UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF STAND-ALONE APPLICATION FOR COMPUTING PLATE TECTONIC MOTION OVER THE EARTH'S SURFACE

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ABSTRACT

Plate tectonic motion is the displacement of the plates over the earth's surface that usually occurs due to earthquakes. Significant displacements can be detected in regions with high seismic activities. Therefore, the plate tectonic motion is emphasized where the rate of movement is calculated periodically every year. Hence, this study aimed to develop a stand-alone application to automatically calculate the plate tectonic motion with reference to Euler's theorem. A plate tectonic calculator (PTC) was developed based on optimized parameters and formulations that are efficiently capable to calculate the motion in any region. Furthermore, the set of formulations from Euler's theorem that has been revised into a comprehensive form, were verified using manual calculation in MATLAB. The formulations were categorized into two stages which are inverse Euler pole problem in Local Geodetic Coordinate System (LG CS) and direct Euler pole problem in LG CS. After integrating the PTC using C# programming language through Visual Studio, the sample coordinates and velocities of stations from four cases were used to test the developed application. Moreover, the effectiveness of the developed PTC was further assessed by comparing the output with the existing Euler pole calculator (EPC). Evidently, the result showed no significant differences in all parameters for each case. This is because the differences were too small and did not exceed the tolerance range of standard deviation for each parameter involved. Consequently, this research has achieved all objectives and the expected outcomes. In addition, it could assist the current detection of plate tectonic motion more effectively in the given regional area.

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter describes the research details that consists of research background, problem statement, research question, aim and objectives and significance of study.

1.2 Research Background

This study focused on the concept of plate tectonic that occurs in a region by considering the most efficient solutions to perform the process involved. Aktug et al. (2013) explained that the motion of tectonic plate is presently parameterized on a spherical geometry through Euler's theorem that applied the concept of Euler pole parameters (EPPs).

By referring to Euler's theorem, the axis of the rotation's pole and the surface of the sphere are the two points that are intersecting to each other (Goudarzi et al., 2014). They also stated that the rotation about the Euler pole of relative rotation that occurs between the plates can be characterized by the displacement from one tectonic plate relative to another plate. This theorem provides the possibility of locating any region to resolve the tectonic plate in space. Therefore, the analysis of intraplate motions can be performed (Goudarzi et al., 2015). Previously, the plate motion models successfully performed the comparison of estimation from different sources including hot-spots tracks, space geodetic measurements, spreading rates of ocean ridges, earthquake slip vectors and transform fault azimuths (Aktug et al., 2013 & Goudarzi et al., 2014). These models were able to elucidate the plate kinematics with large-scale features.

Despite the critical necessity of Euler pole computations in geodynamic research, only a few applications that had been established to automatically calculate the EPPs from absolute velocity data. For instance, Gourdarzi et al. (2014) have developed the Euler pole calculator (EPC) via Matrix Laboratory (MATLAB) software, whereas Okino (2018) and Andrews (2003) have developed the Plate Motion Calculator and the Rice University Plate Motion Calculator, respectively. All these applications are capable to run automated calculations for the plate tectonic motion. Hereby, new