



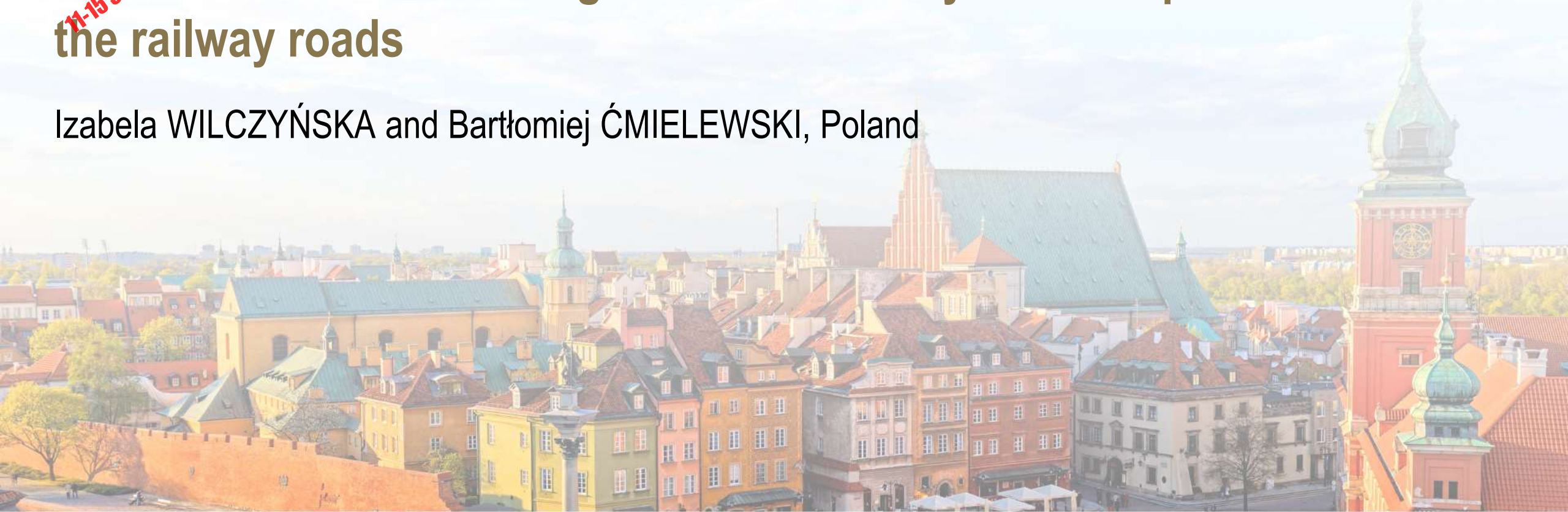
XXVII FIG CONGRESS

11-15 SEPTEMBER 2022
Warsaw, Poland

Volunteering
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Semi-automatic measuring device for survey selected parameters of the railway roads

Izabela WILCZYŃSKA and Bartłomiej ĆMIELEWSKI, Poland



1. INTRODUCTION

Many countries are introducing new railway lines and extending existing ones to reduce congestion and improve the urban environment. Such development is related to the issues of operational safety of rail vehicles.

Development works and tests were performed in cooperation with GEOSTER company under the MOZART project organised by the Wroclaw Academic Center.



2. SURVEYS OF TRAM TRACKS

Depending on the measured geometrical quantities, stocktaking measurements of railways can be carried out using various technologies.



3. SEMI-AUTOMATIC MEASURING DEVICE

The railroad measuring device developed by the MOZART project consists of:

- a measuring trolley designed to measure tram tracks,
- Terrestrial laser scanner Leica ScanStation P40,
- linear displacement sensor PTx from Peltron,
- GNSS receiver NovAtel OEM615™,
- inertial measurement unit IMU STIM300 from Sensoror.



