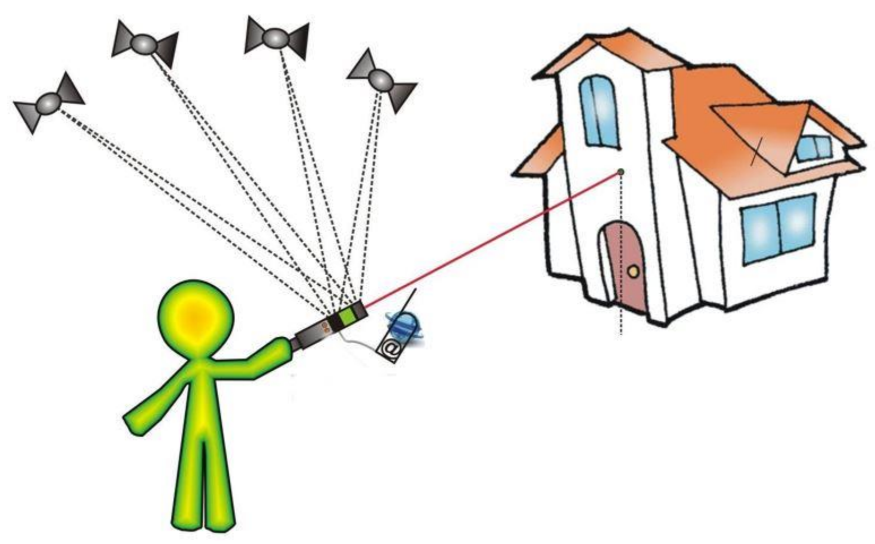

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Evaluation and Further Development of The NAVKA Smartphone-Laser-Georeferencer

Introduction

The integration of GPS/INS in the application of Georeferencing has brought a small revolution into the mapping industry by driving down the cost of mapping products and speeding up the production cycle. Commonly several measurements originating from different sensor systems are combined in order to completely model the state of an object. An important step preceding data fusion is the consideration of the geometric alignment of the measurements with a geodetic coordinate system (lever-arm). The NAVKA contactless Georeferencer is developed under PREGON-X project. The project is dedicated to precise positioning and georeferencing by Smartphone for various mobile GIS applications. Several measurements coming from different sensors are fused using a data fusion filter in order to calculate the position of the target object.

Objectives

This research work has three main objectives. The first objective was to Evaluate the Georeferencer algorithm followed by the optimization and further improvement of the system by adding more features such as Object identification with Error Propagation to the system and the third objective was to introduce server client architecture .

