



**Candidate**

Fengwei Sun

**Masterthesis (Year: 2014)**

Concept, Design and Implementation of a Smartphone APP for the ITRF-Datum and -Plate Transformations

**Referee**

Prof. Dr.-Ing. Reiner Jäger

**Summary**

Due to the dynamics of the Earth the parameters of the international terrestrial reference system (ITRS) are repeatedly estimated in different frequencies. In this context, new realizations of the ITRS in respect to the parameters of the datum, datum-drift and plate-parameters, are published every couple of years by the IGS member IERS (International Earth Rotation Centre). Generally the ITRFzz.yyyy.mm coordinates  $x(t)$  of a point position in the ECEF (Earth Centred Earth Fixed Frame) frame change dynamically in time (zz = Datum, yyyy.mm = datum-Drift and monthly plate stand. The dynamics of the plate movement as most dynamical parameter can reach a velocity up to 1/dm per year.

Nowadays high precise GNSS positions  $x(t)$  can be estimated based on Low-Cost GNSS sensors, which are controlled by smartphones, or directly embedded into tablets ("Smartphone-RTK") with different sources of OSR and SSR GNSS-correction data.

In order to transform  $x(t)$  between generally two different frames (source and target frame) and times 1 and 2, namely ITRFzz1.yyyy1.mm1 and ITRFzz2.yyyy2.mm2 a concept for a respective transformation functionality is needed on mobile devices. The aim of this master thesis is to design and implement an Android App for a datum-, datum-drift- and plate- transformation, which will become a very common procedure in mobile computing.

