Contribution ID: **18**   Type: **Data Reduction, Analysis and Visualization**

The Impact of Scientific Data Visualization on Astronomical Research: A New Perspective for the Gaia Mission

Wednesday 16 October 2024 17:00 (20 minutes)

Scientific visualization is currently a very active and vital area of research. It involves the synthesis of large and complex amounts of data into images, videos or even virtual experiences allowing us to immerse ourselves directly into the data. The success of scientific visualization is due to the fact that the brain finds it easier to understand an image than words or numbers. In this way, scientific data visualization is extremely effective not only for communicating the results to different audiences, be they fellow scientists or the general public, but also for the scientific process itself by improving the scientific understanding of the data. The increasing accessibility and volume of data requires effective ways to analyze and communicate the information contained in data sets in simple and understandable formats. The use of different digital technologies in the scientific visualization of this data opens new horizons for understanding the Universe. Virtual reality, for example, offers an immersive environment in which scientists can explore the vast and complex structure of the Milky Way, allowing for a deeper perception of the relationships between stars and other galactic structures. This approach provides real-time information context, facilitating the understanding of correlations between various celestial elements. The ability to simultaneously view multiple data in intuitive ways allows for better identification of astronomical patterns and the formulation of more precise hypotheses.

This approach is widely recognized in the DPAC (Data Processing and Analysis Consortium) consortium as a necessary effort, to properly communicate the importance and impact of the extremely large and complex Gaia dataset. Within CU8, we have started to organize working group to use emerging technologies to visualize some of the CU8 specific data products and the results. One of the latest examples of this work is a video, produced for the FPR 2023, that translates into a sequence of easily understandable steps the complex science behind the 235,000 DIB (Diffuse Interstellar Bands) measurements. The language used in the video allows the tone of the video to be adapted to different audiences. The DPAC recognizes the importance of promoting its data releases (DR) to maintain community interest. Given the embargo on results by the European Space Agency (ESA) until the official release of data, the DR become crucial to attract the attention of the scientific community and the public. In DR3 an even greater effort was required from each CU to produce material to adequately advertise the products that would be released. Our goal is to consolidate efforts and continue the analysis of new scientific visualization tools as we prepare for DR4. This will serve to maintain the skills acquired and expand further.

In this talk, we will explore the importance of scientific visualization in the field of astronomical research, focusing on the integration of videos, images, and immersive experiences for better visualization and understanding of scientific data produced by the Gaia mission. We will also examine the strategies implemented by CU8 to visualize and improve the accessibility of astronomical data, with an outlook towards DR4. Finally, the creation of virtual environments accessible to the public offers an unprecedented opportunity to engage students, and the general public, enabling them to explore space in ways previously unimaginable. This fosters the dissemination of scientific knowledge and interest in space missions such as Gaia.

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Session Classification: Session 9