HoloCluster

User Manual of the HoloCluster mobile application developed by Quasar Science Resources for the StarFormMapper project

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1. Introduction

HoloCluster is an application for smartphones that allows the visualization of “VideoHolograms”. Holograms are 3D images created by the interference of light beams that are visible from any angle without lenses, screens, etc.¹

HoloCluster does not show real holograms, it creates a 3D illusion using Geometrical Optics that make you think that you are looking at a real hologram. In 1862 the English scientist John Henry Pepper (1821 - 1900) popularized this effect in a demonstration. Since then, this illusion is known as Peper’s ghost².

When an object is reflected in a film made of a transparent material (glass, methacrylate, etc.) at an angle of 45 degrees, the observer sees a virtual 3D image reflected in the material. This image is semitransparent or "ghostly".

![Diagram showing how the 3D illusion is created.](https://starformmapper.org/2018/03/21/dr-annes-log-creating-a-holodeck/)

In the case of this application, the holograms created use scientific data from the Gaia³ and Herschel⁴ space missions as well as from results obtained within the “StarFormMapper (SFM) A Gaia and Herschel Study of the Density Distribution and Evolution of Young Massive Star Clusters” project.

HoloCluster has been developed by Quasar Science Resources S.L. in collaboration with the rest of the StarFormMapper Consortium. The main objective of the SFM project is to combine data from two of ESA’s major space missions, Gaia and Herschel, together with ground-based facilities, to constrain the mechanisms that underlie massive star and star cluster formation. This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 687528. Find out more at:

¹https://en.wikipedia.org/wiki/Holography
²https://en.wikipedia.org/wiki/Pepper%27s_ghost
³http://sci.esa.int/gaia/
⁴http://sci.esa.int/herschel/
1.1. Scope

This document belongs to the deliverable D36. Outreach activities update for the EU H2020 (COMPET-5-2015 – Space) project “A Gaia and Herschel Study of the Density Distribution and Evolution of Young Massive Star Clusters” (Grant Agreement Number: 687528), with abbreviated code name StarFormMapper (SFM) project.

1.2. Acronyms

ACID Atomicity, Consistency, Isolation, and Durability
App Smartphone application.
QSR Quasar Science Resources S.L.
2. HoloCluster Application Installation

2.1. Current Version

The current version of the HoloCluster Application is v1.0.

2.2. Requirements

In order to run HoloCluster in a mobile device the following is needed:

- Android 7.0 Nougat and higher (at present, there is no version for Apple OS devices.)
- Free disk space in your device.

Important: before installing, any previous version of the application must be uninstalled.

2.3. Download

HoloCluster can be installed by using the APK file. An APK file is the package file format used by the Android operating system for distribution and installation of mobile apps and middleware. In order to install the current version of HoloCluster in your Android mobile device one needs to enable installing applications from outside the Google Play Store in the mobile device. To do this, follow these steps:

a) Enable on your Android phone the option to allow the installation of Android applications from outside the Google Play Store. In order to do this,

   a. Go to Settings » Security » check the Unknown sources box (see Figure 2).

b) From your mobile device, download the HoloCluster.apk file from the web project by going to the following URL using your internet browser application,

   https://www.starformmapper.es/material-de-divulgacion/
2.4. Installation

Once the APK file has been downloaded, install HoloCluster by opening the APK file that you will find in the download notifications area of your smartphone. If the installation was successful, you will find the HoloCluster icon along with the rest of your applications (Figure 3).
3. HoloCluster Application Contents

Once the application has been installed, launch the application by taping on it (Figure 4). The application displays 6 different sections to navigate (Figure 5):

- **What is SFM?:** Brief introduction to the StarFormMapper project.
- **Star Clusters:** Brief introduction to star clusters and how SFM is going to contribute to our understanding of them.
- **VideoHolograms: A 3D Illusion:** VideoHolograms explained.
- **Build your VideoHologram:** Guidelines on how to build your VideoHologram.
- **SFM VideoHolograms:** Play the VideoHolograms developed for the SFM project.
- **About HoloCluster**
Figure 5: Different sections of HoloCluster.
4. HoloCluster SFM VideoHolograms

By clicking on "SFM VideoHolograms", a list with the available holograms is displayed. Currently, the SFM team has developed three simulations, Figure 6.

![Figure 6: Hologram simulations available in HoloCluster.](image)

To visualize the VideoHologram, you have to click on the playback button and place a pyramid built with transparent material on your smartphone. In the "Build your VideoHologram" tab you can find information about how to build the pyramid.

![Figure 7: Example of a pyramid used to visualize VideoHolograms.](image)
(Source: http://www.spectrehologram.com)
4.1. Video 1: Merging of two star clusters with an initial velocity of 5km/s, within 10 Myr

Two clusters interact with one another... with destructive consequences!

Figure 8: Merging of two star clusters.

4.2. Video 2: Dynamical evolution of a star cluster

This video shows simulations of a cluster with total mass of 1000 Solar-mass and half-mass radius of 0.1 pc, non-segregated and without any initial binaries. The simulation is for 10 Myr.

Figure 9: Cluster simulation developed by the SFM project.
4.3. Video 3: Star Cluster Formation

This simulation follows the gravitational collapse of a cloud with enough mass to form 10,000.
More information at https://starformmapper.org/outreach/visualisation/

Figure 10: Column density in one of our simulations.