News on the ISOPHOT Interactive Analysis PIA

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Abstract. The ISOPHOT Interactive Analysis system, a calibration and scientific analysis tool for the ISOPHOT instrument on board ESA's Infrared Space Observatory (ISO), has been further developed while ISO is under operations. In this paper we will describe some of the improvements achieved in the last few months in the areas of scientific analysis capabilities, documentation and the related service to the astronomical community.

1. Introduction

The ISOPHOT Interactive Analysis (PIA) is an IDL based software tool developed for calibration and scientific analysis of data from ISOPHOT (Lemke et al, 1996), one of the instruments on board ISO (Kessler et al, 1996). The general features of PIA, its use as a calibration tool and the built-in mapping capabilities were presented at the ADASS VI conference (Gabriel et al, 1997a, 1997b and 1997c).

The development of PIA up to the initial phase of the mission, is described by Gabriel et al, 1996. After 2 years of ISO operations considerable experience has been gained in the use of PIA, which has led to several new features in the package. This experience has been achieved by the ISOPHOT Instrument Dedicated Team in its tasks of e.g. calibration, instrument performance check and refinement of analysis techniques, and also by a large number of ISOPHOT observers in more than 100 astronomical institutes all over the world.

PIA has been widely distributed since July 1996 to all astronomers wishing to use it for ISOPHOT data reduction and analysis. The feedback from the

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different users is reflected not only in the extension of the analysis capabilities but also in a more friendly graphical interface, better documentation, and easier installation.

2. PIA improvements

In the last year of the ISO mission the PIA capabilities have been continuously enhanced. All the areas of data processing routines, automatic analysis sequences, graphical user interface, calibration menues, configuration, distribution and information have been affected by changes. In this paper we describe the development in three sections:

- transients modeling implementation, showing changes in the areas of data processing routines and GUI,
- documentation improvements, for the areas of information and maintenance, and
- system testing procedures implementation, for the areas of reliability and support.

2.1. Transients modeling

ISOPHOT detectors have long stabilization times, which is a known feature affecting IR detectors (Si:Ga, Si:B and Ge:Ga) operating at very low backgrounds. The measurement times are usually shorter than the required stabilization, and this represents a major impediment to the calibration of the instrument and to the obtainment of a good signal to noise ratio. The transient behaviour depends on several parameters, like the flux level to be measured (stressing over several orders of magnitude), the previous flux history (flux down or flux up with all levels of difference) and the detector type of the sub-system used.

The approach followed is to use physical and empirical models to fit the data and predict the final flux which would have been obtained for a fixed sky point if measured for sufficiently long. Depending on the sub-system detector different functions and model parameters are proposed:

- physical models for silicon based detectors (Schubert et al 1995, Fouks et al 1996)
- empirical models for Ga:Ge detectors (Fukiwara et al 1995, Church et al 1996)

The dependencies on flux level and history are reflected in the starting parameters of the different models (which can be fixed for the fitting procedure).

Fitting of a signal distribution corresponding to the measurement of a sky position begins with the determination of the starting parameters corresponding to the type of data and function to be used. The minimization of the Chi-square or least square fitting is done first with a downhill simplex method[2] for a first

[2]as given by the IDL function AMOEBA.

approximation varying the parameters. The parameters with the values thus obtained are then used as starting parameters for a second fit using a Gradient-expansion algorithm for a least squares fit to a non-linear function[3].

The graphical user interface includes the possibility of: a) choosing among the different functions with the corresponding parameters initialisation, b) general parameters for the analysis can be set, such as selection criteria, tolerance level for the fit, weighting method to be used, c) specific function parameters can be reset after initialisation, varied or fixed, tolerance limits can be set.

All the start parameters can be tested and adjusted before analysing a full measurement using portions of the data. After full analysis PIA also provides the opportunity of reassessing the results with partial refitting, using eg the Chi-square or the adjusted parameter distributions of all the fitted data for evaluation. This makes the analysis of large data sets very efficient, while permitting fast and deep data manipulation.

