

## MAKING PRESS RELEASE ASTRONOMICAL IMAGES COMPLIANT WITH THE NATIONAL VIRTUAL OBSERVATORY

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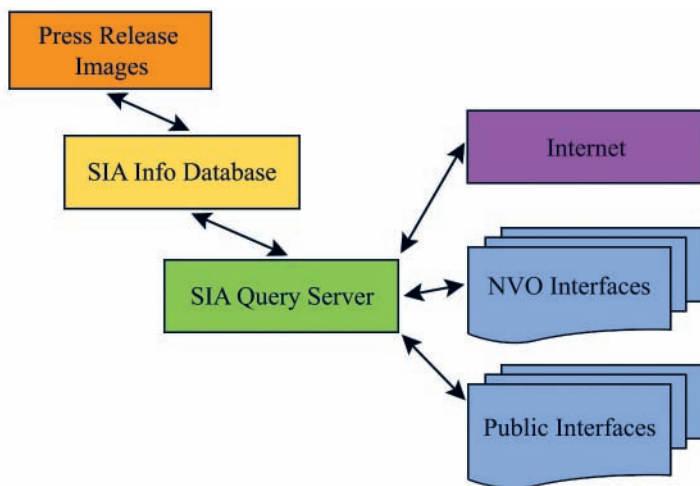
### ABSTRACT

The beauty and splendour of astronomical images has made an enormously positive impact with the media and public alike. As a leading provider of astronomical imagery and a major contributor of Hubble Space Telescope press release images, the outreach division of the Space Telescope Science Institute (STScI) recognizes the importance of making press release images compliant with Virtual Observatory standards for inclusion in databases and repositories. A small working group has been formed to define and evaluate the procedures for making outreach images accessible by Virtual Observatory applications, and more specifically, to establish a World Coordinate System (WCS) for these images, which so far have none. We report on the status of various software techniques that can be used to transform coordinates on images easily and accurately, using reference images and astronomical star catalogues when available.

### INTRODUCTION

Several virtual image repositories and observatories (the International Virtual Observatory Alliance, the Astrophysical Virtual Observatory, the Global Virtual Observatory, to name a few) have been gathering the momentum in the last few years to include pointers to digital astronomical data from all major observatories. The National Science Foundation's National Virtual Observatory (NVO) is no exception. The NVO is a U.S. effort to organize and make astronomical data, images, and other content available systematically so that it can be retrieved and used by many users. Preliminary work has begun to include raw and processed astronomical data into the NVO. To this end, it is well understood that the educational, inspirational and aesthetic impact of press release quality astronomical images should also have their place in such virtual databases.

Modern imaging techniques and the combination of multiple datasets calls for a change of format from the telescope's inherent data format of Flexible Image Transport System (FITS) files. The advent of astronomical data processing software such as IRAF, IDL, AIPS, and their combination with the latest image processing software, such as Adobe Photoshop (and Photoshop Elements) and The Gimp (GNU Image Manipulation Program), has improved the composition of the images, but at the cost of removing coordinate information from the file.



**Figure 1:** Diagram showing how press release (PreSS) images can be included into a virtual database, which can then be accessed via a query from multiple users.

One major step in making press release astronomical images compliant with those of the virtual observatories is to measure and record spatial information about the final presentation image that was lost due to processing. More specifically, measuring and recording the World Coordinate System (WCS) or the image's position on the sky is an absolute necessity in being able to catalogue these images into any sort of database.

The NVO has designed a list of guidelines known as the Simple Image Access (SIA) Protocol. This contains standards that are necessary to have images meet the compliance requirements. The specified format of the image and the metadata associated with the image will allow numerous query databases to search for and access the press release image. The SIA Protocol, available from the NVO Website (<http://www.us-vo.org>), is an important resource for those who manufacture astronomical images from digital instruments or observatory data and wish to have their press release quality images included and recognized in the NVO image database. This list of users may include professional and amateur astronomers, image processors, and personnel involved with observatory- and mission-based press release efforts.

We have created a python-based software script that can, with human interaction, identify like objects (usually stars) in both a coordinate-based FITS file from the raw telescope data and a press release TIFF image. Ideally the instrument used to create the input FITS file should be a similar to that which was used to create the press release image. Once an appropriate FITS file is identified and made available, it is recommended that a cosmic ray rejection be performed on the reference image(s). Combining like-filter images to remove cosmic rays and improve signal is also a popular method of image preparation.

