GPS Solut
DOI 10.1007/s10291-013-0354-4

GPS TOOLBOX

EPC: Matlab software to estimate Euler pole parameters

Mohammad Ali Goudarzi · Marc Cocard · Rock Santerre

Received: 13 May 2013 / Accepted: 8 November 2013

Abstract The estimation of Euler pole parameters has always been an important issue in global tectonics and geodynamics studies. In addition, the increasing number of permanent GPS stations and the ease of access to their data, along with advances in computers, promise new methods and tools for the estimation and the quantitative analysis of Euler pole parameters. Therefore, we developed the Euler pole calculator software using a set of mathematical algorithms based on the model of tectonic plate motion on a spherical surface. The software is able to calculate the expected velocities for any points located on the earth's surface given the relevant Euler pole parameters and to estimate the Euler pole parameters given the observed velocities of a set of sites located on the same tectonic plate. Mathematical algorithms and functions of the software are explained in detail.

Keywords Direct Euler pole problem · Inverse Euler pole problem · MATLAB

The GPS Tool Box is a column dedicated to highlighting algorithms and source code utilized by GPS engineers and scientists. If you have an interesting program or software package you would like to share with our readers, please pass it along; e-mail it to us at gpstoolbox@ngs.noaa.gov. To comment on any of the source code discussed here, or to download source code, visit our website at http://www.ngs.noaa.gov/gps-toolbox. This column is edited by Stephen Hilla, National Geodetic Survey, NOAA, Silver Spring, Maryland, and Mike Craymer, Geodetic Survey Division, Natural Resources Canada, Ottawa, Ontario, Canada.

Disclaimer: We provide the EPC software with the hope that it will be helpful for scientific research. Although we did our best to implement the described mathematical models in our software free of coding errors, it comes without any warranty. Please refer to the "disclaimer file" in the software root directory for more information about the liability.

M. A. Goudarzi (✉) · M. Cocard · R. Santerre
Department of Geomatics Sciences, Laval University, Louis-Jacques-Casault Building, Quebec, QC G1V 0A6, Canada
e-mail: mohammad-ali.goudarzi.1@ulaval.ca

Introduction

Motion of the tectonic plates across the earth's surface can be represented by Euler's rotation theorem in spherical geometry. According to the theorem, the movement of a rigid body across the surface of a sphere can be described as a rotation around an axis of rotation that passes through the center of the sphere. The pole of rotation is one of the two points where that axis intersects the surface of the sphere (Lowrie 2007). Application of this theorem in geophysics states that the displacement of one tectonic plate relative to other plates takes place as a rotation about the Euler pole of relative rotation between the plates.

The Euler pole can be located by different methods. Previously, most of the successful plate motion models were determined from transform fault azimuths, earthquake slip vectors and spreading rates at mid-ocean ridges (Chase 1972; Minster and Jordan 1978; DeMets et al. 1990, 2010; Argus and Gordon 1991). These models can explain the large-scale features of plate kinematics (Qiang et al. 1999).

Despite the importance of the Euler pole estimation in geodynamic studies, to the best of our knowledge, there is only one other software program for the calculation of Euler pole parameters using GPS velocity vectors. It is called PlatE-Motion (PEM) and was developed at the National Institute of Geophysics and Volcanology (INGV: Istituto Nazionale di Geofisica e Vulcanologia) in Italy (Cannavò and Palano 2011). However, developing a new

Published online: 22 November 2013