Hochschule Karlsruhe (HSKA) - University of Applied Sciences
Geomatics Master (MSc.) IMM

Candidate
Mrs. B.Sc. Hsin-Chieh Chen

Masterthesis (Year: 2014)
Conception, Design and Implementation of the Windows Application Software for the GNSS/-MEMS based Kaleo-Georeferencer Tablet PC

Referee
Prof. Dr.-Ing. Reiner Jäger

Keywords
Mobile GIS, GNSS/MEMS/Laser, NTRIP, RKTLIB, Mobile Internet, NAVKA-Algorithms, 3D-Georeferencing of Objects, Datum und Height Reference Surface, DFLBF/DFHBF

Summary
The task of the masterthesis taking place in the frame of the joint B.W. RaD project was to implement the complete georeferencing component for a mobile GIS, as given by the tablet based teXXmo KALEO Georeferencer system (fig. 1, www.texxmo.de , www.navka.de). The georeferncing of a point P of interest (POI) is based here on a L1-GNSS RTK component, an orientation giving MEMS box (gyroscope, accelerometer, magnetometer) and a laser distance measurement system as hardware components of the Windows tablet. For receiving TCP/IP based DGNSS-corrections mobile internbet and an NTRIP-client were implemented. So the precise position of the POI in the earth fixed frame (ECEF) $\mathbf{x}^e$ can be computed as:

$$\mathbf{x}^e = \mathbf{x}^e_{\substack{GNSS \\ p-Origin}} + \mathbf{R}^e_n(B,L)\cdot\mathbf{R}^n_p(r,p,y)\cdot\mathbf{x}(s,\alpha,\delta,t_x,t_y,t_z)^p \quad \text{with} \quad \mathbf{x}^p = s\cdot\begin{bmatrix}\cos\alpha\cdot\cos\delta\\ \sin\alpha\cdot\cos\delta\\ \sin\delta\end{bmatrix}+\begin{bmatrix}t_x\\ t_y\\ t_z\end{bmatrix} \quad (1a,b).$$

The parameters $\alpha,\delta,t_x,t_y,t_z$ are the orientation and eccentricity of the laser in respect to the GNSS-position. The software development was done in the programming language C#. A general API with the above application for KALEO Georeferencer was developed. As concerns the positioning part (B,L,h), the open-source software RTKNAV was integrated. For the orientation (r,p,y) giving the NAVKA algorithms were used based on the data of the integrated MEMS-box, and finally a commercial laser measurement unit for the slope distance measurements s (1b) to the POI. The ITRF (ECEF) position of the POI is presented on the integrated OSR map (fig. 1), and stored to the database. The transformation of the ITRF-based position of the POI to the classical horizontal network datum and height reference system, is based on Euler-plate rotation (from ITRF to ETRF89), and then on DFLBF and DFHBF databases (www.moldpos.eu), see fig 2.

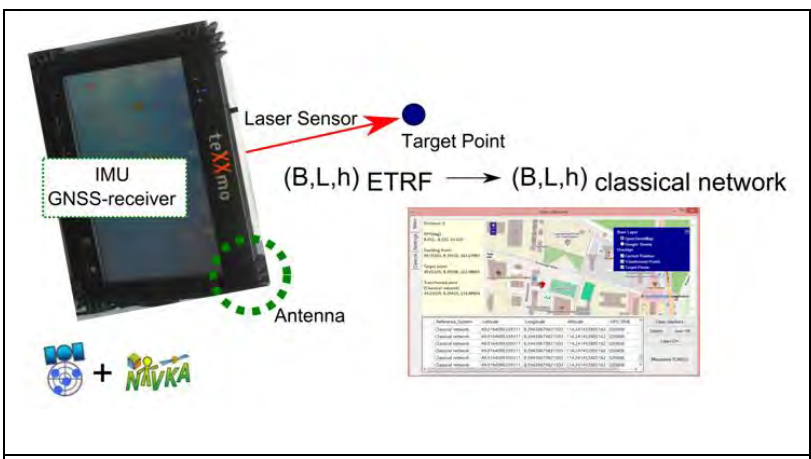

Fig.1 Concept and implementation of the thesis.

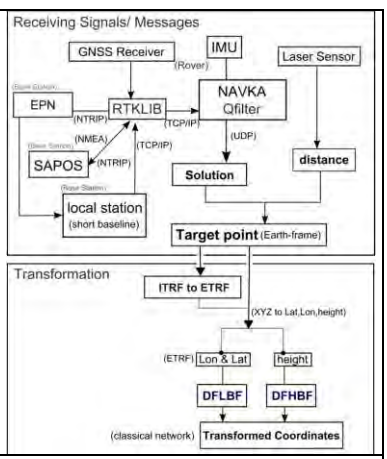

Fig.2 SW - Implementations

In the close range an accuracy of 1-3 cm-level could be achieved. For larger distances s the attitude determination (r,p,y) needs to be improved further..