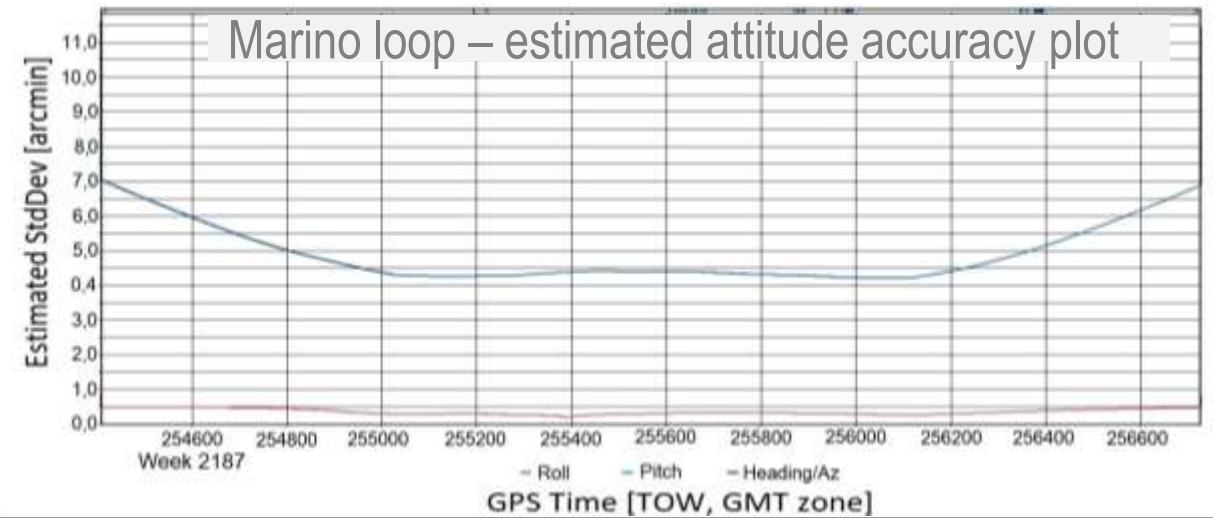
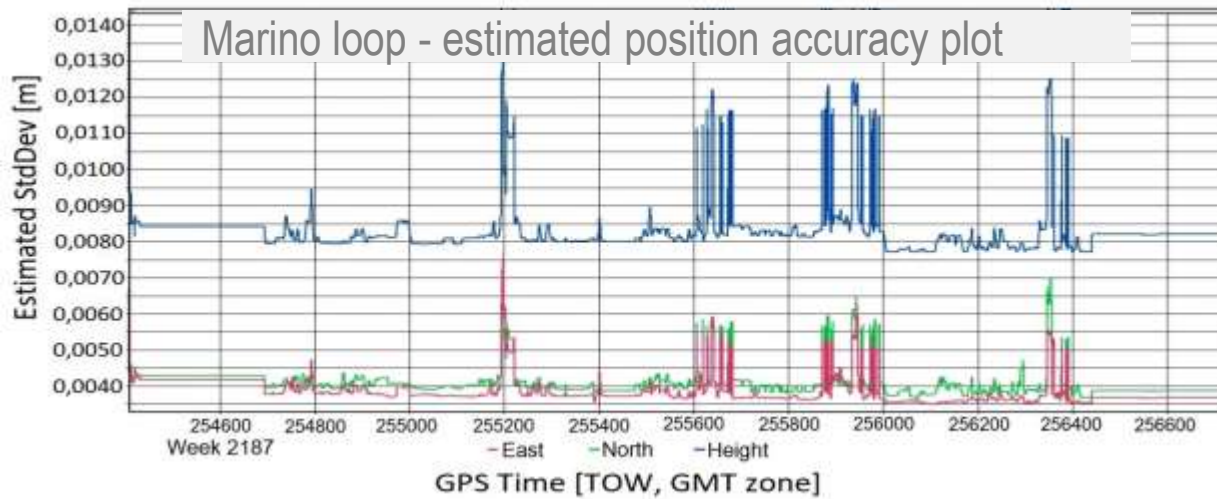
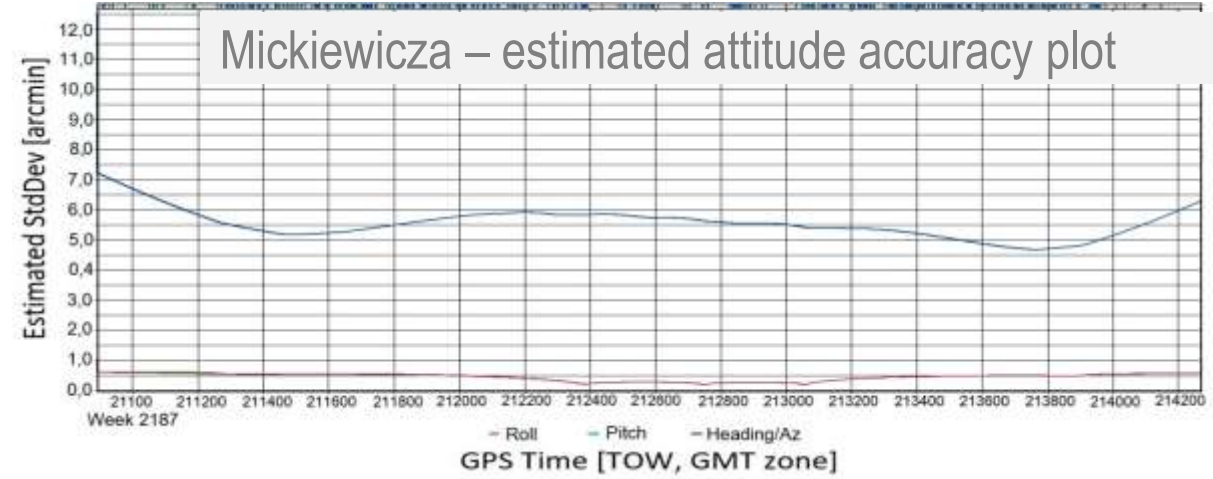
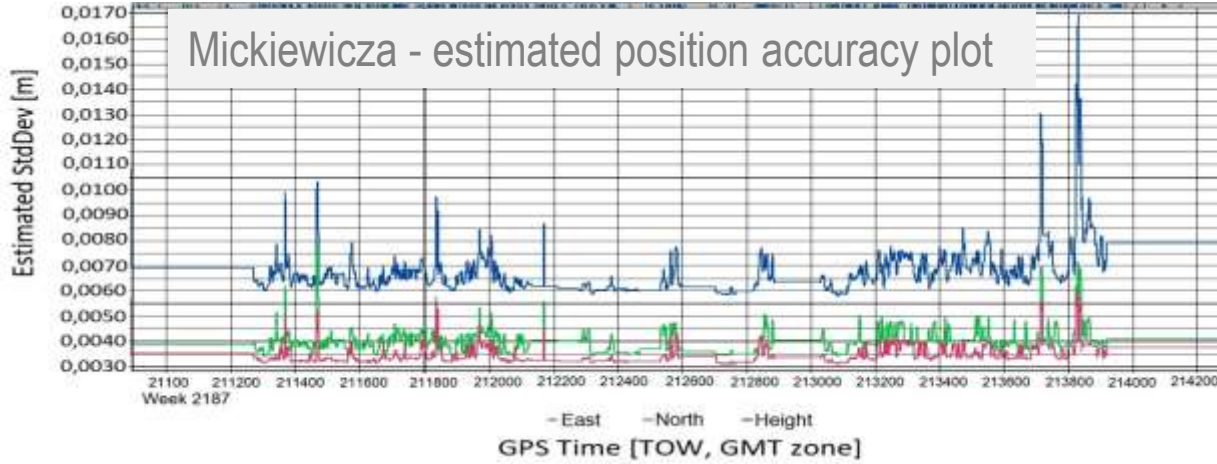
<https://www.sensoror.com>