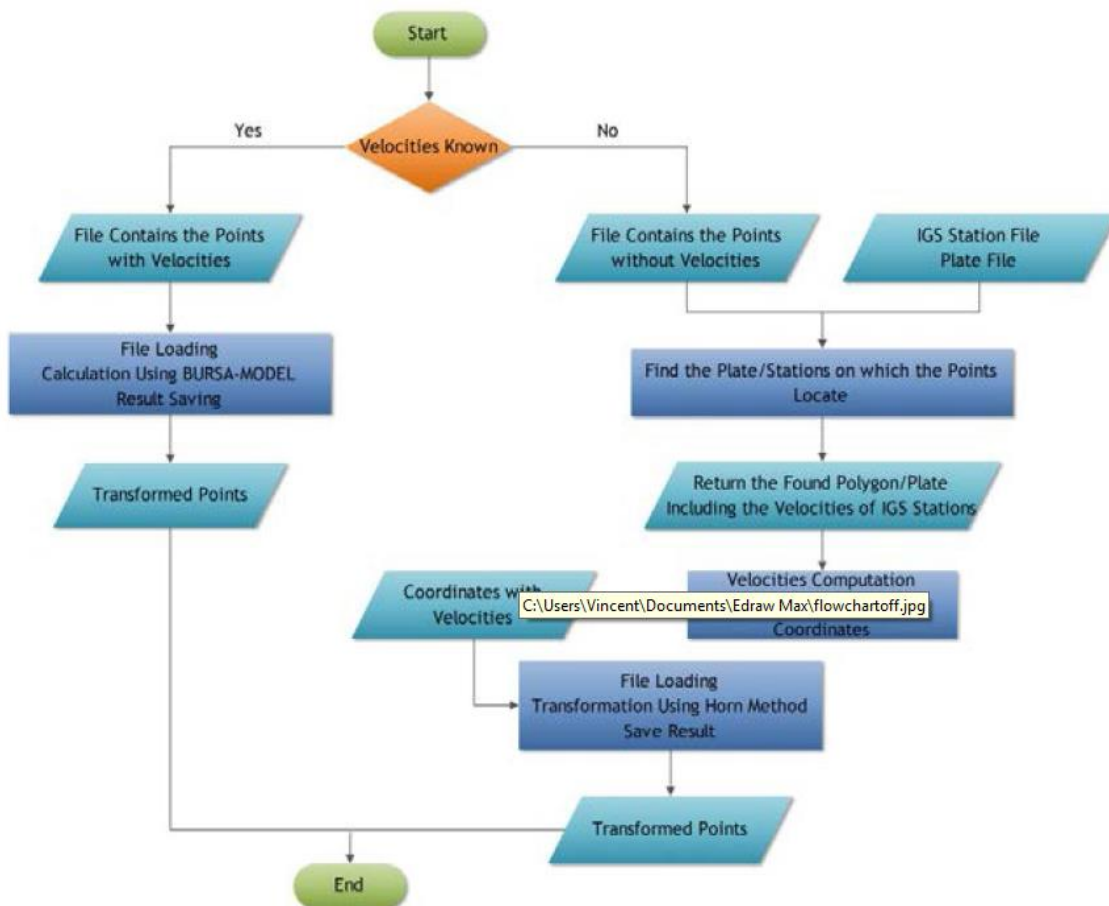


Fig. 1: Flowchart using the BURSA-Model Transformation

Two sorts of methods have been applied to perform the above transformation. Both of the methods are based on seven parameters transformation, which can cover all three components in one. One of them uses the BURSA-

Model to implement the transformation; the other one utilizes the Horn method to perform the datum transformations. By using the BURSA-Model transformation, there are two possibilities have been provided. One possibility is the coordinates and velocities of the points are known, while the other one is that the velocities of the points are unknown, but the coordinates are known. To use either of them, the points which need to be transformed should be on the same plate. Therefore, a defined tectonic plate file has been applied to check if the points are on the same plate. And to calculate the velocities of the points, an estimation of velocities by using Euler Plate has been used, as well as an IGS file which contains the velocities of IGS Stations, can be downloaded from a FTP server. Since the parameters are known between different datum, 10 cases have been taken into account to make the transformation by using the BURSA-Model. The Fig. 1 shows the flowchart by using this method. By using the Horn method to perform the datum transformations, at least 3 identical points in start and target system are necessary, the transformation parameters between the start and target system would be calculated by using the known coordinates, and then, the computed parameters would be used for achieving the transformations.

The Fig. 2 shows the flowchart by utilizing Horn method.

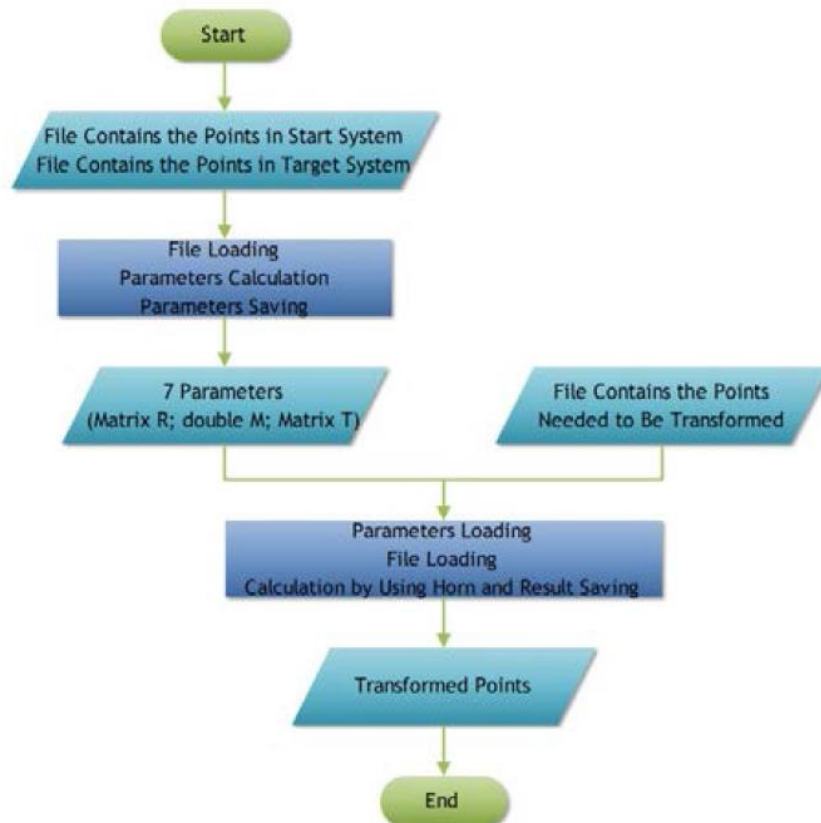


Fig. 2: Flowchart using the Horn Method Transformation