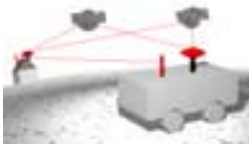
Positioning System with DGPS

S_G57650

DGPS Positioning and Automatic Steering of Gantry Cranes (RTGs)

With the, in general use, Global Positioning System (GPS) it is possible to determine a geographical position. The commonly used standard GPS provide an accuracy of approx. 20 m.

With the aid of additional equipment and under certain area conditions it is possible to achieve a geographic position with an accuracy of up to ±3 cm.



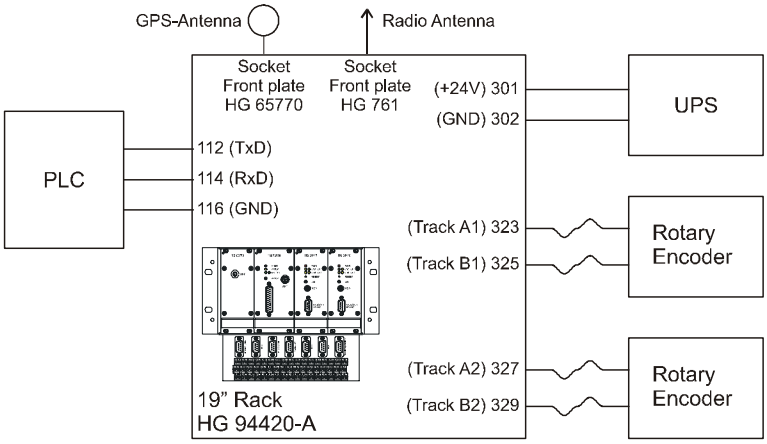
RTG Autosteering

Due to the achievable positional determination of approx. ±3 cm, that in addition is refreshed every 100 ms, it is possible to track a vehicles movements. Consequently by using a series of measurements along with the geographical positional data it is possible to determine the vehicles direction of travel and velocity.

With the aid of these functions it is possible to automatically steer a RTG over a predetermined route within the container yard. This means, that apart from the free movability that the rubber tired vehicles provide, they like the rail mounted vehicles can be used within the container storage area without disrupting the drivers attentiveness, with unnecessary requirement to control the tracking and manually steer the crane. A special advantage of this system is that for both functions there is absolutely no requirement to mount equipment within the track surface of the container yard.

All these points serve to aid the operational safety and therefore remove some of the stress placed on the driver, which in turn reduces the error rate. A looped memory stores all relevant information so that in the event of a disruption with the systems function or during testing, a quick and easy error diagnoses is available. For special or emergency uses all these functions are manually operable so that a complete operational shut down can be avoided.

Sideways sway of less than 5 cm of the RTG are allowed; in any other case is the use of an additional slope controller necessary.



Elements of the System
(Rotary encoders and PLC not in the scope of supply)

Container Tracking

The temporary storage of containers by use of visual means with manual confirmation leads to an error rate in the storage handling, which disrupts the efficient turn over time of the container ships. Therefore it is better to use GPS to control the positioning and documentation of containers within the container port environment.

Now the Rubber Tired Gantry Cranes (RTG), working on container transport within a seaport, communicate with the controlling container management system, via a data Radio Transceiver, when they pick up or set down a container at a predesignated position within the container yard. This takes some of the load off of the driver as well as it reduces the error rate – complicated and time exhaustive container searches are no longer neccessary.

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Functional Description

The system incorporates a combination of systems, (sensor fusion), the advantages of satellite navigation with the advantages of odometry (dead reckoning).

PDGPS Position Calculation

GPS is the Global Positioning System, which enables worldwide position determination via GPS satellites using special GPS Signal Receivers. With special technology the normal accuracy of about 20 m can be improved.

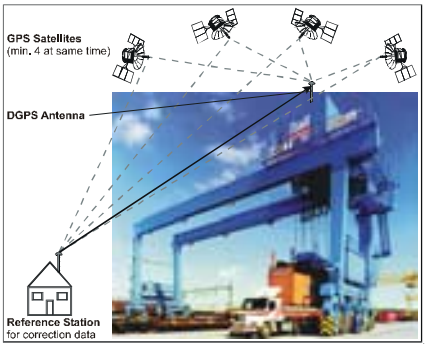
A base station that calculates the difference between the measured by the GPS and the real position (Differential GPS; **DGPS**) and then transmits this difference via radio data transmitters to the mobile stations (cranes) helps positioning these cranes with an accuracy of up to 3 m.

Via the determination of the carrier wave of the GPS signal it is possible to increase this accuracy level to ±3 cm (Precision DGPS; **PDGPS**).

The GPS system seen over a long period of time offers a very stable service but can due to shadowing, or reflection become temporary unstable.

Odometry

The odometric (dead reckoning) navigational system calculates the cranes position in a different way. Here the wheel revolutions are ascertained, via rotary encoders. It is then possible to calculate, from the wheel revolutions, the vehicles position and any alteration of angle.



Principle of Function DGPS

The Odometric system is permanently available and has a high degree of accuracy over a short distance. It's draw backs are however that it can not determine the starting position of the crane and angle of error rises over time, so that the system becomes increasingly unstable.

Sensor Fusion

In system S_G57650 Satellite navigation and odometry are so combined, that long term exact positional data can be delivered. In order to do this the PDGPS calculates the cranes starting position and passes this onto the Odometry, with which the crane is driven. The PDGPS is then used to correct the worsening positional information delivered by the Odometry, a further advantage to this system fusion is that should the PDGPS become inoperable for short periods the crane is still operable over the Odometry.

Technical Data

- **Dimensions of the 19“ Rack** — **269 x 203 mm (W x H)**
- **Power Supply** — **130 V AC or 240 V AC**
- **Availability of the PDGPS** — **approx. 95 % with an accuracy of ±3 cm**
  approx. 99,7 % with an accuracy of ±5 cm
- **Update Rate of Position Output with Sensor-Fusion**
  up to 20 Hz
- **Interfaces for the Position Output**
  RS 422 or RS 232
- **Operating Temperature of Electronic Components**
  0 to +50 ^{O}C
- **Operating Temperature of Antennas**
  -20 to +65 ^{O}C

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