4. DATA PROCESSING

- The survey was performed on Mickiewicza street and Marino loop.
- Collected data were processed in Inertial Explorer 8.90 as a tightly coupled solution. In both cases, we got precise and solid trajectory, most time better the 1 cm estimated accuracy.
- The separation between forward and backwards was better than 5 cm. Also, the solution about attitude was accurate.





4. DATA PROCESSING

What we done with collected data:

- We compared the difference between the classic survey using total-station and the developed device. (In Poland standard spacing is 1,435 m, which is the same for tram and rail.)
- Both techniques gives similar results differing from 2-5 mm.



VS



4. SELECTED PARAMETERS

$$W5 = 1 - (1 - W_e)(1 - W_g)(1 - W_w)(1 - W_z)(1 - W_y)$$

where:

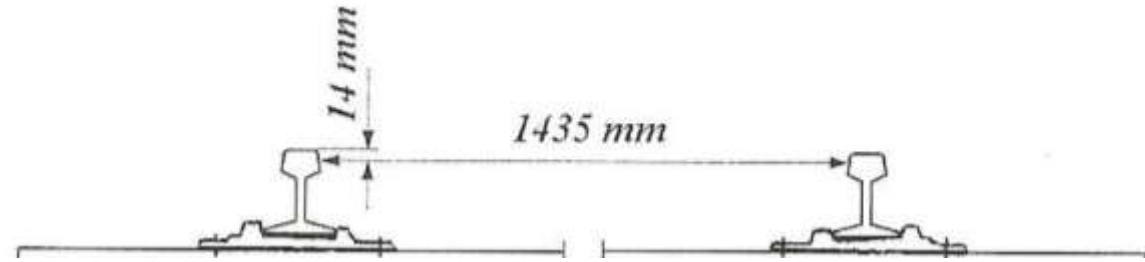
W_e – width defectiveness,

W_g – cant defectiveness,

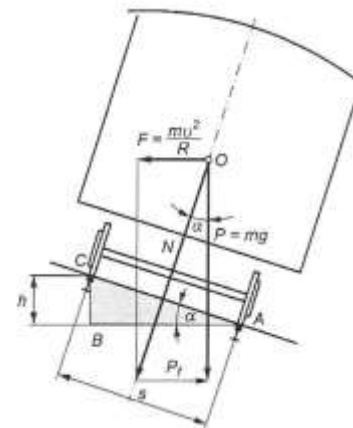
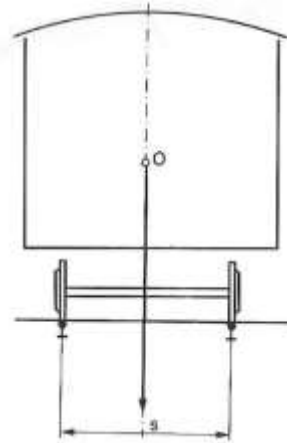
W_w – defectiveness of twist,

