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Immersive Visualization in Planetarium Domes

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Abstract

Most planetariums today offer immersive presentations of scientific topics, with a focus on astronomy and planetology, to their audiences; making them highly relevant for outreach activities in planetology. To further facilitate the use of planetariums in planetology outreach, easier methods for transfer of visualization data to the planetariums would be required.

1. Planetarium Presentations

Most planetariums are equipped with a video projection system that delivers a dome-filling immersive video image ("fulldome projection"). In Germany alone, planetariums have more than a million visitors per year. Planetariums are thus the probably most common place for the public to experience immersive scientific visualizations. Therefore they are highly relevant for outreach activities, since an immersive presentation allows to convey content to an audience in a more sustainable and more effective way than non-immersive presentation methods.

Such presentations in planetariums are created using proprietary software that allows to either playback pre-rendered immersive video, or to create realtime-rendered, live controlled immersive visualizations.

Planetariums employ these tools in a number of ways:

1.1 Day-to-day live presentations

Most planetariums offer live-presented shows, in which a trained staff member presents basic facts as well as news items to the public, using the according features of the proprietary planetarium software and live-controlling the visualization, e.g., interactively controlling camera movement as to create the impression of a flight to and a landing on Mars, to name just one example.

It would be useful to ingest latest planetology data into the planetarium software on a day-to-day basis in order to present latest news in such regularly scheduled, staff-presented shows, but currently the necessary workflow makes this a challenge.

1.2 Scientific talks

The immersive visualization of planetology data in planetariums is especially useful during invited talks by planetology scientists. Data that are relevant to the talk can be prepared and then presented using the planetarium software, which requires some lead time and the availability of the speaker to aid in the correct representation of his or her data in the planetarium software. Such an immersive presentation to the public can be very captivating and thus can serve to convey points of a talk much more effectively than by traditional means; thus the extra effort that has to be made by the speaker is always justified, in our experience.

1.3 Pre-rendered planetarium shows

Another common form of planetarium presentations are pre-rendered immersive movies, similar in style to TV documentaries. Some institutions have created such presentations on planetology topics, e.g. the California Academy of Science ("Incoming!", 2014) or the production company Mirage3d ("Mars 1001", 2018), just to name two examples.

Another relevant example, "A Journey Through The Solar System" (2017) was created by a collaboration of 19 planetariums in Germany, Austria and Switzerland, led by LWL-Planetarium Münster. Data that were provided for this project by ESA, DLR, MPS, and TU Berlin, e.g. DTM and shape models, were rendered into immersive graphics that serve to explain basic concepts as well as latest research results on different solar system bodies in an entertaining way. This production is very well received by audiences and thus effectively serves to convey planetology topics to a wider audience.

2. Planetarium Software

Planetarium visualization software is heterogeneous and proprietary; currently, about five software products exist that offer the features that planetariums require to operate and present immersive video or realtime-rendered immersive graphics. Not all of them allow to ingest and present planetology data, and those that do cannot interpret the common scientific data formats.

For pre-rendered visualizations (1.3) this is not a challenge as long lead times and budgets of such projects allow to process all kinds of data. For more ad hoc presentations (1.1) however, data conversion and ingestion into the planetarium software is a challenge that hinders most planetariums from employing such data in their day-to-day live-presented shows.

ESO's (European Southern Observatory) EPO department recently spearheaded the definition of an interface ("Data2Dome", www.data2dome.org) to easily transfer outreach media from EPO departments directly to the planetarium domes. This transfer standard allows a planetarium staff member to display a news item (e.g., an image) in the planetarium without any human preparation (e.g., without any human work related to copying or converting of files). It could be envisioned to expand this interface in the future to allow the direct, automated ingestion of planetology data, e.g. DTM data, into the planetarium software.

3. Summary and Conclusions

Modern Planetariums are a highly relevant outreach instrument for the planetology community, and speakers invited to planetariums should strive to present their talks not just through standard means but employing "Fulldome" immersive visualizations related to their topics. Such visualizations can be created by the planetarium software as interactive realtime renderings of e.g. DTM or shape model data.

In the future, such talks and projects would be facilitated if data conversion and ingestion into proprietary planetarium software were to become more streamlined, e.g. through an expansion of the existing "Data2Dome" framework. This would enable presenters to create immersive visualizations of latest planetology data on a day-to-day basis.