Amsterdam University of Applied Sciences

ASTRON

Summer school Assignment: Astronomy data visualization Milky Way and integration radio astronomy Pulsar data

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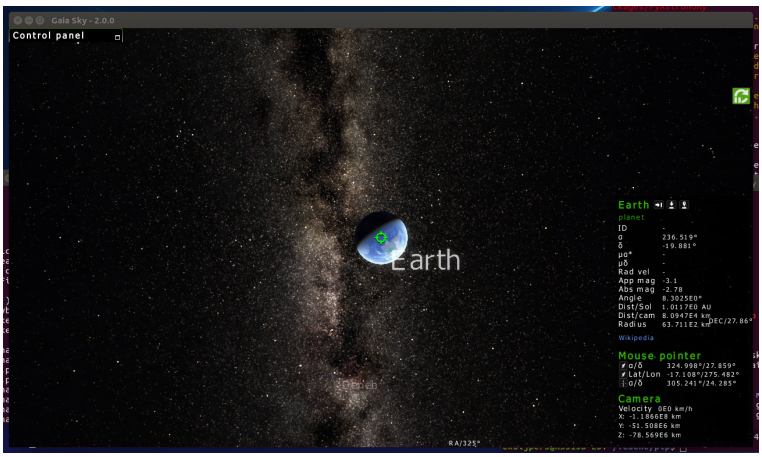

Figure 1: Multi-dimenstional visualization of Gaia science data

1 Introduction

In astronomy visualization is important to analyse the environment of stellar objects. An enormous amount of data is generated by many telescopes on ground and in space. Gaia is a space mission to measure our Galaxy with the Gaia satellite, i.e. the Milky Way. Gaia Sky [1] is a real-time 3D Universe application that runs on Linux, Windows and macOS. It is developed in the framework of ESA's Gaia mission to chart about 1 billion stars of our Galaxy.

The Amsterdam University of Applied Sciences(AUAS) is cooperating with ASTRON on exploring technologies for the Square Kilometer Array (SKA). The assigment is to explore techniques to visualize and navigate through millions of stellar objects. The map made in the Gaia project is useful for understanding the radio sources in our neighbourhood. This dataset is to be considered multi-dimensional as next to location at least velocity and properties of the stellar objects are to be depicted.

The objective of the activity is to learn about the development methods used for a Research Software Science community [5]. This includes understanding of FAIR-principles, i.e. data should be Findable, Assessible, Interoperable and Reusable) [6], when storing and managing data and metadata. The GAIA Data Release 2 is an important example of open data science which motivates the activities.

2 Assignment

Compare and demonstrate multi-dimensional visualization of the Milky Way based on Gaia sky and to try to expand capabilities and understanding. The assignment will be aligned to skills and experience.

3 Prerequisites

A number of prequisites need to be considered:

- Laptop with sufficient diskspace (Core I5,GPU)
- Virtualbox environment
- Windows or Linux environment
- Linux experience
- Physics background

4 Activities

4.1 Analyse Gaia sky

Gaia Sky [1]covers the following functionalities:

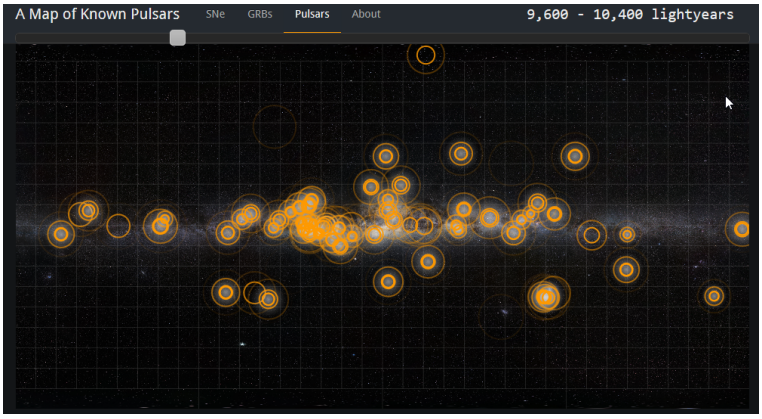

Figure 2: Visualization of pulsar radio sources

S-1 The software allow to visualise Gaia subsets.

S-2 The use can navigate through the dataset.

S-3 The user can manoeuvre through the Milky Way using scripts.

Of interest is to analyse whether other datasources can be integrated. Of interest are Pulsars [3], see fig 2. The corresponding software is available [4]). In addition a comparison needs to be made between de Gaia Sky database and the raw database [2]

4.2 Demonstration requirements

The actvity should result in an analyses, but should also include a demonstration with the following goals:

D-1 Demonstration and explanation of science software installation and procedure.

D-2 A demonstration showing understanding astronomy coordinate systems.

D-3 A demonstration showing a mix of galactic resources in the neighbourhood of our solar system.

D-4 A demonstration of the use of scripting.

D-5 A demonstraton of the integration of other data sources than avaiable with Gaia.

5 Learning objectives

The following objectives will guide the learning activities:

- Learning how to understand and install scientific software;
- Learn about the importance of coordinate systems;
- Gain experience in the astronomy application;
- Improve understanding of software support for research.

References

[1] *Gaia Sky https://github.com/langurmonkey/gaiasky*, June 2019.

[2] *Gaia data release 2 - https://www.cosmos.esa.int/web/gaia/dr2/*, June 2019.

[3] *Pulsar Map*, June 2019. `https://ishivvers.github.io/maps/pulsars.html`.

[4] *Pulsar Map software*, June 2019. `https://github.com/ishivvers/GalacticMaps`.

[5] J.C. Carver, N.P. Chue Hong, G. T. *Software Engineering for Science*. CRC Press, 2017.

[6] Wilkinson, M., et al. The fair guiding principles for scientific data management and stewardship. Available at `https://www.nature.com/articles/sdata201618/`.