi:10.1017/S174392131102761X

RaveSpan - Radial Velocity and Spectrum Analyzer

Bogumil Pilecki[1,2], Piotr Konorski[1] and Marek Gorski[1]

[1]Warsaw University Observatory,
Al. Ujazdowskie 4, 00-478 Warszawa, Poland
email: (pilecki,piokon,mgorski)@astrouw.edu.pl

[2]Department of Astronomy, Universidad de Concepcion,
Casilla 160-C, Concepcion, Chile
email: bpilecki@astro-udec.cl

Abstract. The RV analysis tool integrates widely used methods of radial velocity determination (CCF, TODCOR, BF) in an easy to use graphical environment. No advanced knowledge of these methods is required to use it. The obtained velocities may be immediately analyzed with the same tool as it comprises flexible fitting of orbital parameters, which includes the third body influence and pulsational velocities of the components. These features together help to establish the most accurate combination of templates, spectrum range, and method. Scripting functionality is to be implemented in the future.

Keywords. methods: data analysis, techniques: radial velocities, spectroscopic

1. Overview

RaveSpan is an easy to use graphical application that brings together three major velocity extraction methods: CCF, TODCOR, and Broadening Function (BF). All extracted velocities are instantly plotted in the RV curve window. Selected orbital parameters may be fitted afterwards.

RaveSpan is composed of several components. There is a spectrum viewer, where you can inspect the collected spectra, compare them with templates, and choose a wavelength range for your analysis. In the orbit viewer, one can see extracted velocities and a model orbit. There is also an orbit fitting tool, with which one can fit selected orbital parameters.

The radial velocity analysis tool allows users to see the output of CCF, TODCOR or BF and interactively fit several profiles of different types.

2. Software features

Spectrum analysis. Currently three methods for velocity determination from spectra are implemented. The simple cross-correlation method (CCF; Simkin 1974, Tonry & Davis 1979), two dimensional cross-correlation (TODCOR; see Zucker & Mazeh94) and the broadening function technique (BF; Rucinski 2002).

Profile fitting. Once one of these functions is calculated, the maxima (or maximum) are automatically detected and velocities evaluated. To improve accuracy, one of a few types of profiles may be fitted. For CCF and BF response functions, we can fit up to 4 (it is just set to 4 now, but may be increased easily) profiles, either Gaussian, rotational or a simple polynomial one. With TODCOR, there is only one two-dimensional polynomial surface fitted.

Radial velocity curve. All extracted velocities instantly appear in the radial velocity curve window, where we can directly see the orbit shape and quality.

Orbital parameters. Once we are ready with velocities, we can fit selected orbital parameters. Third body influence and pulsational velocities of one or both components can be included in the analysis and separated from the basic orbital motion.

Other features. This software allows for selection of different (preset by the user) wavelength ranges for analysis. To allow for radial velocity determination, a normalization is applied to the spectrum, unless a user disables the feature. For convenience, a Calculate All function was implemented to explore different templates and spectrum ranges. This function attempts to extract velocities from all the collected spectra in an automated way.

Technical details. RaveSpan is written in pure Python using the PyQt4 graphical library with Matplotlib as a plotting tool.

3. First results

This software is now being tested in the ARAUCARIA project and it has already proved to be useful both as an easy tool for simple objects and as a powerful tool for more complex spectra, eg. with a third light or pulsations. Several binary systems in the Magellanic Clouds were analyzed, including those with cepheid variables as one of the components.

The code is now in testing phase and is not yet public, but we are going to publish it once the tests are finished.

Acknowledgements

We gratefully acknowledge financial support for this work from the BASAL Centro de Astrofisica y Tecnologias Afines (CATA) PFB-06/2007 and the FOCUS and TEAM subsidies of the Foundation for Polish Science (FNP).

References

Rucinski, S. M. 2002 *AJ*, 124, 1746
Simkin, S. M. 1974 *A&A*, 31, 129
Tonry, J. & Davis, M. 1979, *AJ*, 84, 1511
Zucker, S. & Mazeh, T. 1994, *ApJ*, 420, 806