

# GPS Newsletter – General

A monthly newsletter on System 500 GPS, 03/01, January 27<sup>th</sup> 2003

## Introduction

Thanks to its ClearTrak™ technology and its integrity ambiguity monitoring, System500 is the **most reliable and efficient** GPS system in the market today.

This newsletter briefly summarizes the advantages of the **ClearTrak™ technology** and the principles of the **integrity ambiguity monitoring**. An example of a System500 application in Sweden is given in which both features play a major part.

## How ClearTrak™ Works

ClearTrak™ is the name for sophisticated RTK algorithms used in System500. ClearTrak™ provides three main advantages:


- **Multipath mitigation technology** differentiates direct GPS signals from signals reflected from surfaces. This is realized by filtering with carrier aided code smoothing.
- **Interference protection** eliminates “foreign” signals from disturbing the GPS signals by filtering.
- **Anti-spoofing solutions** assure that both GPS frequencies are still available to civilian users in case the US Government decides to switch anti-spoofing on. This is realized through the receivers tracking the P code and through the Y code signal being correlated with the known P code before further processing.

## How Ambiguities Are Solved

In order to guarantee correct ambiguity solutions, the results of the ambiguity determination are continuously monitored.

The ambiguity solution in System500 comprises five steps:

1. The ambiguity search begins with five satellites available on L1 and L2. From one set of GPS observations, the most likely set of ambiguities is computed.
2. The ambiguity search is then repeated using a second, different set of GPS observations. A second set of ambiguities is determined.
3. The two sets of ambiguities are compared. Only if they are identical are the ambiguities considered to be correct. In this case, an RTK position with cm accuracy is computed on the rover.

4. The fixed and checked ambiguity solution becomes visible for the user by a high precision icon on the terminal screen: 

5. The **monitoring cycle** begins. System500 continuously determines sets of ambiguities and compares the ambiguity solutions with those from the preceding set. As long as they are identical, the high precision icon on the terminal screen is shown.

## System500 in Sweden

There is no doubt that the excellent signal processing technique and the unique integrity check of the fix solution has made System500 the **most demanded and most sold geodetic GPS system** in Sweden.

System500 is used in one of the largest infrastructure projects in Sweden in the last decades, the Botniabanan project. The Swedish National Railway Company is building a new railroad along the coast from Härnösand in the south to Umeå in the north. The project consists of a completely new railroad with a length of 180 km and a modernisation of a 50 km long older railroad. The project runs through "the land God forgot", this means through deep forests, across lakes and rivers.



From the very start, System500 has been used. It was chosen for this project, since it is the only GPS system that can provide a fixed and reliable ambiguity solution in almost any condition. 25

SR530 receivers are involved. The pictures in this newsletter illustrate the **harsh environment** System500 is exposed to in this project.



## **Procedure in the Botniabanan Project**

Initially, a **control network** was set-up using System500 in static and rapid static mode. All control points were then used for the photogrammetry work. From the arial photos, a DTM was created.

Based on the DTM, several alternatives on where to build the railroad were investigated carefully. After that, the work building the railroad could start.

The project requires collaboration between many different companies such as consulting companies, construction companies, the National Land Survey of Sweden and all communities along the track. One of the communities is Örn-sköldsvik.



## **A Wide Range of System500 Applications**

In Örn-sköldsvik, Leica GPS systems are in use since 1994. Today, they have nine SR530, two SR9500 and one RS500 in their daily work. Their GPS applications prove the flexibility of System500.

- As **permanent reference station**, the RS500 is used for all work in and around the city of Örn-sköldsvik. With a transmitting radio modem, a 0.5 W Sateline 3As modem, it is placed on a hill in the centre of the town providing the surveyors with high performance RTK data in a radius within 15-25 km.
- As **non-permanent reference stations**, the receivers are applied when the working area is out of reach from the permanent reference station.
- To **measure areas**, they have used System500 for the first "rough stake-out" as well as for new properties and for reshaping older ones. This was necessary in order to give the landowners correct financial compensation.
- To **calculate the depth of lakes**, they use System500 in real-time in automatic logging mode along with echosounders for determining the amount of material that should be moved for building banks.
- To **stake-out with a reference line**. "Something we cannot live without" they say.
- To **stake-out the railroad**. Sensors are equipped with **RoadX**. The whole track is stored on the PC cards. They state "Without **RoadX** we would not be as fast as we are today. RoadX is the perfect tool for this kind of job".



# GPS Newsletter – General

- **Working in extreme conditions.** Should there be very extreme conditions where getting a fixed solution ambiguity solution is impossible, they turn on **MaxTrak** and continue working. After the lumbering company knocks out the trees, they return and do the precise stake-out. They can work in virtually all conditions.
- **Data transfer to CAD packages.** Back in the office, data is exported to various CAD programs via **format files**. In case something went wrong during the day, the data is imported to SKI-Pro first where all necessary editing can be done.

## **Remember...**

- **ClearTrak™** includes sophisticated RTK algorithms providing protection against multipath mitigation, interference and anti-spoofing.
- The ambiguity results in System500 are **continuously checked** in order to guarantee correct ambiguity solutions.
- System500 is used in one of the largest infrastructure projects in Sweden in the last few decades.
- System500 **withstands harsh environmental surveying conditions.**
- System500 is the **most flexible GPS surveying equipment** in the market.

## **Ideas for Future Newsletters...**

If you have any ideas or wishes for topics that you would like to be discussed in a future newsletter, please contact your local selling unit or representative. These ideas can then be passed to Heerbrugg. Thank you.