Robotic Total Stations

Servomotors move the total-station telescope horizontally and vertically to detect the prism. When detected, the system “zooms in”, aims, and locks onto the reflector of high accuracy. A Robotic Total Station: I know what it is, I know what it does, but how does it work? Several instruments listed in the product survey on high-end total-stations are able automatically to detect, recognise, aim and lock onto a prism. These so-called Robotic total Stations (RTS) were first introduced by Geodimeter in 1990 and are equipped with servomotors for automatically rotating the instrument horizontally and vertically, and an Advanced Tracking Sensor (ATS) for tracking the prism. A communication link between the RTS and prism pole makes it possible for just one operator to carry out a survey, controlling the instrument from the prism pole. RTS also enables unmanned deformation monitoring. Usually the communication link is established by radio signals, but some systems also use infrared signals.

The introduction of RTS enabled surveyors to increase productivity; for example, in carrying out measurements for the creation of digital elevation models, as-built checking and hydrographic surveys. However, the automated guidance of dozers, graders, excavators, harvesters, tractors and scrapers, in short, machine guidance, became the major new application. RTS is also often used for unmanned deformation guidance in constructions such as dams and plant chimneys. For land-survey applications the most beneficial feature is that one surveyor can do the job, thus saving time and money. Accuracy is high, even under conditions of low visibility (night).

A total station may be called robotic if it is able automatically to follow a prism moving through 3D space; key to this feature is the communication link between base-station and prism pole. In the almost twenty years of RTS a diversity of communication solutions have been developed. The first stations were aimed by measuring the strength of the laser-beam reflected at the prism and locking onto its maximum. They were able to find prisms only when these were mounted on approximately known positions, and they were actually suited only for deformation survey. With time came more advanced solutions. New developments focused particularly on avoiding loss of contact while the prism was moving, and automatically tracing it when loss of contact had occurred. Today RTSs use CCD (charge coupled device) or CMOS (complementary metal-oxide-semiconductor) imaging sensors to track the prism. These sensors increase the field of view, so that there is no longer any need to know the approximate location of the prism. By computing the shift indicated by the imaging sensor they even allow accurate measurement when the prism is not in line with the optical axis of the theodelite.

To avoid loss of contact caused, for example, by interruption of the signal by a vehicle driving between base-station and prism, software is used that predicts the prism’s path. This may often, but not always prevent loss of contact. To re-establish contact after loss, solutions have been developed based on making a quick laser scan of the broad environment, a technology Leica has termed Power Search. Another method makes use of active prisms. Unlike their passive counterparts, active prisms themselves generate signals that are received by the base-station and direct targeting of the prism. Use of active sensors also avoids faulty aiming at reflective objects, such as traffic signs, windows or vehicle mirrors. The ability to generate signals on the prism side comes at a price: increased complexity, cost and weight.

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