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# Range Analysis of RTK Base Station in Urban Environment

Marcin Uradziński

Chair of Land Surveying and Geomatics  
University of Warmia and Mazury in Olsztyn, Poland

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## Introduction

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- Traditional radiolink's drawbacks:
  1. short transmission range of low-powered systems caused by obstacles located in the path between a base station and a mobile receiver,
  2. signal interference, which can reduce transmission range and cause poor signal quality
- The main **aim** of the work:

The approach of testing the base station range is based on field experiments and the analysis of both the accuracy and availability of RTK data in urban environment using radiomodem transmissions.

Experiment was conducted on the test marks which were determined by static occupation (below centimeter level of accuracy) under different conditions (opened areas and covered by trees and buildings or close to the water). All the tests were performed using the latest Topcon HyperPro GPS/GLONASS receivers.

## Localization of test points

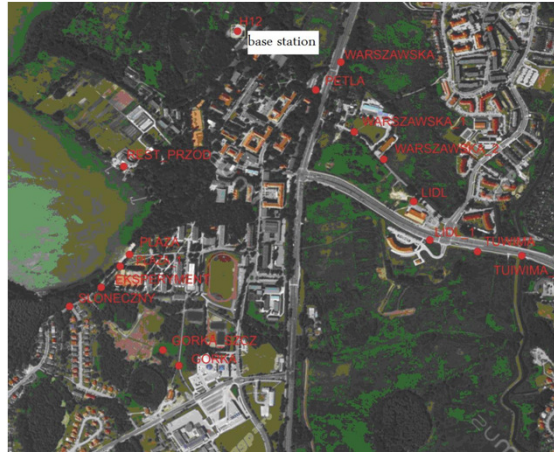


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## Analysis of the results

	name of the point	type of the point	radiomodem signal power in % (fixed RTK solution)
1	EKSPERYMENT	test mark	97%
2	GORKA	test mark	99%
3	GORKA_SZCZ	test mark	80%
4	LIDL	test mark	97%
5	LIDL_1	test mark	92%
6	PETLA	test mark	100%
7	PLAZA	test mark	90%
8	PLAZA_1	test mark	94%
9	REST_PRZOD	test mark	84%
10	SLONECZNY	test mark	92%
11	TUWIMA	test mark	81%
12	TUWIMA_1	test mark	80%
13	WARSZAWSKA	test mark	100%
14	WARSZAWSKA_1	test mark	97%
15	WARSZAWSKA_2	test mark	96%
16	H12	local base station	

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## Analysis of the results

Name	Grid Northing (m)	Grid Easting (m)	Elevation (m)	Std Dev n (m)	Std Dev e (m)	Std Dev u (m)	Distance from base station
EKSPERYMENT	5958307,052	7463877,069	104,028	0,013	0,010	0,018	950,07
GORKA	5958025,432	7464109,685	125,429	0,011	0,006	0,017	1155,25
GORKA_SZCZ	5958072,342	7464071,961	130,584	0,009	0,008	0,014	1115,21
LIDL	5958562,857	7464827,295	106,100	0,012	0,008	0,018	817,46
LIDL_1	5958417,426	7464921,753	105,728	0,013	0,010	0,016	989,03
PEŁLA	5958974,260	7464520,262	109,888	0,015	0,015	0,022	310,35
PLAZA	5958383,128	7463935,995	102,871	0,010	0,016	0,024	856,50
PLAZA_1	5958364,536	7463934,300	104,757	0,014	0,011	0,015	874,24
REST_PRZOD	5958703,547	7463927,605	103,730	0,013	0,012	0,020	582,13
SLONECZNY	5958253,020	7463835,005	106,718	0,015	0,010	0,016	1016,92
TUWIMA	5958409,501	7465032,386	104,260	0,015	0,011	0,017	1069,96
TUWIMA_1	5958396,229	7465090,040	104,512	0,008	0,008	0,014	1120,46
WARSZAWSKA	5959020,524	7464595,519	106,351	0,007	0,006	0,011	350,16
WARSZAWSKA_1	5958823,678	7464612,086	106,861	0,010	0,008	0,016	479,95
WARSZAWSKA_2	5958745,014	7464709,780	106,420	0,010	0,009	0,013	604,62

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## Conclusions

- There were a lot of electronic devices in the surrounding buildings and many radio transmitters placed on roofs of academic buildings.
- Point position accuracy was dependent on a radio signal power(0.5W used). Usefulness of radio-modems with higher power would definitely increase a range of RTK measurements. Unfortunately, it is not allowed to use such radio-modems in Poland.
- Distances of ten points from base station were within one kilometer. Five of test points were over 1000m away from the base station. Considering the hard environment, where the points were located, the results were very satisfactory.
- One should also mention that in experimental situations, combination of GPS and GLONASS constellations definitely sped up all the measurements.
- Field experiments showed that examined RTK kit fulfills the expectations of base station range and required accuracy in difficult urban scenario. However, there were some places (tree canopies or multipath effect close to buildings) where obtaining RTK fixed solution was difficult or impossible.

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Thank you for your attention!