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VAMP in Stellarium/VirGO: A proof of concept

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Abstract

The Virtual Astronomy Multimedia Project (VAMP) and the Astronomy Visualization Metadata (AVM) standard will give observatories and astronomers an easy way to distribute their astronomical visualisation products. The CAP2007 demonstration which is described here is an early, although fully functioning, proof-of-concept for the VAMP project showing the capabilities and functionalities of the AVM.

Our hope is to encourage people to begin applying the AVM standard to their Education and Public Outreach (EPO) images as they witness the spectacular end results that applications like Stellarium, World Wide Telescope, and Sky in Google Earth can bring to the future.

The demonstration tools

A live demonstration was carried out at the CAP2007 as a proof-of-concept for the Virtual Astronomy Multimedia Project (VAMP)[1] and the Astronomy Visualization Metadata (AVM) standard[2] (Hurt et al., 2006). These two concepts are described in detail in Gauthier et al. (2007) and Hurt et al. (2007) elsewhere in this volume.

[1] http://www.virtualastronomy.org
[2] http://virtualastronomy.org/avm_metadata.php

The demonstration used the popular open-source desktop planetarium package called Stellarium[3], alongside the recently developed VirGO[4] plug-in for Stellarium. Stellarium is a free software package which displays the celestial sky based on a catalogue of 600,000 stars. Specific features in Stellarium outline constellations, superimpose constellation art, show Messier objects, track orbits of celestial bodies, etc.

Currently being developed at the European Southern Observatory's (ESO) Virtual Observatory Department, the VirGO plug-in (see Chéreau et al. 2007) mainly creates an innovative method for scientists to tap into data products of the ESO/ST-ECF Science Archive Facility in a visual manner. Features of VirGO include the ability to visually locate ESO datasets, filter through data products, display Digital Sky Survey 2 (DSS2) images on the sky, and even allow other observatories to load their data using a VOTable[5] or FITS[6] images with World Coordinate System (WCS) information in the header. Using these tools as examples of the many different "data visualisation tools" that exist today, the VAMP group was able to import a different type of data – Education and Public Outreach (EPO) JPEG images of various galaxies and nebulae.

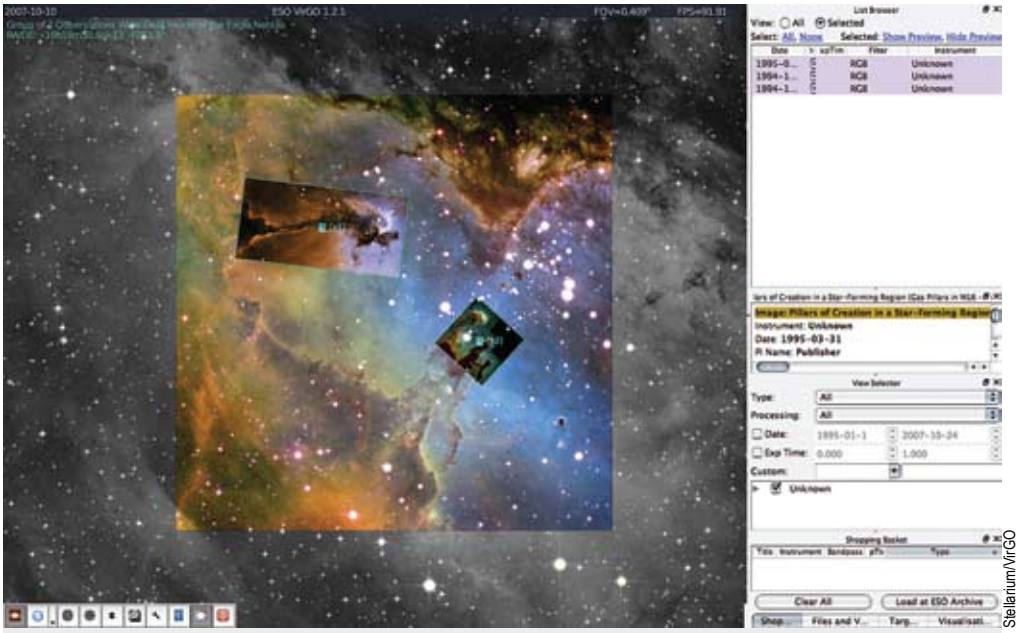


Figure 1 – Screenshot of Stellarium/VirGO displaying images of the Eagle Nebula aligned using WCS data from AVM tags with DSS2 in the background.

[3] http://www.stellarium.org/
[4] http://archive.eso.org/cms/virgo
[5] http://www.ivoa.net/Documents/latest/VOT.html
[6] http://fits.gsfc.nasa.gov/

Astrometry

One of the most important means for bringing astronomical images into their right context are the World Coordinate System (WCS) coordinates used to designate the position of astronomical objects in the sky (the so-called astrometric positions). WCS information is needed to properly align and orient astronomical images on a sky grid. Astronomical images that come directly from a telescope are usually stored in the FITS format. The FITS format usually contains a header with relevant information of a telescope's observation, including WCS information. However, during the processing of the scientific images to EPO images the WCS information is often stripped away as it is seen as irrelevant. Alternatively the original WCS information from the FITS header becomes useless due to post-processing of the image which may change the scale, orientation, cropping, etc. In order to implement emerging tools such as the VirGO module, correct WCS information for the new EPO image (JPEG or TIFF) needs to be resolved.