Georeferencer System Description

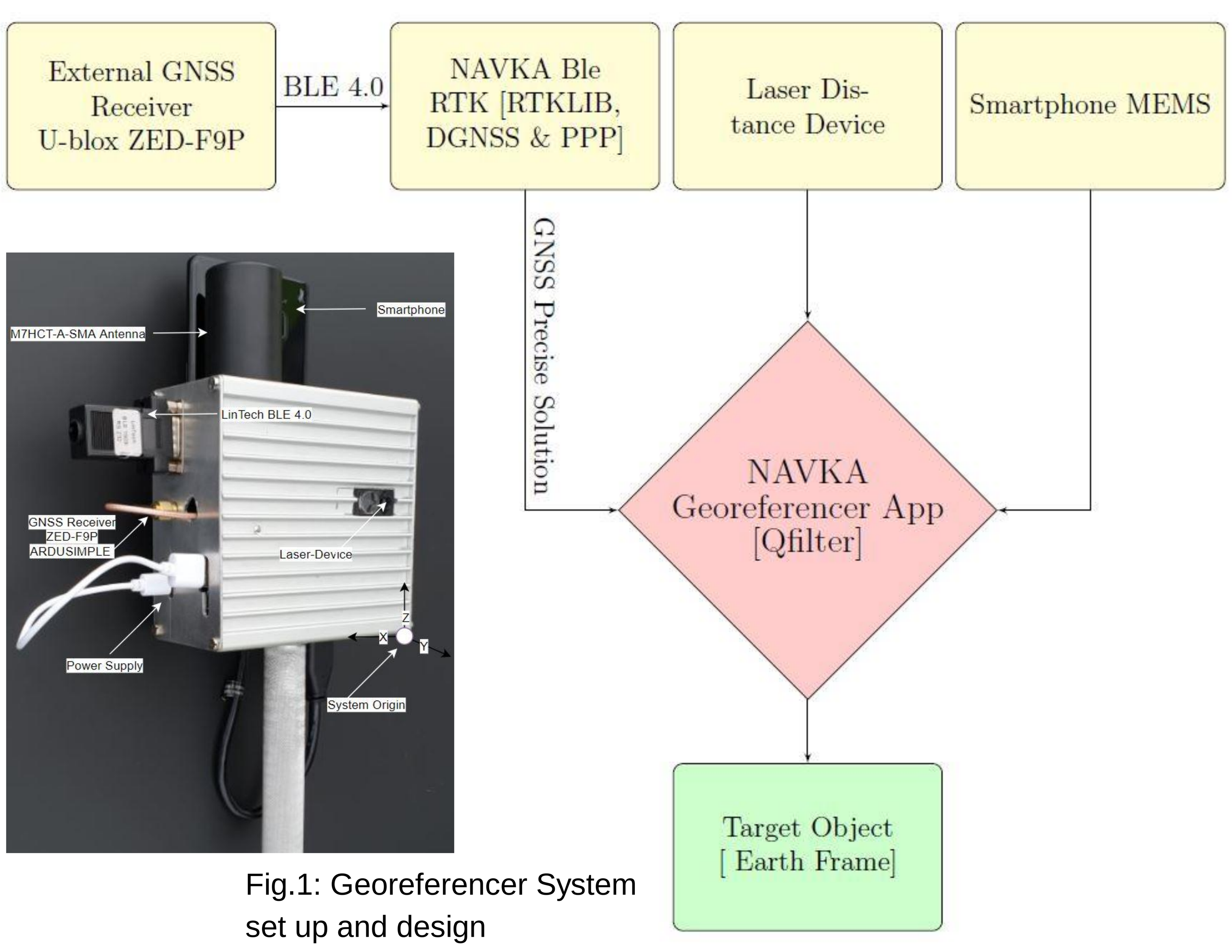

Fig.1: Georeferencer System set up and design

Smartphones have been used to record voices, register movement, navigate, count stair steps and much more. The contributions of the sensors that provide the data for the smartphones to do so, is considerable. These applications make sense if the quality of the sensors used is enough. However, the actual quality of the built-in sensor component remains unknown.

For this reason, no conclusion can be specified about the smartphone sensor accuracy in actual use and software such as Qfilter is very important to be used in order to improve and assess the accuracy of the sensors.

Qfilter

The Qfilter a quaternion kalman filter, Least-Squares (L2-norm) with a special linearisation at the state prediction, was used to better estimate the the GNSS position and the smartphone attitude (azimuth and tilt). The figure below shows the equations and the lever-arm translations used to calculate the coordinates of the target object.

$$X^e = X^e_{GNSS-P\ Origin} + R^e_n(B,L).R^n_p(r,p,y).X^p(s,\alpha,\delta,t_x,t_y,t_z)$$

$$X^e = \begin{pmatrix} x(B,L,h) \\ y(B,L,h) \\ z(B,L,h) \end{pmatrix}$$

$$X^p = s * \begin{pmatrix} cos\alpha * cos\delta \\ cos\alpha * sin\delta \\ sin\alpha \end{pmatrix} + \begin{pmatrix} t_x \\ t_y \\ t_z \end{pmatrix}$$

