

Separation of Control Quality and Measurement Accuracy for Guiding Control Tasks of an Indoor Construction Machine Simulator

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ABSTRACT

The Institute of Engineering Geodesy developed an indoor construction machine simulator to carry out investigations of tachymeters, additional sensors and Kalman filters during the operation in control-loops for guiding tasks of construction machines. In this simulator remote-controlled model vehicles are used in the scale of 1:14 which project the kinematic behaviour of construction machines close to reality. In combination with a control computer, a remote control, and a robot tachymeter as position sensors it is possible to guide the model vehicles on a given trajectory autonomously. The control aim is to guide the vehicles as well as possible on the given trajectory.

To describe the reached control quality, a Root Mean Square (RMS) is computed with lateral deviations between the given trajectory and vehicle positions during a test drive. Due to the reachable position accuracy of the tachymeters (3-10 mm), the RMS represents not only the control quality. There is also a random part included which falsifies the result of control quality.

In this paper a measurement setup will be shown which makes it possible to use a tachymeter as position sensor for the control task and a laser tracker (accuracy less than 1 mm) as reference sensor for the vehicle trajectory simultaneously. By using the results of this measurement setup it will be possible to separate control quality and position accuracy of the tachymeter.

During the test drives a measurement accuracy of the used tachymeters of around 1-3 mm could be reached. Thereby, the control quality achieved 2-4 mm by using a PID controller at a velocity of 10 cm/s (average speed of an asphalt paver). Furthermore, it is possible to show the influence of systematic effects during the test drives e.g. due to the used 360° prisms.

KEYWORDS: Laser Tracker, Robot Tachymeter, Control Quality, Construction Machine Control and Guidance, Simulation