HAPIEST: Flashy Eye-catching Title

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***Abstract*—Current high-resolution spectroscopic data has become increasingly complex and extensive. In order to make connections between spectroscopic data in different formats and spectra observed in different applications, one may need a reliable, flexible tool which is easy to learn, use, and deploy.**

The cross-platform and portable program HAPIEST is an answer to this need. The current features, future plans, and limitations of HAPIEST be explorered in this paper.

***Index Terms*—HITRAN, HAPI, HAPIEST**

I. Introduction

THE **H**ITRAN **A**pplication **P**rograming **I**nterface and **E**fficient **S**pectroscopic **T**ools (HAPIEST) is a joint project which started in the Fall of 2017 as a collaboration between the HITRAN team and the State University of New York at Oswego. The purpose of HAPIEST is to simplify usage of the the **H**ITRAN **A**pplication **P**rograming **I**nterface (HAPI, http://hitran.org/hapi) [1] to work efficiently with HITRAN and to allow users who are not familiar with Python to access the spectroscopic data offered by HITRAN [2].

HAPIEST provides cross-platform graphical interactive tools which give access to the basic features of HAPI such as data fetching and selecting, as well as generating and plotting of the spectral functions (absorption coefficients, transmittance, absorption, and radiance spectra). Moreover, HAPIEST provides access to most of the controls which are involved in the spectral filtering and simulation, and is distributed both as binary and source code. The recent version of the source code can be found on Github (https://github.com/hapiest-team/hapiest). The HAPI library, on which the HAPIEST is based, is a free open-source Python module (library) which provides a set of tools for working with the structured spectroscopic data from different sources. The principal aim of HAPI is facilitating physically-sound interpretation of observations and more realistic models for a wide variety of applications such as astrophysics, planetary science, climate simulations, remote sensing, theoretical spectroscopy, and data mining. Having such a tool is important in particular to prevent possible errors in radiative transfer calculations caused by misuse of spectroscopic tools and databases. The description of the first version of HAPI and its features can be found in the dedicated paper [3] and in the official web page (http://hitran.org/hapi).

A. Current Development Status

HAPIEST is currently in the alpha-stage of development - it's layout and features are still quite volatile, and may contain bugs. If you use HAPIEST, it will be very benificial if you document any bugs you experience on this Github issues page (https://github.com/hitranonline/hapiest/issues). Moreover, development will be in a bug-fix only state until mid-2019 at the soonest.

II. Usage

HAPIEST has a manual which documents all of the functionality and features HAPIEST has to offer. The manual can be downloaded in a PDF format from the Github page (https://github.com/hitranonline/hapiest#manual)

A. License

HAPIEST is licensed under the GNU Lesser General Public License version 3 (LGPLv3). You can read more about the specific terms of the LGPLv3 here: https://www.gnu.org/licenses/lgpl-3.0.en.html. Changes and redistribution of HAPIEST are welcomed but must be documented and free.

B. Binary Distributions

There are several binary distributions available for HAPIEST. This includes Windows, Mac OSX, and Linux. They are available for download on the releases section on HAPIEST's Github page (https://github.com/hitranonline/hapiest/releases).

III. Features

A. Line-by-Line Data

By using HAPI, HAPIEST can retreive line-by-line data. Line-by-line data can be retreived for any molecule or isotopologue that HITRAN contains. Moreover, additional parameter groups like those required for speed-dependent Voigt and Galatry line profiles are optionaly available.

[1] Kochanov RV, Gordon IE, Rothman LS, Wcislo P, Hill C, Wilzewski JS. HITRAN Application Programming Interface (HAPI): A comprehensive approach to working with spectroscopic data. J Quant Spectrosc Radiat Transf 2016;177:1530. doi:10.1016/j.jqsrt.2016.03.005.

[2] Gordon IE, Rothman LS, Hill C, Kochanov RV, Tan Y, Bernath PF, et al. J. Quant. Spectrosc. Radiat. Transf. 203, 3-69 (2017).

[3] Kochanov RV, Gordon IE, Rothman LS, Wcislo P, Hill C, Wilzewski JS. J. Quant. Spectrosc. Radiat. Transf. 177, 15-30 (2016).

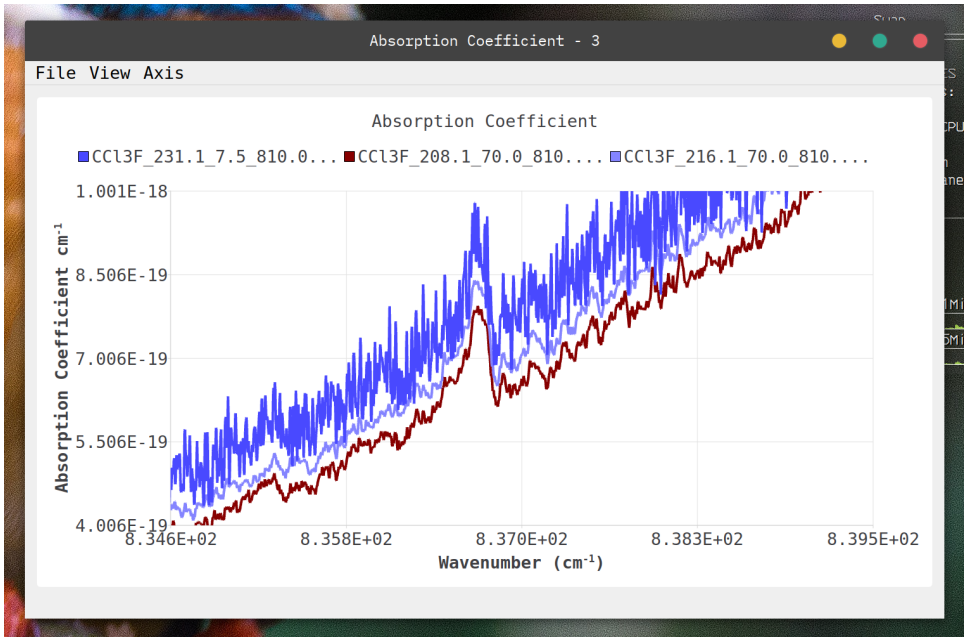

Fig. 1. A screenshot of a graph display window in HAPIEST. In this example there are 3 cross sections of CFC-11 on the plot.

1) Viewing: HAPIEST has a 'view' feature which allows line lists to be viewed in a spreadsheet-like widget. The view feature automatically paginates tables to save on system resources, but this page-length can be changed in the user-configurable settings ('Settings' -¿ 'Edit Configuration' in the main window). The view functionality also allows for manual editing of tables, although it is not recommended. As a safety measure, fields that have been modified manually will be flagged highlighted red in the view widget.

2) Graphing: One of HAPIEST's major features is it's graphing capabilities. HAPIEST can graph Line-by-Line data by calculating the absorption coefficient, and absorption, transmittance, and raidance spectra. There is also the option to apply instrumental functions and line profiles to these spectra. HAPIEST can also separate and graph the bands of each table. HAPIEST creates a special legend for band graphs which will show the upper and lower quanta of each band.

3) Data Selection: Line-by-line data retrieved from HITRAN can be modified using SQL-like queiries in a LISP-like domain specific language. These queries can transform and filter data efficiently.

B. Cross Sections

HAPIEST can download cross sections from HITRAN, and graph the retreived cross sections. HITRAN has cross sections for 324 molecules as of August 2018.

1) Graphing: Graphing of any downloaded cross sections is possible. Cross-sections can be plotted, as seen in Fig. 1.

IV. Conclusion

The conclusion goes here.