Possibilities and Limitations in the Extrinsic Synchronization of Observations from Networks of Robotic Total Stations

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SUMMARY

High-precision, real-time positioning is a critical aspect of automation in the construction industry. Especially for the collaborative control of multiple manipulators or robots, absolute positioning within mm accuracy is often required. One way to provide absolute positions in real time is to use robotic total stations (RTSs). Although they are indispensable on most construction sites and are often used for tracking purposes (e.g. in machine control), networks of multiple RTSs are rarely used. In addition to providing positioning redundancy, RTS networks can help ensure the uninterrupted flow of the automated process. This can only be achieved if a common temporal and spatial frame is available for all the RTSs in the network. The common spatial reference frame is self-explanatory and easy to achieve, but the common temporal frame is challenging. This paper presents an approach for synchronizing observations from a RTS network. This will be referred to as the extrinsic synchronization. Four Trimble S7 RTSs are used in this network and the time frame is provided by an NTP server. The possibilities for synchronizing observations streamed at 10 Hz and 20 Hz are exemplified using reflectors mounted on a rotating arm. Two different scenarios are presented with angles combined with distance measurements and angle measurements only. Simultaneous measurements are possible if synchronization between the four RTSs is realized. The achieved simultaneity is around 0.3 ms between measurements of four individual RTS. This means that even at speeds up to 2.5 m/s, the error induced by this delay remains theoretically in sub-mm level. Limitations of this type of network are related to the hardware capabilities of the RTSs and the external control software.