Astrometry.net[7] is an innovative web-based "black-box" service that resolves WCS information for many astronomical images irrespective of their file format (FITS, JPEG, TIFF). Using a vast library of reference stars, Astrometry.net is able to deliver proper WCS information in the format of a FITS header within minutes. Currently Astrometry.net is in its alpha phase of testing and is the most promising candidate for delivering simple astrometry solution for images to both scientists and EPO people. Many of the images shown during the demonstration at CAP2007 were automatically positioned using WCS information retrieved via Astrometry.net.

Results from this demonstration

At CAP2007, the VAMP team demonstrated the potential of the AVM standard. Astronomical images in JPEG format were imported into Stellarium via the VirGO module and properly aligned on the sky using WCS information pulled from a VOTable translated from an AVM file. This process was semi-automatic in the sense that the alignment on the (digital) sky happened automatically, but someone had to act as the translation layer for the metadata between AVM and VOTable as no automatic tool was built for this prototype demonstration. In the future this import process can be automated for applications that use only VOTables. Once the metadata are inside Stellarium, images are automatically located and pulled into their correct location on the sky grid.

This demonstration showed the capabilities of the AVM standard as a way to access and deliver astronomy visualisation products along with new media. Images can now be downloaded from any server and loaded into such programs, EPO images from different observatories can easily be seen and compared, and contextual information will soon take its place in the presentation.

It is our clear impression that the Stellarium demonstration only marks the beginning. As mentioned in Gauthier et al. (2007) groups at Spitzer Space Telescope, Chandra X-Ray Observatory, and Hubble Space Telescope (NASA and ESA) are tagging their images using the AVM standard. With more metadata-tagged image resources becoming available and better metadata tagging tools produced by the VAMP group, we expect to see several applications emerging soon which

[7] http://www.virtualastronomy.org

natively read AVM, and make better use of the WCS and contextual information (e.g. headline, description, colour mapping, etc.) stored in the metadata. The possibilities for the interconnection and exploitation of these resources are virtually endless.

Stellarium/VirGO

Figure 2 – Multi-wavelength images of the Sombrero Galaxy imported into Stellarium. From left to right: DSS2, Spitzer Space Telescope, Chandra X-Ray Observatory.

Future development

The demonstration was naturally a major breakthrough for the VAMP methodology, re-emphasising the strength of a metadata standard + metadata-tagged images + a (visualisation) tool that can exploit these. It is however clear that any type of application using astronomical data will have different ways of dealing with the import and export of the data and their metadata. Currently VirGO strictly imports the VOTable format, thus a translation layer is necessary for a successful import. Future development will focus on further automating the process of import into various software packages. Translation layers will be developed so that AVM will work with many existing tools. Additionally, we hope to make further use of the contextual information stored in AVM tagged images. This included an aesthetic description of each object, as well as categorical filters for viewing, say spiral galaxies.

The latest version of the AVM (Version 1.1) outlines the translation between AVM and VOTable using the equivalent Unified Content Descriptor (UCD) codes. This demonstrates that other software applications will be able to use VAMP and the AVM standard via a translation layer, thus not limiting the use to only AVM native applications. One early adopter of the VAMP technology is Microsoft's World Wide Telescope project.

Conclusion

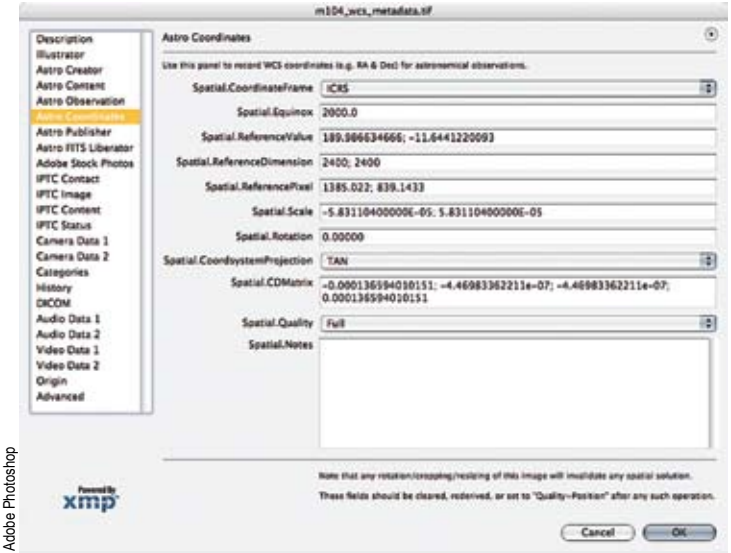
CAP2007 showcased many emerging technologies. Virtually every software package shown at CAP2007 can benefit from VAMP and the AVM standard, including packages which currently employ VOTables. The demonstration showed the abundance of functionality VAMP and AVM will allow. The AVM standard is currently being adopted by the Spitzer Space Telescope team, the Chandra X-Ray Observatory team, and the Hubble Space Telescope teams at STScI and ESA/Hubble.

[8] http://virtualastronomy.org/avm_metadata.php
[9] http://www.ivoa.net/Documents/latest/UCD.html

The VAMP team wants to encourage all observatories and amateur astronomers to adopt this standard. Soon new outlets of distribution will be available for astronomy visualisation products.

Using tools similar to those described above, VAMP and AVM will enable easy distribution of astronomy visualisation products. This demonstration was enabled using the AVM standard, but far richer capabilities are possible than what was shown at CAP2007. In the future, all developed tools and applications supporting VAMP and AVM will be accessible at virtualastronomy.org.

To begin tagging images using the AVM standard, please use the online[10] instructions.



Adobe Photoshop

Figure 3 – Adobe Photoshop panel displaying the WCS tags of AVM

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[10] http://virtualastronomy.org/avm_metadata.php