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**ACCURACY AND APPLICABILITY ANALYSIS OF GIS AND GPS BASED
SYSTEMS**

Ph. D. Thesis

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1. Prior events of research

The measurement and information technology that serves as a base of this thesis has gone through on an unforeseen development within the last decades. Analysis of positioning based on GPS techniques clarified the achievable accuracy in details, its application possibilities and the measurement technologies.

Because of the above mentioned reasons, I found more interest towards paying attention to the analysis of applications during my studies and research at the University of Miskolc, department of Geodesy and Mine Surveying.

The result of positioning measurements has been applied to visualisation and information systems that the research aimed.

The parameters, properties, accuracy and conditions of applications of the parts of the systems had to be analysed.

The transmission of differential GPS corrections via commercial radio transmission, which has been applied in Hungary, was also analysed, however it partially lost its market.

The necessity of collected information about our surroundings based on 3 dimensional positions for different requests shows the importance of this subject.

There are several systems working that satisfy the needs of users, but the performance of the application is limited by financial conditions and the quality of the given or achievable technique.

It has been two years now that I am working on the design, development and analysis of integrated geographic information systems applying the advantages of mobile communications. The result of it is that most of the systems for safety and logistics both in Hungary and abroad.

The publications related to this research and work have been published in conference proceedings and periodicals and performed in Hungary and abroad.

2. The aim of the research

The main aim of the research and the carried out works was to secure the agreement within GIS and economy requested services through the applications of the available positioning techniques, information and data transmission services as effectively as possible.

The ultimate aim was to determine the base parameters which with the available technologies can be used optimally. These are the reason of use of the system, qualitative and quantitative limits of the elements of the system and possibilities for development.

During development of the systems built in order to satisfy the needs of the economy many examinations had to be done which with the quality of data collection, reliability issues, hardware stability, data transmission effectiveness and all of their errors could have been modelled.

3. Methods of examinations

In order to achieve the above mentioned questions every time particular methods of examinations needed every case.

The examination of the quality of positioning was determined by the accuracy requirement of the complex system.

The main point of view generally is the accuracy of the maps in GIS analysis. This is determined by test measurements.

The examinations were carried out by experiments, testing the relevant element and analysis of the result accessed during the use of the system. The parameters of planned systems were determined regarding these experiments.

The object of the analysis also was the methods of assessment of the achieved results in GIS and database handling methods.

4. New scientific achievements

1. Analysis of error sources has key importance in designing the technology of measurement and carries them out. There are error sources like influence of ionosphere and troposphere, which has the main part of total electron content and the water vapour. Since the elimination of Selective Availability many analyses has been performed the improvement of accuracy, however applications of differential techniques need to be applied in many cases. I determined that the ground based DGPS correction through radio transmission data latency is the smallest, so as it is optimal performance can be secured with appropriate infrastructure.
2. It has become known during the development that on the level of current technology and within the frame of practical reason the GPS based data collection units have basically the same structure. Differences can be recognised in the basic theory of reason of development, so the structure of the data sentence shows significant differences. I determined that Kalman-filtering is necessary in integrated data collection measurement units. Units for details measurements do not need this filter to be applied, the separated units are not proof against outside influences. I suggest eliminating or decreasing these influences.
3. According to the experiences collected during the research it can be said that the accuracy requirements of the most important element of the system determines the accuracy that the whole system can provide given the current technical and technological level as well as market needs. The structure, operation and costs of a geographic information system are based on its aim of application. The tests have shown the limit of the dynamic accuracy achievable at measurement and their properties. Use of measurements that have been taken within equal circumstances in GIS the quality of maps and the reliability of measurements have to be in agreement.

4. Industrial application examinations have shown the applicability of state-of-the-art technology, and its necessity, indeed. I prove the accuracy and effectiveness of the integrated systems. Handling the data collected in the most cost effective way is to use automatic database software and application.
5. I determined the following regarding the effectivity of data collection: regarding the current level of data transmission media the technology limits the rate of effective data transmission as well as the quality of the result. The establishment of links within the applied software elements and their quality is additional to it. I suggest a system that supplies the graphical and attributive databases to the client via “distance access”, while the data collected in to high security database.
6. One of the most important requirements for a logistic system is that route planning and optimisation should be available on the application. It is and obvious interest to all of the companies to reduce their cost. I determined through analysis of optimisation algorithms that the most effective algorithm for applications in GIS is the Dijkstra method. It provides simplicity, effectivity, and good speed and calculation, therefore I suggest it to use in an implemented form.

5. Possibilities of application of the results

Regarding the explained above there are many opportunities for application of the technology. Some of them were object of this paper, while there is a good possibility to develop the system based on the basic idea given here applied the latest technologies according to the requirements. These are like new communication channels (WAP, GPRS, TETRA, etc.) or peripheries interface changes, newer applications on them (PDA) technology).