StarGateVR: A Virtual Reality Tool for Exploring Gaia Data

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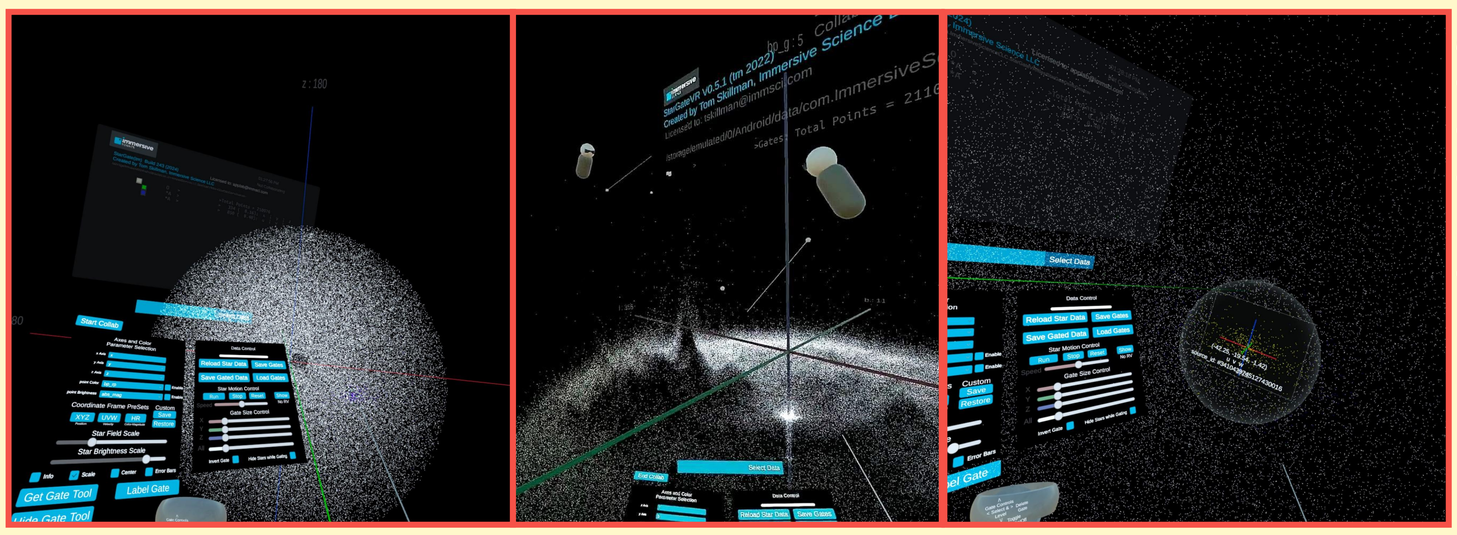
BACKGROUND

- Virtual Reality (VR) is an emergent technology seeing increasing use in astrophysical contexts [1].
- Astrophysical data has become increasingly large and multidimensional in recent decades.
- The European Space Agencies Gaia mission has produced a wealth of positional, kinematic, and photometric data for some 2 billion stars in our galaxy [2].
- VR lends itself particularly well to the task of early exploration of multidimensional astrophysical data, leveraging its intrinsically 3-dimensional nature and use of the human visual system.

TOOL OVERVIEW

- Runs on Meta Quest 2 and 3 headsets – does not require desktop tethering.
- Allows the user to plot any 3 dimensions of Gaia data against each other.
- Natively supports conversion of physical position and Gaia-derived kinematics to heliocentric coordinate frames of XYZ and UVW.
- Has a suite of functions which allow the user to filter ("gate") data in program.
- Contains collaborative features so scientists may explore and manipulate the same dataset together in real time.

STARGATEVR



Left: StarGateVR screenshot illustrating the user-interface and control panel (attached to the left hand). In the background is a Gaia dataset of all astrometrically well-behaved sources within 100 parsecs of the sun, totalling around 200,000 stars.

Right: Screenshot showing that gating tool (the semi-transparent sphere) used to filter the data in-program. Located interior to the gate the Hyades, a nearby open cluster, seen here in 3D heliocentric kinematic space.

Center: Screenshot of two users in collaborative mode observing a "3D" view of extinction caused by interstellar material around the globular cluster M4.

APPLICATIONS

- StarGateVR is an ideal tool for the hypothesis generation & early exploration phase of projects using Gaia data.
- Also strongly suited for class projects at the upper-undergraduate & graduate level.

<u>Projects StarGateVR has been applied to thus far:</u>

- Identifying nearby, young stars on the basis of position, kinematics, and photometry. [3]
- Revealing the population and demographics of the open cluster NGC 2287. [4]
- Searching for open clusters associated with planetary nebulae.
- Probing stellar populations as a function of galactic scale height.
- Comparing metallicities of galactic open clusters.

In addition to the Gaia data, we have also successfully applied StarGateVR to data from the eROSITA X-ray mission [5] and the Sloan Digital Sky Survey [6].

ACKNOWLEDGMENTS

This work has made use of the StarGateVR software (Immersive Science LLC, https://www.immsci.com/stargatevr) to analyze the data.

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Please scan the following QR code for a full list of references:

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