The Virtual Reality activities of the ESA Φ-Lab

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The ESA Φ-Lab, created in 2017, aims to be at the forefront of innovation and, particularly, at accelerating the uptake of disruptive technologies in Earth Observation (EO). Whilst the vast majority of resources has been and will continue to be dedicated to Artificial Intelligence techniques and how they can be applied to EO, some attention has been dedicated to Virtual Reality (VR) and its exploitation in the frame of EO use-cases.

Two main lines of activity have been pursued.

Together with NORCE, the Norwegian Research Centre, a setup has been developed and deployed physically in the Φ-Lab in 2018, consisting of general purpose VR hardware, general purpose VR software and NORCE's GeoViz software. GeoViz allows navigating a full 3D globe of the Earth and even flying to other planets/satellites (e.g. the Moon). This installation has gone through a series of major updates that have seen its feature set, configurability and usability evolve remarkably. In addition, through a very fruitful cooperation with EOP-C, it has been possible to load dozens of ESA EO promotion and outreach materials, consisting of processed EO satellite imagery as well as infographics and videos, into the virtual environment. This, in turn, has allowed using the setup to support events, both organized by ESA (Living Planet Symposium, Φ-Week, European Researcher's Night) and external (EGU, SLUSH) in an outreach context. In parallel, the technical evolution of the software has made it possible to use it as an environment for advanced EO visualization applications, suitable of being operated by a user autonomously using the VR controller. Once the system is started, no operator intervention is required – just a short introduction to how the controller can be used, for users not familiar with the system. Users are free to choose which locations to explore and, for each of those locations, which EO images/products to examine (typical products are Sentinel-2 band combinations, Sentinel-3 scenes and Sentinel-1-derived products such as interferograms, coherence, intensity). Apart from imagery, GeoViz is also able to display 3D models (e.g. of spacecraft, buildings), point clouds (e.g. of cities, sites, inSAR showing soil subsidence) and laser scans (e.g. of plantations). Finally, one of the latest functionalities to have been introduced is the visualization of hyperspectral data: hyperspectral datasets (e.g. from AVIRIS) can be loaded and users can browse through 200 bands or more in a matter of seconds using handy VR controller buttons.

The second line of activity consists of mostly in-kind partnerships with other Industry players in the frame of specific events and workshops. In the first edition of Φ-Week, in 2018, a VR workshop was part of the programme, allowing several companies and institutions to show their work, present their ideas and initiate a discussion on strategical aspects and future vision for *VR4EO*. In the second edition of Φ-Week, as recently as September 2019, a VR corner was also part of the programme, and four stands with different exhibitions were available, focusing not only on EO and data (including VHR) visualization, but also space segment, as with the Thales Alenia Space exhibition, which allows very rich satellite and payload visualization and manipulation, as well as advanced interaction using Leap Motion technology.

These two lines of activities have provided the Φ-Lab with a good understanding of the challenges and limitations that currently affect VR technology, particularly for what concerns its use in the context of EO use-cases. They have also enabled the identification of synergies between different activities and ideas for short-term and long-term evolution activities and collaborations.