2.2. Documentation

We have created the PIA homepage[4] for several reasons:

- to allow users a faster access to PIA,
- to create a way for efficient feedback from the astronomical community to the PIA developers,
- to provide the community with better maintenance and service.

The PIA homepage contains the latest version of PIA together with the release notes, the PIA user's manual both in its html and postscript versions. Also publications on PIA can be seen/retrieved, frequently asked questions and answers are listed. A mailbox attached serves to receive bug reports, comments, etc. Especially useful for advanced PIA users are the listed routine headers, which permit use by external calls or re-use of the PIA routines.

2.3. System testing procedures

Procedures for testing PIA are applied prior to every new release (main versions are released annually, while sub-versions are every two to three months). The automatic sequences built within PIA are used for running over a huge representative dataset containing all major ISOPHOT observing modes with good reference data. The sequences run through all the data reduction steps performing all the default corrections and saving data in the different formats at all reduction levels. These procedures allow not only for checking the reliability of the new version but also for testing the level of calibration accuracy for a new sub-version and/or new calibration files. These tests are also used for checking the reliability of the S/W under different IDL versions and different machine architectures.

[3] we use a slightly changed version of the IDL routine CURFIT

[4] http://isowww.estec.esa.nl/manuals/PHT/pia/

3. Outlook

The end of the ISO mission due to Helium boil-off is foreseen for April 1998. PIA will be further developed during the "Post-operational phase", starting then and lasting at least 3.5 years. The huge amount of ISOPHOT data collected, the excellence of their scientific content, the quality of the instrument and the further consolidation of its calibration result in scientific work for a wide community for years to come. One of the reasons for this is that the ISO archive will be open to everyone for archive research once the proprietary rights expire. PIA plays a major rôle as the tool for data reduction and scientific analysis of the ISOPHOT data, and new requirements are continuously arising from the analysis experience of its users. Concrete planning for further PIA development includes eg the provision of imaging enhancement techniques as well as coherent maps co-addition, polarimetry analysis, time and orbit dependent calibration, etc..

References

Church, S. et al 1996, Applied Optics, Vol. 35, No. 10, 1597

Fouks, B., & Schubert, J. 1995, Proc. SPIE 2475, 487

Fukiwara, M., Hiromoto, N., & Araki, K. 1995, Proc. SPIE 2552, 421

Gabriel, C., Acosta-Pulido, J., Heinrichsen, I., Morris, H., Skaley, D., & Tai, W. M. 1996, "Development and capabilities of the ISOPHOT Interactive Analysis (PIA), a package for calibration and astronomical analysis", Proc. of the 5th International Workshop on "Data Analysis in Astronomy", Erice, in press

Gabriel, C., Acosta-Pulido, J., Heinrichsen, I., Morris, H., Skaley, D., & Tai, W. M. 1997a, "The ISOPHOT Interactive Analysis PIA, a Calibration and Scientific Analysis Tool", in ASP Conf. Ser., Vol. 125, ADASS VI, ed. Gareth Hunt & H. E. Payne, 108

Gabriel, C., Acosta-Pulido, J., Kinkel, U., Klaas, U., & Schulz, B. 1997b, "Calibration with the ISOPHOT Interactive Analysis (PIA)", in ASP Conf. Ser., Vol. 125, ADASS VI, ed. Gareth Hunt & H. E. Payne, 112

Gabriel, C., Heinrichsen, I., Skaley, D., & Tai, W. M. 1997c, "Mapping Using the ISOPHOT Interactive Analysis (PIA)", in ASP Conf. Ser., Vol. 125, ADASS VI, ed. Gareth Hunt & H. E. Payne, 116

Kessler, M. et al 1996, A&A, 315, L27-L31

Lemke, D. et al 1996, A&A, 315, L64-L70

Schubert, J., et al 1995, Proc. SPIE 2253, 461