W_z , W_y – are the arithmetic means of the defectiveness, the corresponding vertical and horizontal irregularities determined from the defectiveness of the left and right rail tracks.

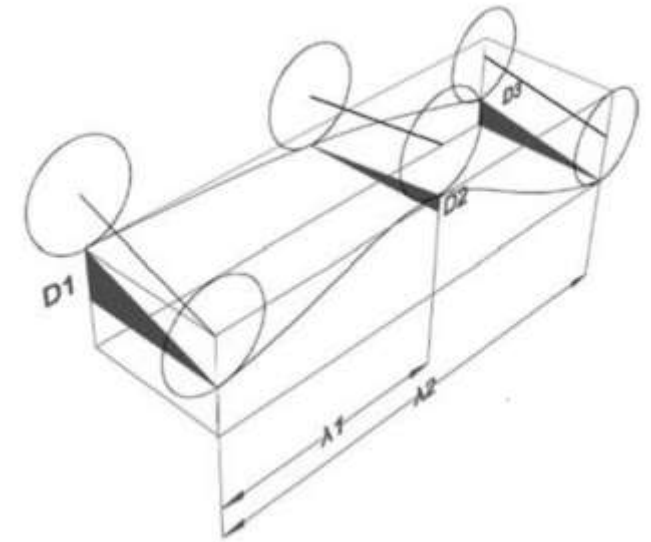
Id-14 PKP PLK (2005)



Jacek Makuch (2016)



Jacek Makuch (2016)



Michał Migdał (2016)

4. SELECTED PARAMETERS

Summary of W5 values in individual classes

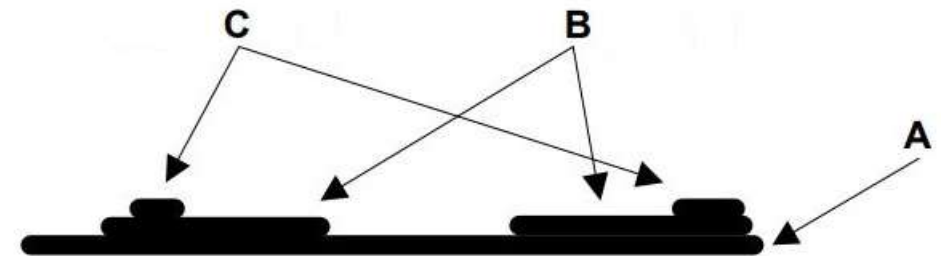
W5	Classes C	Classes B	Classes A
Developed device	0,473	0,645	0,864
Tacheometer	0,462	0,630	0,850



PKP POLSKIE LINIE KOLEJOWE S.A.

Id-14 PKP PLK (2005)

Condition	W5
Very good	$W5 \leq 0,1$
Good	$0,1 < W5 \leq 0,2$
Sufficient	$0,2 < W5 \leq 0,6$
Bad	$0,6 < W5$



5. SUMMARY AND CONCLUSIONS

- Multi-sensor device and a method for collecting and processing spatial data.
- Determine railways' technical conditions (data integration, analysis and interpretation).
- Systematic track inventory is necessary to manage the tracks used in Wroclaw's urban rail transport system.
- The project concerned the implementation of a measuring device for collecting information about the geometric condition of the railroad.
- Inertial solution for track survey is interesting devices, and the current state of technology provides tools for precise surveying in motion.
- Tests confirmed the inertial device's usability and obtained accuracy compared to traditional surveys.

5. SUMMARY AND CONCLUSIONS

- The research was developed in cooperation with GEOSTER Sp. z o.o. as part of the MOZART project organised by the Wrocław Academic Center, Wrocław City Hall.
- Partnership topic: "Multisensor device for measuring railroad parameters with software."
- The survey results were used in the diploma theses of Martyna Tomaszewska „Inventory of the tram loop track using an innovative device measuring the geometry of railroads” and Aleksandra Totoń „Inventory of a section of tram track using an innovative device measuring the geometry of railroads”.





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Thank you for your attention

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