## PREPPING PRESS RELEASE QUALITY IMAGES FOR WCS MEASUREMENT

No preparation is necessary for the input target TIFF image, although for problem images where pattern recognition may be difficult, it may be advisable to split channels into a single colour component and to use the strongest filter for the image comparison. Note that desaturating, or splitting channels, will not impact the spatial resolution, size, or rotation of the image, and thus measurements of the WCS on a desaturated image can be automatically assigned to the full-colour image.

Due to the equatorial coordinate nature of the WCS, there are several press release images for which it is not possible to deduce a WCS. These image types include: Solar System objects (Sun, Moon, planets, asteroids, comets, etc.) or other moving targets; press release images contained within a composite layout such that more than one celestial object or multiple images of the same celestial object are included in the layout; those images that have a complex page or print layout attached; and artwork or artificially created images.

## SOFTWARE TO MEASURE WCS

WCS.PY is an astronomy comparison routine that helps to determine a target's WCS based on manual comparison with like objects in a reference image. It consists of a python-based Graphics User Interface (GUI) that is compatible on all platforms. *Python Imaging Library (PIL)* and *matplotlib* are required in order to use the program. To compute WCS parameters, both the reference FITS image (with valid coordinate parameters in the header) and the target press release TIFF image are displayed. Rotation and resizing changes are allowed within the software so that more common features in both images can be recognised more easily. Four or more points should be selected in both images, noting that the residual fit may improve with more points. The software allows for the non-inclusion of points that have a large deviation from the computed fit.

As with other astrometry routines, extended objects, saturated stars, stars too close to the edge or stars very close to another object should not be used to create the fit. A linear transformation is computed from the set of marked points, and this transformation is then applied to the coordinate parameters in the reference image to obtain the parameters for the public-release image. The WCS transformation coefficients are then written to an output file. Work on attaching these values as metadata directly to the TIFF image header is still under examination.

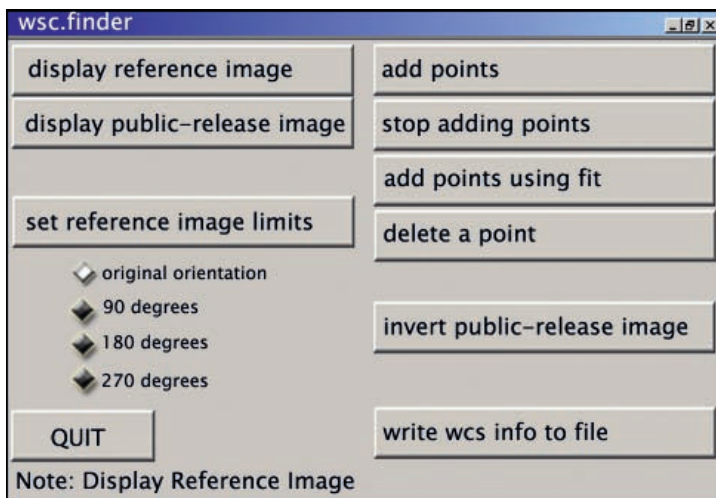


Figure 2. GUI interface for WCS.PY

The WSF.PY script and its GUI interface were created during the spring and summer of 2005 and have since been tested extensively. WCS transformation coefficients have been generated for several hundred images from the STScI Office of Public Outreach (OPO) Newscenter database (available at: <http://www.hubblesite.org/news>).

In the near future, we anticipate refining the WCS-finding software and GUI interface as needed, testing the software for systematic errors, and measuring WCS values for the remainder of press release images in the STScI OPO Newscenter database. Further work will also be done on creating an SIA Image database, and SIA Query Server, as well as a possible Public Image Access Interface. We also plan to make the WCS-finder software and accompanying documentation available to other observatories that are in need of such a function.

The NVO/SIA working team includes Frank Summers (STScI—[summers@stsci.edu](mailto:summers@stsci.edu); project manager, database and web service development), Zolt Levay (STScI—[levay@stsci.edu](mailto:levay@stsci.edu); HST press release procedure development), Lisa Frattare (STScI—[frattare@stsci.edu](mailto:frattare@stsci.edu); software research and outline), and Kaushala Bandara (U. Toronto/STScI 2005 summer intern: processing of HST press release archive images). We also wish to thank Phil Hodge (STScI; programming), and Carol Christian (STScI; NVO/EPO coordinator). Funding for this work comes from the Virtual Cosmos Project (Berkeley/STScI). Future status reports, software releases and discussions will be available at: [http://terpsichore.stsci.edu/~summers/projects/hst\\_pr\\_sia/](http://terpsichore.stsci.edu/~summers/projects/hst_pr_sia/)

## CURRENT WORK AND IMMEDIATE FUTURE GOALS

## TEAM MEMBERS AND ACKNOWLEDGMENTS