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ABSTRACT

The doctoral dissertation was created due to the doctor's interest related to the safety of travelling and transport of goods. In the past, in Poland, there was a "tear" or a “rupture” of the train, which resulted in a bad railway crash in which people died.

By analyzing national and foreign literature and by reviewing industry portals, the author noted the lack of train integrity based on satellite technology.

The dissertation is divided into 6 numbered chapters and the unnumbered chapters containing: a list of abbreviations and signs, a summary, a bibliography and a list of drawings and tables.

Chapter 1 provides an assessment of the knowledge concerning rolling stock control. This chapter also presents the purpose and scope of the work and the scientific thesis, with the appropriately chosen assumptions.

The second section contains the characteristics of rolling stock identification systems. It reviews the existing equipment and systems for rolling stock identification, including various sensors for train wheel detection. It also presents the methods of train integrity control currently applied, including the method of observing the signals at the fore and the end of the train, and the method of using the counting track circuits. The attention is paid to the role of self-contained brake in the control of train integrity.

Chapter three deals with satellite navigation systems used in railways. The particular attention is paid to errors occurring when determining GNSS receiver positions and a mathematical apparatus for describing these errors is also presented.

The fourth chapter contains the concept of train integrity control using signals derived from satellite navigation systems, which is the original solution presented by the author. A train integrity control algorithm is developed, a system model and a Kalman filter is used as a mathematical tool for estimating measurement results from GNSS satellite systems.

The fifth chapter contains the results of the simulations conducted by the author. Not only the purpose and methodology of the research are presented but also the influence of the

environmental aspects on the operation of the GNSS receiver system. It shows the ways of positioning a GNSS receiver in different configurations (using one satellite system and two satellite systems). The positive influence of the Kalman filter on the positioning accuracy is also depicted. The approximation of measurement results is made and GNSS positioning errors is determined after using the Kalman filter.

Chapter six contains the results of field research. The objective and methodology of the research as well as the data collected on real objects are analyzed. The study was conducted for a variety of environmental scenarios, e.g. for wooded, open and built-up areas. The research was conducted both on cloudy days and on sunny days – without cloud cover. This chapter demonstrates that using the Kalman filter for estimating measurement results allows you to achieve accurate positioning of the GNSS receiver. This allows you to determine the length of the train composition (with the assumed measurement error), which is the basis for the control of train integrity, presented by the author.

The summary of the dissertation includes the conclusions from the dissertation and the statements concerning the demonstration of the scientific thesis, as well as application results and indications for further development perspectives.