Astronomy also enables a new approach to the scientific training of students and the development of skills – Teaching Science by doing Science. Access to robotic telescope constellations to record or study astronomical objects or phenomena, whether optical telescopes or radio telescopes, as well as participation in asteroid research campaigns allows a very high level of motivational and scientific experience to students. In addition to reinforcing their learning, they acquire structuring scientific skills and a clear idea of the importance of the method and critical observation. NUCLIO, together with several other partners, is developing activities for schools in projects such as LaSciL (Large Scientific Infrastructures Enriching Online and Digital Learning) or the IASC (International Astronomical Search Collaboration) among other projects, with training of teachers for the use of space and astronomy, combining teaching methodologies by inquiry and project based learning, for schools interested in adopting new approaches that point the way to the future.

But astronomy can provide more than scientific resources or concepts. It can help create a new perspective of a world without artificial barriers. To promote the idea that we are the ones who belong to the planet and not the planet that belongs to us. To embody the concept of the cosmopolitan as one who integrates the Cosmos. That is why it is essential to bring astronomy to the school.

Introduction to Stargazing and Image Processing with Automated Observation Stations

Presenter: Olivier Parisot, Luxembourg Institute of Science and Technology

Collaborators: Pierrick Bruneau, Patrik Hitzelberger (Luxembourg Institute of Science and Technology), Gilles Krebs, Christophe Destruel, Benoît Vandame (Vaonis)

Electronically Assisted Astronomy (EAA) consists of capturing images with a camera coupled to a telescope and then applying lightweight processing to display views of celestial objects. During the MILAN research project (funded by FNR in Luxembourg), we use automated stations of VAONIS for stargazing sessions, helping greatly to arouse the curiosity around astronomy. Firstly, participants can learn how to localise and then observe objects like galaxies or nebulae. Secondly, playing with settings like exposure time shows how image acquisition works. Thirdly, displayed live views continuously improve as data is accumulated, allowing to discuss the basics of image processing (SNR, alignment, stacking). Finally, participants can use raw data to practice image edition trough dedicated software.

Poster link: https://astro4edu.org/siw/p118

Figure 1: Observation of the Sh2_101 nebula with a Stellina automated telescope (night of 31/7/2022) [4]. The image on the left corresponds to a single 10s exposure frame and the image on the right is the result of the stacking of 340 frames (10 s exposure too).

During a stargazing session with direct observation through eyepieces and telescopes, it is not uncommon to have some disappointed participants, especially because of the lack of contrast and colour of the observed celestial targets [1, 2]. Without forgetting that during direct visual observation via a telescope, people with physical constraints will not be able to take full advantage of it (poor eyesight, handicap, etc.).

Nowadays, Electronically Assisted Astronomy (EAA) is widely applied by astronomers to observe deep sky objects (nebulae or galaxies) and planets [3]. By capturing images directly from an image sensor coupled to a telescope and applying lightweight image processing, this approach allows to generate enhanced views of deep sky targets that can be displayed in near real time on a screen (laptop, tablet, smartphone). EAA makes also possible to observe in difficult outdoor conditions, for example, in places heavily impacted by light pollution – deep sky objects almost invisible through direct observation in an urban or suburban sky become impressive and detailed.

Unfortunately, for those who want to start practising EAA, the implementation is not straightforward because a strong technical background is needed [1, 2]. In fact, EAA requires a complex hardware setup: motorised alt-azimuthal or equatorial mount for tracking targets (w.r.t the Earth's rotation), refractor/reflector with good-quality optic, CMOS/CCD dedicated cameras, pollution filters, etc. Depending on the apparent size of the celestial targets, a Barlow lens (for planets and planetary nebulae) or a focal length reducer (for large nebulae) is also required. Moreover, dedicated software like Sharpcap or AstroDMX are needed to control the camera and then deliver the live images on a display device.

This is where the use of automated observation stations makes sense. During the MILAN research project (MachIne Learning for AstroNomy), funded by Luxembourg National Research Fund, we use automated instruments provided by VAONIS to collect images of deep sky objects by using smartphones & tablets [3]. With these observation stations, required steps are automatised and transparent for the end-user: tracking, focus, capture, lightweight image processing, and then display. Thus, these instruments provide live images in different conditions (e.g. low or important light pollution) and with different parameters (exposure time and gain for each unit shot).

During outreach events or during outdoor workshops with a lay audience, the automation of tedious tasks makes it easy to address a wide range of subjects during live EAA sessions. Such automated telescopes allow to easily inspect the sky map and then explain how to choose the celestial sky targets that are visible according to the season and their position during the night. It is thus possible to show live views of visible objects (stars clusters, galaxies, nebulae) while describing their characteristics (e.g. apparent size, magnitude and even distance of the observed targets).

In practice, these automated instruments can be connected to several devices at the same time, so it is convenient to organise interactive observation sessions where each participant can easily observe the captured images. For the more curious, the usage of these observation stations allows at addressing advanced concepts. As a first example, participants can better understand how the image acquisition process works – by visually observing the impacts of capture settings like exposure time and gain. As a second example, it is visually obvious that the quality of the image shown on the screen increases as the station accumulates data, allowing to discuss the basics of image processing in astronomy (signal-to-noise ratio, images alignment and stacking). Finally, participants can retrieve the captured images (raw, unprocessed, or final) for further exercises in image processing – providing an opportunity to learn new techniques to make the most of the data captured trough dedicated open-source software. For example, SIRIL can be applied to stack the raw images while GIMP can be used to make the final images more attractive.

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