

1. Objectives

The following is a list of the objectives stated at the beginning of the project and a brief description of whether they have been achieved or not or any changes that we might have decided on making throughout the development of the project:

- Understanding how the current methods to study solar flares work and be able to work with GNSS data in order to use it as the input for our algorithms.

Research has been done on this topic to be able to develop the new algorithms. We started with simpler tests to see if solving our problem was feasible. These test were successful and were of great help to understand the current methods.

- Using this data, developing new algorithms that can perform the detection using solar flares first but without knowing the origin of the source, that is, not only detecting the solar flare, but the position of the Sun relative to the Earth.

A brute force approach was developed to test this and then several optimizations were presented. After this test, we presented different optimizations to reduce its computational complexity. Instead of developing the algorithm using just one method we presented various ways to solve the problem, and focused on studying which one was more reliable and yielded the best results.

- Applying this to the challenging scenario of far-away stars without knowing the position of the potential ionizing source.

This has been applied too, by adapting the previous algorithms to work only considering the night hemisphere (which is not under the effect of the Sun).

- Prepare these algorithms to be applied for real-time data.

The algorithm just takes the data of an epoch, so we would only need to input each epoch to the algorithm. However, instead of moving forward with this, we decided to focus on studying the two presented methods to see how well they performed using previous data, both from solar flares and flares from far-away stars that had been registered in the past.

2. Development tools

The tools used for the project are the same ones listed in the Project Management deliverable with the addition of C++ and the LAPACK library for Fortran. We intended to write all the code using Fortran due to it's performance in numerical computation but decided to use C++ for the logic of the algorithms and Fortran for the parts that required more demanding numerical computation. For one of the methods we needed to perform matrix operations and the LAPACK library provided some of this operations difficult to implement on our own.

3. Obstacles

The main obstacles that have appeared during the project have been:

- Learning to use new technologies like GNSS or programming languages like Fortran or Latex for the report, although this was problematic only during the first weeks of the projects.
- Understanding some of the problems more related to Math or Physics, but Manuel, the project supervisor, has helped me a lot in this regard in the effort to understand this and be able to apply it to the algorithms.

4. Methodology

The methodology has remained the same as stated at the initial document, every week a meeting with the supervisor is organized in order to track the progress and comment on the results and solve any problems that might have appeared.