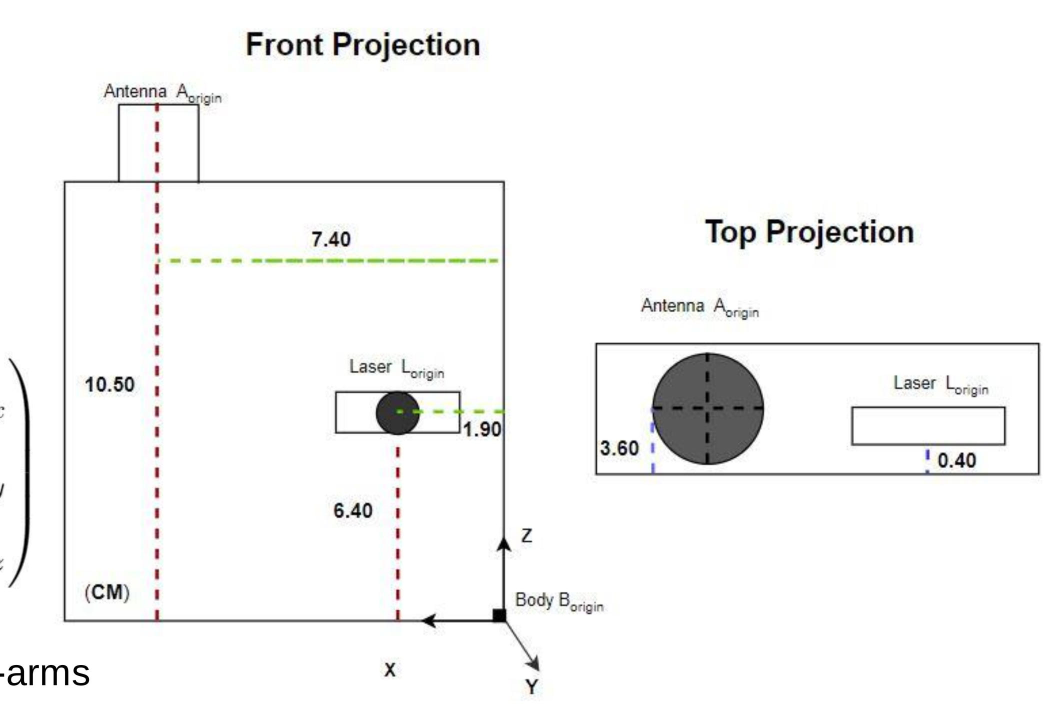

Fig.2: Algorithm and Leve-arms

Result

The NAVKA Georeferencer testing for system evaluation was done using two RTKLIB versions with fixed setup and free (Kinematic) setup. In these two setups, the system was tested in two GNSS solutions services and positioning modes (DGNSS, PPP). The test field on the HSKA rooftop was prepared in both ETRF89 using Trimble R8 SAPOS service and ITRF2014.2019.08 using Leica SR530 with free PPP correction service. The accuracy of the system using the first RTKLIB version 2.4.2 in the free setup was not acceptable due to the delay and the instability in acquiring the precise GNSS solution. The accuracy when testing the system with the updated version 2.4.3 in different distances from the target object was much better (decimetre range).

Fig. 3 below shows sample of the graphical user interface of the developed android app presenting the home screen, the NTRIP client settings and the object identification fragment.

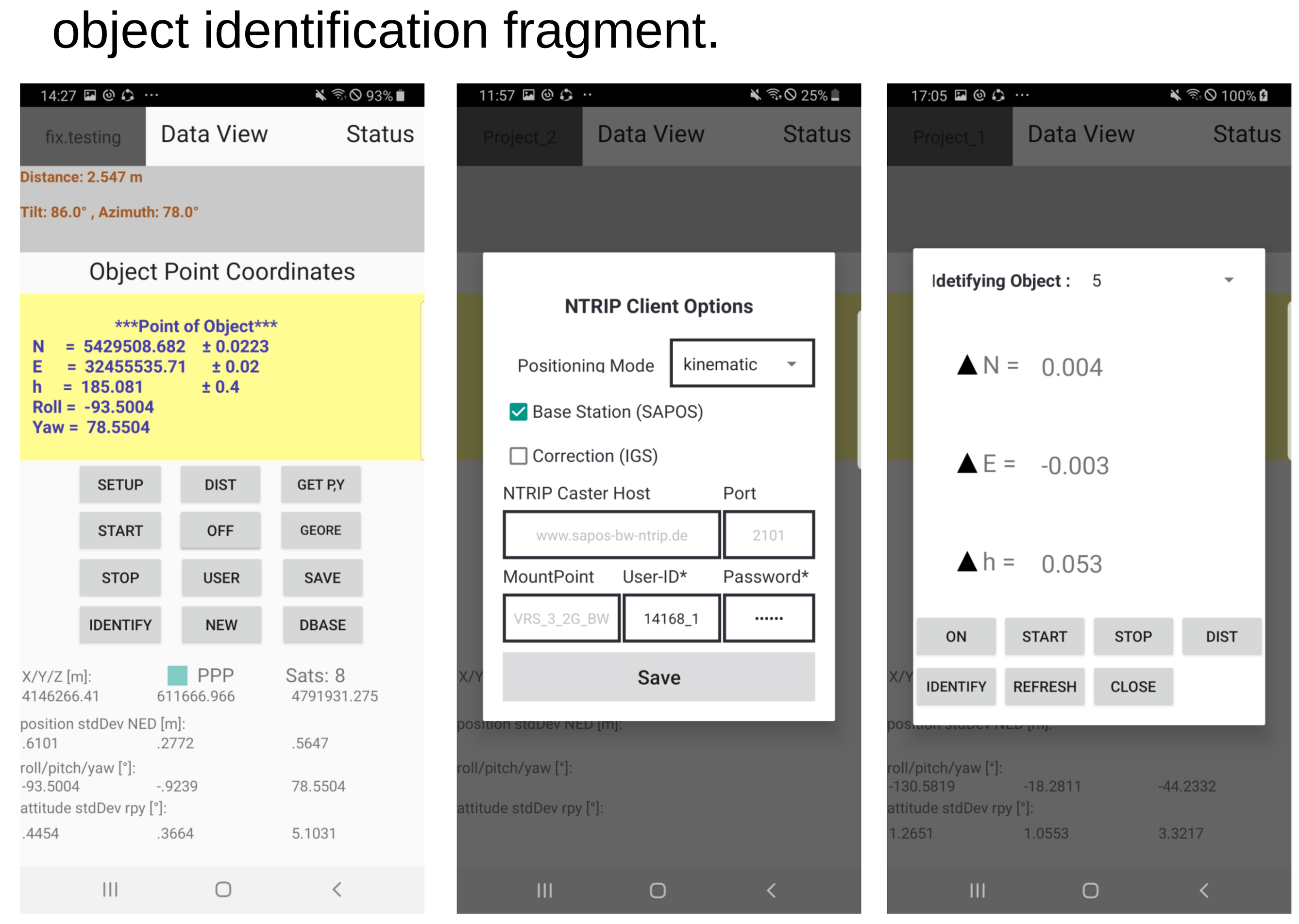

Fig.3: The Home Screen, NTRIP client settings and object identification fragment.

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