1. Introduction

Earthquakes is a natural catastrophic which can causes major damage to the infrastructure, social or economic aspects. Earthquakes can be happened due to several things, such as crust dislocations, volcanic eruptions, the collapse of underground mines (karsts) or even by a deliberate explosion [3]. However, finding the source of earthquakes can be a really important task. The data can we use to avoid collateral damage or for the sake of further research. According to that reason, this paper will be focused on approximating the epicenter of earthquake in mathematically, using the data from the earthquake that happened in central Italy at 24 August 2016. The data itself was gathered from five observation stations (channels) that give variables of arrival time, distance, and azimuth. All of that variables can be used to produce nonlinear system of equation.

There was a work that try to discuss the same topic with the same data [5]. In that previous work, the nonlinear system of equations has been approximated by a method called Newton's method. This method is used because of its ability to find numerical solutions of nonlinear systems. Nevertheless, there is another method who can do the same trick, such as Steepest Descent method, Fixed Points iteration, Quasi-Newton method, Broyden method and etcetera [2]. In this paper, we will use Steepest Descent method because it is Newton-based technique and usually not need a good initial approximation to get converge [2]. So, in the end, we can compare the effectiveness of the two methods from the solution path they can generate.

The problem statement applied in the search of coordinates of earthquake source in this journal include:

1. The data used is data from the Italian earthquake that occurred on August 24th, 2016 that has Pg seismic phase [11].
2. Numerical simulation use two method, Newton's method and Steepest Descent method.
3. Several conditions applied at the time of calculation. That condition includes the value of velocity variable and initial guesses.

Based on the background, the goal to be achieved by this final project journal is written below:

1. Knowing how Steepest Descent method in determining point of an earthquake epicenter.
2. Know the solution path pattern created by Steepest Descent method.
3. Analyze the differences of solution path, a number of iteration and the numerical error between Newton's method results and Steepest Descent method results.

Note that, before we use Steepest Descent method and in order to support its process, we will presenting several numerical simulations. All these procedures are the same as those used in previous work. Next section will give the detail of the whole simulations.