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Virtual Reality in the Astronomy Classroom

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Project description

Virtual reality (VR) can be a powerful technique for interacting with 3D models and for the exploring complex data sets. As a pedagogical tool, VR should be especially useful for disciplines such as astronomy – in which the environment studied remains out of physical reach, and where direct laboratory experiments of many key processes are impossible for practical reasons. In this TUFF project, we have developed and implemented VR exercises for 3 of our MSc-level astronomy courses. These exercises are carried out in the Ångström Visualisation lab using an Oculus Rift headset.

VR exercise sessions

These exercises require the students to work as a team to plan and run numerical experiments in the Universe Sandbox^2 software. During the VR sessions, they are faced with various simulated astrophysical environments and are asked to solve problems related to these. Examples:

- If a star happens to drift close to the black hole in the centre of the Milky Way, what is likely to happen to it?
- Here's a system with 10 planets… Which of these would make the best place for a human colony? If no planet is suitable, can you somehow alter the properties of the system to improve the situation?
- Here's a system with two stars in stable orbits… Now, try to add a third star. Can you make this triple-star system reasonably stable? If so, how?

How well does it work?

Student satisfaction: Excellent! These exercises scored 4.8 out of 5 in two anonymous evaluations that were completed by all students.

Learning: Pre- and post-exercise tests reveal that students did improve their understanding of the astrophysical processes involved.

Problems: Very few VR software titles meet our requirements. This makes it difficult to scale up the project to include more exercises or more courses. Also, the Ångström Visualisation Lab only has one VR headset, which means that at most 3-4 students at a time can participate in each VR exercise session. This bottleneck prevents us from using exercises of this type in courses that have more than ≈10 students.

Something to ponder…

The VR experience definitely contributes to the 'wow' factor evident from the student evaluations, but does the VR aspect – as compared to projected 3D on a screen – otherwise enhance student learning? Would learning outcomes be the same if equivalent computer exercises were carried out using a traditional screen interface?